# RESONANCE

What Music Actually Does to Us

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*For the twelve-year-old version of me, who was afraid he was different.*

*He was.*
*It's the best thing about him.*
*It's the best thing about all of us.*

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# PART I: RECOGNITION

**The personal experience**

# Foreword

Babies dance. Not eventually, not after someone shows them how. Before they can walk, before they have words for anything, a beat comes on and they grab the nearest table or chair and bounce. Just bounce, with everything they have, for as long as the music lasts. My own kids did this. Diapers, unsteady legs, no context for what they were hearing. They felt it anyway.

Nobody taught them that. There was no lesson. The music arrived and the body answered. Whatever music is, it got to them before anything else did.

So what is it, exactly?

The answer, at least the beginning of one, is stranger than the explanations we've settled for. We've been calling it entertainment for so long that the word has stopped feeling like a choice. Music is a stimulus, the same category of thing as heat or pain or the smell of food, something that produces specific physiological responses through specific mechanisms that science has now documented well enough that ignoring them requires effort. And those mechanisms point toward something most of us have filed under 'just how music works' without ever stopping to ask what's actually doing the filing.

I’m a musician, have been most of my life, and I also see music, literally and not poetically, which is a neurological condition called synesthesia that I’ll explain when we get there. I’ve carried the argument in this book for years without knowing how to make it. Making it correctly means being honest about where the evidence ends and the hypothesis begins, and I’ve always been more comfortable playing music than talking about it.

This book moves through three kinds of territory. The first is personal: what I’ve experienced and observed, which gives me standing to make the argument but not the right to treat it as proof. The second is scientific: what researchers have actually established, which is more than most people realize and less than I sometimes wish it were. The third is inference: the places where the evidence points somewhere I cannot fully demonstrate but cannot stop following. I’ve tried to signal which territory we’re in at any given moment. Where I have strong evidence, I’ll say so. Where I’m making a leap, I’ll say that too. The honest version of this argument requires both.

A few terms I will use often enough that they deserve clarification now. Sound is mechanical vibration traveling through a medium. Frequency is the rate of that vibration. Organized sound is sound arranged into patterns a nervous system can track: rhythm, pitch, repetition, variation. Music is organized sound that produces a response in a listener, which means music requires a nervous system to complete the circuit. Entrainment is what happens when one oscillating system locks onto another: your foot tapping to a beat, your heart rate syncing with a choir, your brainwaves following a rhythmic pulse. Response is the broadest term and the one I lean on hardest: the measurable thing a body does when organized sound enters

it, before preference or opinion or taste has anything to say about it. These are not the same thing, and this book tries not to treat them as though they are. When I move from one to another, I will try to tell you.

The cost of misclassifying music shows up in the Alzheimer's ward, in the kid who was told they couldn't carry a tune and stopped trying, in the person who reaches for the wrong thing when three minutes of the right song would have done it. We have been misclassifying something fundamental for a long time, and the bill is personal. Music is an operating system, not entertainment. That is the argument of this book. The evidence for it is stronger than most people realize, and some of where it points is stranger than I expected when I started following it.

One more thing before you start. I could write separate books about most of the artists I've mentioned here. I've cut roughly half of what I wrote to get to what you're holding. For someone with ADHD, condensing a message is genuinely harder than expanding one. The free flow is easy. The discipline is the work. What that means is that everything still here earned its place.

The argument of this book lives in the first three parts. The closing section, the Coda, is where I follow the trail past what I can prove and into what I believe the evidence is pointing toward. I wanted you to know that before you start.

# Chapter 1: What We Carry

Pain is the nervous system's oldest and least subtle employee. It shows up uninvited, ignores your schedule, and communicates in exactly one register: something is wrong. Touch something hot and before a coherent thought forms, your hand has already moved. You didn't decide to do that. Your brain did it for you, routed the whole transaction through the spinal cord before the cortex even got the memo. Pain is a command dressed up as a feeling.

Music works the same way, not identically, but through the same basic architecture. Almost nobody says this out loud, but they should.

Sound arrives. The body reacts. What makes music unusual, what separates it from pain as a stimulus, is that it operates across the full emotional spectrum rather than just the red end. Pain only signals threat. Music can deliver anything: loss, elation, longing, triumph, a Tuesday afternoon in 1994 that you haven’t thought about in two decades. It reaches into states that conversation can’t find and medication can’t reliably produce.

You have already used music as medicine. You did it this morning, or yesterday, or the last time something was wrong and you knew, without deciding, exactly what to put on.

Most of us use music this way without naming it. The playlist for a bad day. The album that got you through something you wouldn’t have predicted music could reach. The song you can’t listen to anymore because of what it dragged in with it. That’s a tool being used, the way humans have always used tools that work before they understand why. Aspirin predates the science of aspirin by centuries. Music therapy predates every study we’ll discuss in this book.

* * *

I was seven or eight, riding in the back of the family station wagon toward a theme park called Dogpatch USA, a comic-strip-inspired attraction in the Ozarks about two hours from home, near the Buffalo National River. It no longer exists. The drive to get there is still entirely intact in my memory, which tells you something.

We were facing backward, the way kids rode in that era before anyone decided that was probably inadvisable, and I was working up a low-grade sulk that had every chance of becoming everyone's problem. Two hours is a long drive when you are seven and the destination hasn't been sold to you convincingly.

Then the song came on.

Your Wildest Dreams by The Moody Blues, on a cassette tape. I had heard plenty of music by then. This was different. The guitar and drums had a weight to

them that felt like a heartbeat. The opening lyric pulled me in before I had decided to be pulled. And then the goosebumps arrived: the back of my neck, my arms, a lift in the chest I didn't have words for. I sat with it, said nothing, and understood in some wordless way that something had just happened that I would want to be able to do again.

I didn't have language for what had happened. I wouldn't for years. But the response was real and physical and produced entirely by organized sound. My mood shifted. The sulk dissolved. The drive became, improbably, a day worth remembering, not because of the park but because of the four minutes before I got there.

This mechanism has a name.

Researchers call it frisson, from the French word for shiver, which is a better word for it than anything English has produced. You may also know it as aesthetic chills, or musical chills, or piloerection, the involuntary standing-up of body hair that creates goosebumps.

For our purposes: frisson. It at least sounds like what it describes.

You have felt this. Maybe you have a specific song that reliably produces it, or a particular passage, or a live performance that triggered it in a way the studio recording never has. If you're reading this book, the probability is high. People for whom music is merely pleasant tend not to pick up books about music. People who feel it do. You are already a data point.

Frisson is not universal, and here is where a lot of people's instinct is to push back. Somewhere between 55 and 80 percent of people experience it, a wide range because self-reporting is unreliable and study populations are messy, but consistent enough to tell us this is a common human experience with genuine variation baked in. Roughly one in five people, by the conservative estimate, have never felt it, and before you assume they simply don't care enough about music, the research suggests something more specific: they are built differently.

A 2016 study by Matthew Sachs and colleagues at USC used diffusion tensor imaging, a type of MRI that maps the physical connections between brain regions, to compare people who get chills from music against people who don’t. What they found was specific: the chills group had denser nerve fiber connections between the auditory cortex and the regions responsible for emotional processing. More lanes on the highway.

When music does something the brain wasn’t expecting, that surprise signal crosses into emotional territory faster and more forcefully in these brains, forcefully enough to continue crossing into the autonomic nervous system, and produce something you feel on the surface of your body.

Frisson. A structural brain difference producing a physical event in response to organized sound. Stated that way it sounds like a neurological footnote.

Experienced, it makes clear why music matters so intensely to the people whose brains respond this way.

The personality trait most associated with frisson is openness to experience, which in psychology means a genuine appetite for new ideas, comfort with ambiguity, aesthetic sensitivity. People high in openness are significantly more likely to report frisson even after accounting for musical background. These aren't people who are more emotional across the board. They are specifically, structurally more permeable to this one particular kind of input.

If you get frisson regularly, you've probably noticed it doesn't come where you'd expect. Not always at the most emotionally obvious lyric, not necessarily at your favorite part. It tends to hit structural pivots: a sudden modulation into a new key, an unexpected instrument entering, a drop to near-silence right before something large. Your brain had been building a prediction about where the music was going, and then something else happened. The body responded before the opinion formed.

The autonomic nervous system controls heart rate, breathing, skin response, and everything else your body manages without consulting you. Frisson lives there. It doesn't take requests.

When music activates the auditory cortex, that signal travels into the brain's emotional processing regions, including a small structure called the nucleus accumbens, buried in the brain's reward circuitry. The nucleus accumbens is also activated by food, sex, social bonding, and certain pharmacological substances that remain technically illegal in several states. It doesn't distinguish between these inputs on moral grounds. It responds to reward. When music produces the right combination of expectation and resolution, it releases dopamine, the same chemical the brain uses to mark events as worth remembering and worth repeating. I had to read about the nucleus accumbens three times before I could say it in conversation without sounding like I was reciting from a textbook. For the record, I still can't.

A 2011 study by Valorie Salimpoor and colleagues at McGill put radioactive tracers in people's brains and watched this happen in real time using PET scanning. Anticipating a pleasurable musical moment releases dopamine in the caudate nucleus. The moment itself releases it in the nucleus accumbens. Two separate structures, two separate phases, same reward signal. Music produces dopamine release in healthy human brains through documented pathways, no prescription required, and so far no known mechanism for physical dependence. This puts it ahead of several therapeutic alternatives currently in wider clinical use, though the dose is not controllable, the response is not uniform, and no one has yet figured out how to prescribe it.

The same wiring runs in both directions. Karen Carpenter had one of the most technically precise voices of the twentieth century, and for some listeners, myself included, her voice produces a response that is distinctly autonomic and distinctly not pleasurable. Nothing against her musicianship. It's something more physical: a

tightening, an aversive activation that arrives before any considered reaction has time to form. The auditory-emotional pathway doesn't curate. It responds to what it responds to, amplifies in both directions, and has no preference setting.

* * *

I once burned a CD of songs I knew would pull me toward something better. Deliberately, song by song, with a printed label featuring a dark hallway and a bright white door cracked open just enough to see the light on the other side. I knew exactly what I was making and why.

Years later I built the opposite. A Spotify playlist I called Funeral Songs, assembled during a stretch of time that probably doesn't need more explanation than that. Same instinct, different direction, and I'm not apologizing for the name because it was accurate.

Most people who know Third Eye Blind know Semi-Charmed Life, which is fair, though the number of people who sang along to it for years without registering that it’s about crystal meth is a testament to what a good melody can get away with. The line that stopped me cold wasn’t in that song. It was quieter than that, easy to miss if you weren’t already looking for it.

The four right chords can make me cry.

Seven words. He moved on. And I sat there thinking: this man has been to the same place I've been, and he just sent me a postcard from it.

The four right chords. You already know what I mean.

Mine arrived on the second day of my first corporate job.

I was nineteen, new, mildly terrified, standing at a urinal on day two of a job I wasn't sure I was equipped for. This is not the setting most people associate with a formative musical experience. The music did not care about the setting.

What I discovered within a week was that the same music played on the hold line. I put on a headset, dialed it, and listened to music at my desk for the better part of a year. I was never caught.

But the song caught me.

If this is it, please let me know. If this ain't love, you better let me go. A song about a relationship at an uncertain juncture. That's not how I heard it. Every time I found myself in a moment of professional doubt, wondering whether I was in the right place, the song surfaced. It had installed itself as the soundtrack to a specific internal state and played back every time that state returned.

I spent four decades in various iterations of that company across multiple runs. The answer, eventually, was yes. It was it. The song was there for all of it, not as nostalgia but as a recurring question that a piece of music had decided to carry forward on my behalf, indefinitely, without my permission, apparently forever.

Not everything we carry is weight. Some of it is a chord progression that defined a summer. Some of it is a piano intro that still stops whatever else is happening thirty years later. Some of it is the hum of something that resists description, a sense that music is running underneath things whether or not you're listening for it.

# Chapter 2: The Compulsion

Nobody needs to make music.

That sentence deserves a moment, because we almost never press that hard on the things we do without examination. Food is non-negotiable. Sleep is non-negotiable. Human connection is close enough to non-negotiable that the research on prolonged isolation reads like a slow-motion horror story. But music-making, actually sitting down with an instrument, opening your mouth to sing, spending years grinding through the accumulated frustrations of learning to read notation and execute it with your hands, that is not required for survival. No documented case of death by failure to play the cello. Not yet.

And yet every human culture we've ever found evidence of makes music. Not most of them. Every last one, across every geography, era, and social structure we have any record of, including the ones that never knew the others existed. The list of true human universals is short. Language. Grief. The belief, in most cultures, that the dead go somewhere. And music.

Every last one.

Researchers in this field call this a biological feature rather than a cultural invention, which is a precise distinction. Cultural inventions spread through contact. You can trace the routes. But you cannot trace a route for music, because it appears independently in cultures that had no idea the others existed, selecting materials with acoustic properties and using them to make organized sound.

Children haven't been convinced yet.

Children, left to themselves, make music constantly. They bang on things. They sing to themselves while playing, unselfconsciously, with no audience and no goal beyond the activity being worth doing. They impose rhythm on ordinary movement. A toddler holding the kitchen table for balance will bounce to the beat the moment music comes on, whether the song is Brahms or Andrew W.K., and the expression on their face is the same either way.

Something happens between a child bouncing to a beat in a diaper and an adult saying they can't carry a tune in a bucket. It doesn't happen all at once. It's more like a slow leak: a music class where someone in the second row giggled, a choir audition that didn't go well, a parent who had specific ideas about what talented sounded like. Somewhere in there, the internal reclassification happens. You stop being a participant and start being an audience. You accept the demotion so gradually that the moment of acceptance is invisible. The door doesn't slam. It drifts shut.

The body still knows. Decades later, the same person who says they can’t sing will hum an entire song while doing dishes, on pitch, without thinking about it. Their nervous system is fluent in a language they were told they didn’t speak.

Why do people who love music, people who have loved it their whole lives, who have built playlists like personal diaries, who can tell you exactly where they were when a certain song found them, who use music to manage emotions the way other people use medication or bourbon, why do those same people, almost universally, say they are not musical?

I mean it as a specific observation, not a general one. Not the person who genuinely has no interest in music, who finds it mostly ambient and unremarkable. I mean the person who tears up when the right song hits, who knows every lyric to three hundred songs, who chooses their morning playlist like it's structural to the day. That person. Ask them if they play an instrument, if they sing, if they consider themselves musical, and watch the deflection. Oh, I wish. I can't carry a tune. I tried guitar for a few months in college. I just love listening.

As though listening doesn't count.

Music is a language. That framing sounds like a metaphor but I mean it as a description. It has grammar: chord progressions, rhythmic structure, the grammar of tension and release. It has vocabulary: intervals, timbres, the vocabulary of instruments and voices and the spaces between notes. It has dialects: blues bends a note in a way that classical phrasing doesn't, and country uses a chord resolution that bluegrass holds in a different register. You can learn all of it. The way you learned to read, the way you learned to speak, at first halting and deliberate, then eventually native. Every trained musician knows this: you start by translating and end by thinking directly in the language.

The person who cries at the bridge of a song they've heard five hundred times is a speaker of the language. They received what was transmitted. The music got through. That is not a lesser relationship to music than the musician's. It is a different seat at the same table.

* * *

I did not have formal training in any instrument until seventh grade, when the school orchestra teacher talked me into trying the cello. I was scrawny enough that hauling the thing through hallways, onto buses, in and out of cars was a daily logistical negotiation that required more commitment than most adults would have predicted from a seventh grader with a short attention span and a chronic case of undiagnosed ADHD. I started fourth or fifth chair. I kept practicing. I started catching on faster than I had any reason to expect.

That was probably the first moment I understood my wiring was a little different.

The sounds I was making with my own hands were doing something. Not impressing anyone, not yet, but doing something internal that I couldn't name at the time and would spend years trying to describe accurately. I had a challenging lower-middle-class childhood. As the oldest of three brothers, I was carrying more

than my share of whatever the household weather happened to be on any given day. Music became the place where none of that was the price of entry.

I made it to first chair. Then I got bored. The particular restlessness of undiagnosed ADHD colliding with the structured pace of a school orchestra is not a collision the orchestra typically wins. I was working against a thirteen-year-old who had recently discovered athletics, girls, and the full catalog of competing interests that arrives without warning in adolescence. Music lost the scheduling battle for a while. It did not lose.

By eighth grade I'd dropped out of orchestra, but the itch was still there. It just needed somewhere to go.

Speech class gave it one. The assignment was to take any literary work we admired and talk about our interpretation of it. This was before the internet. While everyone else was reinterpreting Hemingway and other prose, I found a content gold mine in music because there are no better storytellers than songwriters in my opinion.

Oldies were my thing at the time, stuff from the 50s and 60s mostly. The assignment was just after the new year, and I'd just listened to the annual countdown of the most requested songs of the year on that station. The number one requested song was "American Pie," and I was always fascinated with it. At the time, I knew who Buddy Holly was but I wasn't aware that "American Pie" was about him. Still, I decided to do a lyrical interpretation, which in my head was a literal exercise. Know all the words, then explain what they meant. The intent was to show how we infer messages, and I biffed it.

An hour went into listening to a recording I caught of the song from the radio station on my little boombox. Play, listen, pause, scribble. Play, listen, pause, scribble. It's a song that lasts eight and a half minutes, so the writer's cramp was real toward the end. But I filled out multiple notebook pages and off I went.

The piano drives the intro. A long, long time ago, I can still remember how that music used to make me smile. That line feels like a theme, doesn't it? Is it any wonder that one of the greatest songs ever written says it out loud? The song is about the day the music died. February 3, 1959. A chartered plane out of Clear Lake, Iowa, carrying Buddy Holly, Ritchie Valens, and J.P. "The Big Bopper" Richardson crashed in a cornfield minutes after takeoff. Holly was 22. Valens was 17. Richardson was 28. Don McLean was 13 years old, delivering newspapers, when the news broke. He wrote "American Pie" twelve years later, and the grief was still hot enough to fill eight and a half minutes of music that never loses its footing. The song is about the profound sadness and inability to function that comes with a heavy loss. Loaded with pop culture references, some veiled, some less so, which made the lyrical interpretation tough on a kid that was writing about singing dirges in the dark while speaking about them during the day.

The song is a dirge. But it's upbeat, it's sung in the light, and it's a reminder that we will be okay.

Some years later, the song hits hard. You fall down these rabbit holes relearning what you realize at times as an adult were probably stored wrong in your random access memories. This was one of those, and I feel like I get the Buddy Holly angle from cinema and song, the Ritchie Valens story from cinema and song, but the Big Bopper deserved his flowers too. Maybe he has cinema and song dedicated to him as well, but I never had enough interest to learn.

There was an old upright piano in our living room. A relic from the 1920s, hauled across the country from my mother's aunt's home. I heard my mother play it beautifully and asked where she had studied. She had no training. She had simply listened until she knew where her hands were supposed to go. That answer did more to shape my relationship to music than any lesson I ever took. If you could hear your way into it, I was already halfway there.

From there: other instruments, acquired erratically. Drums shortly after high school. I found Rush, and Neil Peart, who treated the drum kit as a melodic instrument rather than a timekeeper. Then a coworker named Cleland, an older man with declining health and better guitar hands than anyone I'd ever met, sold me a 1992 American-made Fender Stratocaster and offered a few lessons before we lost touch. He was a paid professional guitarist who had performed at Dogpatch USA. The same park I had visited as a child in the back of that station wagon. He was probably there when I was. He was, without knowing it, a cosmic key to my musical life, and he never found out. I think about that sometimes.

The neuroscience of actually making music, as opposed to just listening to it, reveals something more interesting than effortful execution. A 2014 fMRI study of jazz musicians during improvisation found the brain doing something unusual: the regions responsible for self-monitoring went quiet. The regions responsible for expression and generation lit up. The resulting brain state has been compared, carefully and with appropriate hedging, to certain forms of meditation and to dreaming.

Mihaly Csikszentmihalyi (pronounced cheeks-sent-me-high) developed the concept of flow to describe total absorption in a challenging activity where skill and difficulty are matched closely enough that self-consciousness drops away. Musicians describe this state constantly, in almost identical language regardless of genre or instrument: the music plays itself, decisions happen faster than deliberate thought allows, something moves through you rather than being produced by you.

Choir members' heartbeats synchronize during singing. This has been measured. Cardiac rhythms actually converge through the shared respiratory demands of producing music in a group. The breath controls the phrase, the phrase is shared, and the heart follows the breath.

The oldest known musical instruments are bone flutes found in cave sites in Germany, dated to approximately 40,000 years ago. They were made deliberately, from materials selected for acoustic properties, with consistent construction across multiple finds. The impulse behind the problem has not changed in forty thousand

years. The instruments have. The drive itself, the need to take whatever music exists inside and find a way to put it into the world, is as old as the species.

It belongs to everyone, including the people who have been successfully persuaded otherwise.

Is being a conduit, being the kind of person who receives music with unusual force, who hears it everywhere, who cannot easily separate their inner life from the music running through it: is that a form of neurodivergence? And if it is, is not being one also a form of neurodivergence?

The research doesn't frame it quite that way. But the picture it paints points in that direction. Survey-based estimates suggest that people working in the creative industries report neurodivergent traits at higher rates than the general population. Musicians, writers, visual artists, filmmakers. The people who spend their lives trying to make organized pattern carry meaning. There is something about a nervous system that processes the world differently, that finds standard channels insufficient, that needs to make something out of what arrives rather than just receive it, that keeps landing in the same places.

My working hypothesis is that musicality exists on a spectrum, like most human traits, and that what we call musicality is really a measure of how open a particular nervous system is to this particular channel. Wide open: you hear it everywhere, it comes through whether you want it to or not. Narrowed: you appreciate music, you respond to it, but it stays in its lane. Essentially closed: the very small percentage of people born with congenital amusia, for whom pitch processing is genuinely absent and music registers as organized noise rather than organized meaning.

Clinical amusia affects somewhere between one and four percent of the population, with more rigorous recent estimates closer to one and a half percent. These are not people who were told they couldn't sing and believed it. These are people with a specific neurological difference. They can hear perfectly well. They simply experience significant difficulty perceiving pitch, which means a symphony arrives as organized noise rather than a language. That figure does not prove that everyone else who claims to be unmusical has been socially misclassified. But it does tell us that true neurological incapacity is far rarer than our culture pretends.

One and a half percent. Which means the vast majority of people who claim they have no musical ability may be wrong about themselves. They were told something, or they told themselves something, and they believed it, and they stopped. That may be less a neurological story than a social one.

But the one and a half percent are real, and they complicate everything I've been arguing. If music is embedded in the physics, if it is something the nervous system was built to detect, then congenital amusia is not just a quirk. It is a direct challenge to the claim. Some brains arrive without the receptor. The signal is there and they cannot pick it up. I have thought about this more than I want to admit, and the honest answer is that I don't have a clean resolution. A spectrum is not a binary. The fact that the channel exists in the overwhelming majority of nervous

systems, across every culture, with no exceptions, still means something. But the exceptions exist. And a book that argues music is fundamental to human experience owes those exceptions more than a footnote.

# Chapter 3: Who You Were When the Music Played

Your music taste is not a preference. It is a record of who you were becoming.

Preferences bend. You preferred one brand of coffee, tried another, updated. Musical identity doesn't work the same way, and I've spent a while trying to figure out why. There is something about the music that found you during the years you were building yourself, somewhere roughly between ten and twenty-five, that lodges differently than anything you discover after the fact. You can add to it later, expand it. But you cannot un-hear it, and you cannot remove it from yourself without pulling out something that doesn't come back.

There's a neuroscience to this, which I find both validating and slightly cold as an explanation.

Here's why.

Adolescence is when musical identity formation runs hottest, and this is not a coincidence. The developing brain during those years is doing something it will only do once, assembling a coherent self for the first time. Music arrives during this process as an unusually rich resource. It offers pre-made emotional vocabularies for experiences that feel overwhelming and inarticulate. It provides group membership without requiring explanation. It does all of this at the exact developmental window when the question of who you are is genuinely open in a way it will never quite be again.

The songs that land during that window tend to land permanently. Scientists call this the reminiscence bump, the well-documented phenomenon in which adults recall disproportionately more autobiographical memories from roughly age ten to thirty than from any other period. The bump exists because that period contains a higher density of first experiences, and first experiences encode more deeply than repetitions. The novelty amplifies the encoding. The emotional stakes of adolescence amplify it further.

There is probably an album, maybe more than one, that does not merely remind you of a time in your life but actually returns you to it. The texture of it, not the facts. That album is not just a memory. It is a passage back, and it never locks.

* * *

There is a song called Babylon by David Gray. I had heard it plenty of times before the night it became something else entirely.

My parents had separated. My mom had relocated to California, taking one of my two brothers with her. The other had come back to Arkansas to live with my dad, who was an addict working on getting his life back together. The family had split along those lines, and this visit was a reunion of sorts, my mom flying back

with my brother, everyone briefly in the same place, in winter, on roads that had no business being driven.

We got them to the airport. I was parked in the cell phone lot, the way you do, watching the runway because there's nothing else to watch. Babylon came on the radio. I'd heard it before, plenty of times, nothing particular attached to it.

Then I saw the plane in the air.

And something in me broke open.

Not about the lyrics. I couldn't have told you what David Gray was saying. It was the sound, the specific emotional frequency of that song hitting at the exact moment I watched that plane climb out of Arkansas. Everything landed at once. The relief that we'd made it there on those roads. The sadness of watching them go. And underneath both of those, something that felt almost like hope, because I had watched my parents be in the same room and seen something I wasn't expecting. Something that felt like weather changing. They would later reconcile. Standing in that parking lot I couldn't have told you that was coming, but some part of me could feel the signal.

Babylon was playing. The plane was in the air. That was enough to break me open.

I have heard that song hundreds of times since. I cannot access a single thing it meant to me before that night. Whatever associations it carried got completely overwritten, in the time it takes a plane to clear the clouds. The neuroscience has a name for this: memory reconsolidation, the process by which a strong enough emotional event re-encodes whatever a piece of music was carrying and replaces it. I just have a radio and a cell phone lot and a winter sky.

* * *

And then there's Ed Sheeran, because this chapter has to be honest about how this works in both directions.

I have a complicated relationship with a specific Ed Sheeran song that I will not name because naming it makes it worse. Through no fault of anyone involved, I heard it an unreasonable number of times in a bathroom, under circumstances requiring both hands to be otherwise occupied. Classical conditioning is a real and completely indifferent process. It does not negotiate. My nervous system has permanently associated that song with a very specific domestic context and there is nothing I can do about it, and I have made a kind of peace with this the way you make peace with a scar.

The additional problem is that the song sounds, to my ear as a musician, substantially like Let's Get It On by Marvin Gaye. There was a lawsuit. Ed won,

correctly, on the grounds that chord progressions aren't ownable. I agree with that ruling. Chord structures belong to everyone and always should.

But now I've got Marvin Gaye tangled up in all of this, and Marvin Gaye deserved better, and frankly so did I.

The point, which I have not lost, is that music isn't an object. It's a relationship. You don't hear a song and file it somewhere. You hear it inside a moment, and the moment becomes part of what the song is, and what the song is keeps changing every time a significant enough moment opens it back up. You can't recover the previous version. There's no undo. The song you thought you knew is different now, and you can't know which version the next person in the room is carrying.

That's either beautiful or frustrating depending on the day. Ask me about Ed Sheeran sometime. Actually, don't.

* * *

There is a different version of this that happens later in life, and it deserves its own moment because it feels distinct from everything described above.

You hear something you have never heard before. You are forty-two, or fifty-one, or thirty-seven, well past the window when musical identity is supposed to be forming. The thing you hear is not supposed to land the way it lands. There is no developmental reason for it to encode the way the songs from adolescence encoded. The neuroscience would predict a polite response, maybe appreciation, maybe the quiet pleasure of discovering something good. Not the thing that actually happens, which is more like recognition. The feeling of being found by something that was apparently looking for you.

It happened to me with the Appalachian fiddle. I came to it from outside, with no cultural connection, no family history in it, nothing that would explain why it hit the way it hit when I finally heard it properly. Something in it landed in a place that already had a shape waiting for it. I cannot account for the shape. I can tell you it was already there.

The neuroscience of adult musical response is less studied than the adolescent window, partly because the adolescent window makes better headlines and partly because the effect is harder to isolate. What seems to be true is that the formation window is real but not absolute. The brain retains plasticity into adulthood, and the right music at the right developmental moment: a first loss, a major transition, the years after forty when the self starts to settle in ways that require different music, can encode with something close to the depth of adolescent formation. The emotional stakes have to be high enough. The music has to meet you where you are, not where you were.

What is different about late arrivals is that you know you are being found. In adolescence, you don't have the perspective yet to understand what is happening. The music is just the music, urgent and total and unexamined. Later, you notice it. You catch yourself going back repeatedly to something new. You feel the encoding happening in real time, and it is a slightly different sensation than not noticing it at all. More conscious. Less complete, maybe. Or just differently complete.

I have songs that found me in my twenties and songs that found me in my forties and they are not the same kind of thing. The ones from my twenties are inside me in a way I cannot fully see because they are part of the structure I see with. The ones from my forties I can examine more clearly, hold at a slight distance, understand something about. It makes them more like furniture than like air.

* * *

I can’t even remember where I first heard Pete Yorn. I think “Life on a Chain” was playing on a local alternative radio station I listened to at the time. Again, went to Best Buy the night of payday to buy CDs. The first track was “Life on a Chain,” which I learned to play on acoustic guitar pretty quickly. Then I started noticing the other songs were brilliant. It felt very beat-centric, that everything was written around that. I can almost always tell when the chicken or the egg, music or lyrics, come first. I remember having the impression that Yorn was probably a drummer given the musicality. I was right. He played drums on the album himself, along with most of the other instruments. I wore out that CD. I still have it, but it hasn’t withstood several moves, vehicles, kids the way I’d have hoped. That’s what streaming services are for.

That album was the soundtrack of my early 20s. Optimism, awkward relationships that ended before really developing, and just knowing and sitting with the inevitable outcomes. When I revisit that album I’m not listening to music. I’m opening a time capsule. But it’s one that I open a lot, especially on family road trips. It’s a perfect road trip album.

I saw Pete Yorn at a music festival. There is a festival version of me that is quite unlike the person you’d meet in day-to-day life. The festival version is alive, uninhibited, shoes off in the grass, ready to receive whatever comes through the speakers. My wife is my favorite festival buddy.

I was at Memphis in May one year and Pete Yorn was playing early on Sunday. I begrudged that I had to be up early after a late night of shenanigans and walking in Memphis along Beale Street, hoping W.C. Handy was looking out over me. It was obvious that Pete was also not happy about the 11 a.m. concert start time. Wearing Wayfarers and holding a Budweiser, he played the whole show like he’d just woken up and was in a stupor, but he roared through the album and a memorable cover of “I’m on Fire” by Springsteen.

I left the show feeling satisfied, but also like we didn’t get to connect as artist and recipient. It was a similar vibe to the Jack White missed moment.

The album turned 25 in March 2026. The anniversary edition was recorded at Third Man Records in Nashville, which is Jack White’s studio. If you’ve been reading this book in order, you’ll understand why that detail made me laugh.

The question the chapter is asking is not just when music finds you, though timing matters. It is what music carries forward on your behalf, and for how long, and what you find when you go looking for it years later. The answer is different for everyone. But the fact that there is an answer, that the music has been carrying something the whole time, is not different for anyone.

This is why the chapter is not really about nostalgia. Nostalgia is looking backward. What the music is doing is something more structural than that. It is holding a version of you that would otherwise be inaccessible, the specific texture of who you were when the encoding happened, and making it retrievable. Not for sentiment. Because that version of you knew something, felt something,

understood something that you have since covered over with everything that came after. The song is the way back to it.

## Chapter 4: What Remains

The brain disease most associated with memory loss doesn't touch musical memory first. It saves it almost for last. That fact alone should change how we think about what music is.

Alzheimer's disease is patient. It doesn't announce itself and take everything at once. It works the way rust works, selectively, following paths of least resistance, leaving certain things intact precisely long enough for you to notice exactly what's been removed. Names disappear before faces. Recent memories go before old ones. A person can describe a summer from 1962 in vivid, accurate detail and have no reliable memory of breakfast. Families adapt. They learn to stop correcting. They learn that some days are better than others for reasons largely beyond anyone's control.

What they don't always expect, and what still tends to arrive as a surprise even to experienced caregivers, is what happens when someone puts on the right song.

Picture it: a woman in her early eighties, in memory care, largely nonresponsive to conversation. Her daughter visits twice a week and spends most of each visit sitting quietly beside a silence that rarely answers back. A staff member, on a hunch or out of ideas or both, puts headphones on the woman and plays a playlist of songs from her twenties. Early 1960s music. Songs she danced to. Songs she sang along with in cars.

Within thirty seconds she is moving. A slight rhythm in the shoulders, a tapping finger. Her lips begin moving. Then she is singing, full lyrics, correct melody, expression on her face that her daughter hasn't seen in two years. When her daughter takes her hand, the woman looks at her. Actually looks at her, present and located, and says her name.

The song ends. The window begins to close. Three and a half minutes. She was back.

If you've watched something like this, you already know it isn't a small thing. Store this carefully regardless: it is documented, it is consistent, and the explanation for why it happens is considerably more interesting than the event itself.

What I find more interesting than whether it works is why.

Alzheimer's doesn't damage the brain uniformly. It advances along specific pathways, targeting the hippocampus early and with particular aggression. When the hippocampus fails, the road to the memory is destroyed. The memory itself may still exist somewhere. The retrieval infrastructure is gone.

What the disease reaches much later, sometimes years later, sometimes never in the patient's lifetime, are the regions associated with procedural memory, emotional processing, and the deeply encoded patterns of things practiced across a lifetime. Music lives primarily in those intact systems. Familiar music doesn't retrieve through the hippocampal pathway the way a name or face does. It activates through a distributed network involving the cerebellum, basal ganglia, and auditory cortex, with emotional response generated through the amygdala. Different road. Still open.

Researcher Petr Janata at UC Davis identified a region of the medial prefrontal cortex that acts as a hub connecting musical memory to autobiographical memory and emotional response. In some Alzheimer's patients, this region appears relatively preserved compared to others, which may help explain why musical memory can sometimes survive when other retrieval pathways have been damaged. The evidence is suggestive rather than definitive, and the preservation is not universal. So when that woman heard her song from 1963, the brain didn't attempt the road that had been washed out. It found the one the disease hadn't reached yet. The music didn't just trigger a feeling. It temporarily restored access to a version of herself that the illness had been systematically burying.

Dan Cohen, a social worker who founded the nonprofit Music and Memory, built a program around this principle after observing what happened when nursing home residents received personalized music playlists. The transformation in patients who had been withdrawn, agitated, or nonresponsive was consistent enough across enough facilities that the program eventually reached thousands of care centers. The protocol is almost insultingly simple: find out what music mattered to this person when their identity was being formed, put it in their ears, and pay attention. The simplicity is deceptive. It should not work this reliably. It does.

It also does not always work. Some patients do not respond. Some playlists miss because the family guessed wrong about which years mattered most, or because the disease had already reached the regions that even music depends on. The window, when it opens, is inconsistent in duration and unpredictable in timing. Researchers do not fully understand why it opens for some patients and not others. The program works often enough to be remarkable and fails often enough to require honesty about what it is: a tool with real power and real limits, not a cure and not a guarantee.

There’s a 2011 film called The Music Never Stopped, based on Oliver Sacks's essay The Last Hippie, that I return to more than almost any other piece of cinema on this subject. A young man has a brain tumor removed. The surgery leaves him unable to form new memories. He is frozen neurologically in the early 1970s, the years when his identity was forming and the music of that formation was encoding

itself into his brain's deepest structures. Everything since is unreachable. It simply does not stick.

A music therapist eventually discovers that the songs from that era can reach him when nothing else can. The right song plays and he is present: verbal, connected, capable of recognition. The window opens. When the music stops, the window closes. His father, estranged for years, learns to enter through the only door that remains unlocked. The relationship they rebuild is conducted almost entirely through music, in the brief and genuine moments of contact it makes possible.

I watched that film and felt the particular recognition that arrives when something you've known intuitively for a long time is finally shown to you from the outside. Music reaches depths we do not yet understand well enough to respect as fully as we should.

The traumatic brain injury story is related but different. Melodic intonation therapy, developed in the 1970s and well established in rehabilitation literature, exploits the fact that singing recruits the right hemisphere more substantially than speaking does. When the left hemisphere is damaged and the speech pathway is compromised, the right hemisphere’s musical vocalization can sometimes serve as a detour.

The melodic intonation therapy story is almost easier to dismiss than the Alzheimer's cases because it sounds like a metaphor. She was shot in the head and learned to speak again through singing. That sounds like something that happens in a movie.

But this is what actually happened. Gabrielle Giffords took a bullet through the left hemisphere of her brain in January 2011. The left hemisphere is where most people process language. The left hemisphere speech pathway was severely damaged. She could hear people. She understood what they were saying. She could not reliably produce words.

What remained, untouched, was the right hemisphere's capacity for musical vocalization. Melodic intonation therapy works by pitching the syllables of words rather than speaking them. The mechanism is still debated. Rhythm, repetition, slowed production, and sensorimotor coupling all likely play a role alongside whatever the melodic element contributes. The brain finds a way around the damage, and over time some patients build new infrastructure for language that does not depend on the original pathway.

Giffords was doing this at her kitchen table. Singing the names of things around her. Singing her husband's name. She testified before Congress in 2014, slowly, short sentences, words arriving with effort. But they arrived. Through a pathway that runs through the same system that knows every word to every song you've ever loved.

The technique had been working quietly in rehabilitation settings for decades before it had a famous recipient. The technique didn't change. The visibility did.

The musician data is where it gets clarifying.

Professional musicians with Alzheimer's retain their musical abilities significantly longer than they retain almost any other cognitive function. A pianist with advanced disease who cannot tell you what year it is can sometimes sit down at an instrument and perform a Chopin nocturne from memory with accuracy and expressiveness suggesting the music is not just being retrieved but understood.

The explanation is that decades of musical practice don't just accumulate skill. They physically build more neural infrastructure around musical function than a non-musician's brain contains. The musician's brain has built deeper and more distributed networks around music than most brains build around almost anything else. It is the last to go because it was the most thoroughly built.

If there is dark comedy available here, it is this: the thing society most reliably classifies as nonessential, the art elective, the music program, the first line cut when budgets tighten, turns out to be what the brain protects most fiercely when it is under the most serious attack. Make of that what you will. I have been making of it what I will for years, and it has not gotten funnier.

One fact runs through every case in this chapter: music is woven through the brain's motor, memory, emotional, language, and self-referential systems in a way that creates redundancy almost no other cognitive function achieves. To fully disable music processing in a human brain, you would need to damage an unusually large and diverse set of regions. The diseases and injuries that disable almost everything else tend to leave at least some of those regions intact. Music uses whatever is left.

Something that integrated into the brain's core architecture is not a passenger. It is load-bearing. And load-bearing structures tell you something about the requirements of what they're holding up.

* * *

Andrew W.K. arrived the way he was supposed to: loud, immediate, and through a video game.

Party Hard was the opening track on the Madden NFL 2003 soundtrack. You booted the game and it was just there, before you’d done anything, before the menu even fully loaded. The whole I Get Wet album operates that way. The album cover is just Andrew’s face with a very bloody nose. No explanation. No irony. The message is that this is exactly what it looks like and you can decide what to do with that.

She Is Beautiful is my personal favorite on the record. Not because it’s the most sophisticated thing he’s ever done. Let’s be honest about what this music is. It’s pure adrenaline, which is its own form of artistry. Andrew W.K.’s project is the argument that joy is a serious emotion, that the body’s response to loud music is sufficient justification, that partying is a philosophy and not an apology. The songs don’t have mysteries. They have a thesis, and the thesis is: feel this.

My son Anderson has Down syndrome and is nonverbal. He's medically complex in ways that have taken us to hospitals in more cities than I want to count, trying to understand things about how he works that medicine is still working out. But when he's feeling well, he is active and curious and alive in the room in a way that is specific to him.

Dance party nights are a regular event in our house. I'll play music live or stream it, and the living room becomes whatever it becomes. One night I put on She Is Beautiful. There's a little opening guitar riff, clean, almost delicate, and then building punctuated riffs, a crunchy run right before the main event. Anderson heard the opening and paused. He knows that something is coming. When the drums kicked in and everything locked together, he shrieked. Smiled. Stiffened up with the specific full-body joy that is his version of rock hands. I saw it on his face before I could name it.

Rock joy. First time. One of many since.

It turns out Anderson is a metal head. He comes by it honestly.

I have a line of communication with Andrew W.K. and at some point sent him a video of Anderson doing this exact routine: the pause at the opening lick, then the full-body response when the song hits. Andrew liked the message and sent party vibes back.

The frequencies matched.

* * *

I think about this every time I hear a policy debate about music education. The people arguing for its removal are not wrong that it isn't necessary for test scores or job placement rates. They are wrong about what it is. They are making the error the chapter has been building toward: treating music as a pleasant addition to life rather than part of the foundation.

Thin Lizzy came into my life the way the best things do, sideways, through someone else's obsession, at an age when you still have the cellular capacity to be permanently rewired by a band. Phil Lynott was the first Black Irishman to reach significant commercial success in rock. He formed Thin Lizzy in Dublin in 1969, and what he built over the next fourteen years was a body of work that still gets criminally under-cited when people talk about rock's architects.

The twin-guitar sound, the literary density of the lyrics, the way Lynott wrote working-class Irish life into hard rock without sentimentality: these were not things that rock was doing at the time with any consistency. The Boys Are Back in Town is the song everyone knows. Jailbreak, Renegade, Still in Love with You, Don't Believe a Word. Those are the songs that rewired me. Lynott played bass with a pick, pushing the chord slightly ahead of the beat, which gives Lizzy's rhythm section a forward lean that most bands can't replicate because most bass players don't think that way. When I play guitar, that lean is what I am chasing.

He died on January 4, 1986. He was thirty-six. Heart failure and pneumonia, admitted to hospital Christmas Day after collapsing at home while opening presents with his children. Heroin had been taking him apart for years. The band had already dissolved. Live Aid had not invited him, which his bandmates later said may have been the blow that finished his momentum. He had begun work on new material that never arrived.

What Lynott left behind has been growing in stature since his death the way some artists' work does, not because the culture discovered something new but because the culture finally got quiet enough to hear what was always there. A statue of him stands in Dublin now. It is a good likeness. The bass is right.

I have adapted my relationship to his music now that guitar is mostly unavailable to me. I play it on piano, which sounds wrong in ways that are sometimes funny and sometimes not. My wife laughed when I played The Boys Are Back in Town on piano, the dual guitar solo included, note for note, rendered on keys with all the rock replaced by something closer to a ragtime impression of rock. It sounded like the idea of the song rather than the song. But the idea was right, and the joy of playing it was real, and I will take that.

The Alzheimer's patient who comes back through a song is not being treated. The pathway is being accessed. It was always there. The disease had simply made the other pathways unavailable. Music found the way in because music is not stored in one place that can be destroyed. It is distributed through the brain the way a river distributes through a delta, through dozens of channels, each one slightly different, all of them carrying the same water.

What that means, at the level of policy and practice and the decisions we make about what we teach children and what we fund and what we protect, is this: you cannot cut music out of a human life without cutting something that the rest of the architecture depends on. You will not notice the loss immediately. The structure will hold for a while. But you will notice it eventually, when something that should have been there to help is not, when the channel is needed and the channel was not built.

Music in schools is not enrichment. It is infrastructure maintenance. The dark comedy is that we keep treating it like wallpaper and then being surprised when the wall it was on turns out to need it. The kid who was told they couldn't carry a tune and stopped trying. That's not a story about talent. That's a story about a system that misclassified what it was dealing with, and a person who paid the price.

## Chapter 5: The Same Song

Music is one of the most powerful technologies humans have ever built for physically synchronizing the people using it. Chanting, marching, rowing in unison, and other rhythmic collective activities can do related things. Music does it with a range and flexibility that most of those cannot match.

Not emotionally synchronizes. Physically. Heartbeats. Breathing. The electrical response of skin. These are not metaphors for connection. They are measurable physiological events that happen in separate bodies simultaneously when those bodies are sharing music. Nobody coordinates it. Nobody decides to sync up. The music arrives and the biology follows.

You know this moment. A concert, a wedding reception, a bar with a jukebox that someone fed the right dollar at exactly the right moment. A funeral, because music at funerals does something that even the best-written eulogy typically can't manage on its own. Whatever the setting: the room changed. A collection of separate people became, briefly and unmistakably, a single thing. Nobody decided this would happen. The music arrived and the room reorganized itself around it.

The mechanism turns out to be quite specific, which I find more interesting than the general case.

Every person in that room arrived as a separate biological system. Separate heartbeat, separate breath rate, separate neurological state. Music synchronizes them.

Not a figure of speech.

Researchers at the University of Gothenburg studied choir members and found their heart rates converge during singing. Not approximately. Measurably, specifically, synchronized through the shared respiratory demands of producing music together. The breath controls the phrase. The phrase is shared. The heart follows the breath. A room full of singers becomes, at the cardiac level, something closer to a single organism than a collection of separate ones. Skin conductance, the subtle electrical response the body produces during emotional arousal, has been shown to synchronize across people who are not touching, not speaking, not doing anything except experiencing the same music at the same time.

The word for what music does in these moments is entrainment, borrowed from physics, where it describes the tendency of oscillating systems to synchronize when coupled. Two pendulum clocks hung on the same wall will, over time, align their swings through tiny vibrations traveling through the shared surface. They didn't decide to agree. The physics did it for them. The same principle operates in human bodies responding to shared music.

The bone flutes found in German cave sites, dated to approximately 40,000 years ago, were not accidents. Music at that antiquity was communal by default, a community that could synchronize physiologically through shared sound could coordinate and hold together under pressures that would pull apart a less cohesive unit.

* * *

I was sixteen or seventeen, spending part of a summer in California with family, when I ended up at BFD, the Live 105 radio festival at Shoreline Amphitheatre in Mountain View, June 13, 1997. The lineup was the kind that doesn't happen by accident: The Cure, Blur, Bjork, Echo and the Bunnymen, Social Distortion, Erasure. I was there primarily for The Cure, which is the correct reason to be anywhere Robert Smith is performing. I was not paying particular attention to a San Francisco band called Third Eye Blind also on the bill.

I left that festival a lifelong fan of two bands I hadn't expected.

Erasure first. I caught enough of their set that afternoon to understand I had been missing something. Andy Bell's voice and the architecture of their sound did something that required further investigation. It has required further investigation ever since.

Then Third Eye Blind played.

They had released their self-titled debut earlier that year. They were at the precise moment of ignition, past obscurity, not yet ubiquitous, that specific window when a band is becoming something in front of an audience that doesn't yet know what it's watching. What I remember is the quality of attention that assembled around that stage. Not polite tolerance. Something more active, the specific collective focus a crowd produces when it's been given a signal worth locking onto. People who had been moving toward other stages stopped. The density in front of that stage shifted. No prior investment. No reputation to honor. Just a signal arriving through the air and several thousand nervous systems responding before their owners had consciously decided anything.

Entrainment without permission. Recognition without prior knowledge.

The full Third Eye Blind story is longer than this chapter has room for. The short version: the debut album, which I maintain is a masterpiece, with a closing four-song stretch I will put against any other album's finale without hesitation. I am aware of how this sounds and I stand by it. At a show years later I met the original members. One of those nights became an evening that remains one of the more surreal experiences of my concertgoing life: an intimate show in a room with roughly twenty tables and eighty people, where the band played brilliantly despite the venue simultaneously serving a buffet dinner and selling beer from an Igloo cooler. Arion Salazar, one of the more gifted bass players of his generation, paused between songs to inform the room, with evident sincerity, that the meat loaf was stellar.

Fewer than ten people in the room knew all the words. I was one of them. The band played hard anyway, because the music doesn't calibrate itself to the size of the audience.

The recognition moment is the sharpest version. It won't always be that clean. But that's what it's pointing at.

When a musician plays the opening notes of a song a crowd knows, something happens before the first complete phrase has been played. Thousands of people recognize it simultaneously. Not slowly, not cognitively. Immediately, before the thought that names it. And it arrives with everything attached: all the accumulated meaning that song carries for every person in the room, all the memories it's anchored to, all the versions of themselves they were when it first mattered.

For three or four minutes, all of that is in the room at once. Thousands of private histories, thousands of different versions of the same song's meaning, all activated by the same sequence of notes. The people around you don't know your history with it. You don't know theirs. But for its duration, you are all experiencing something simultaneously deeply personal and entirely shared, and neither cancels the other.

Think about what's in a room when a song everybody knows comes on. The person by the door is hearing it as the track that played at their sister's wedding. The one at the bar is back in a car at seventeen, windows down, not thinking about anything. The one in the corner is hearing the version that got them through a divorce. Three entirely different songs, identical notes, all present simultaneously, none of them wrong.

Language can't hold all of that at once. A word means one thing. It narrows as it specifies. Music is imprecise in exactly the way that turns out to be useful: open enough that every listener's version fits, specific enough that the music still gets through. The song doesn't adjudicate between the versions. It carries all of them without contradiction, the way a river carries everything floating on it without choosing.

Either the greatest achievement of art or the most obvious fact about sound. I haven't decided. Probably both.

I have always had what I can only call an intimate relationship with music, closer than enjoyment, which always sounds like a casual thing to me. The relationship of someone who requires it the way other people require sleep or food or the company of people they trust.

When I find another person who has that same relationship, something happens that doesn't have a clean name. It's not just that we like the same music. It's more specific than that. It's the recognition that we arrived at the same place independently, alone, the way two people might discover the same remote trail from opposite directions and find each other at the top of a hill. We found this in the wild. We didn't get it from each other. Which means we found something real.

I didn’t understand for a long time that this wasn’t universal. I thought everyone felt music the way I did. It didn’t occur to me that the option existed. Then, while researching this book, I came across the science on frisson and found out there’s a percentage of people who simply don’t get that physical response from music. At all. A physical response, full-body, unmistakable. Nothing. The thing

that I had assumed was basic human wiring turns out to be a specific configuration, and not everyone has it.

I spent a while sitting with that. Where do they feel it, if not here. What is the equivalent, for them. I genuinely don't know, and I'm not sure the question has a clean answer. But it reframed something for me about what this book is and who it's for.

There is also the specific strangeness of hearing a song you already love performed live for the first time. The track has already earned its place in your permanent memory. You know it the way you know your own name. You've had it alone in the car, alone in headphones at two in the morning, alone in whatever private context it belongs to. And then you're in a room and the song starts and you watch several hundred or several thousand other people have the same response you've always had, privately, alone.

* * *

I've never been so alone and I've never been so alive.

Jenkins wrote that line about the specific emotional paradox of a particular kind of loss: the breakup or the grief that strips everything away and leaves you feeling, underneath the devastation, more present in your own life than you have ever been. Raw sadness as a clarifying force. Tragedy as part of the beauty rather than its opposite. He said something out loud that a lot of people had felt without having the words for it, and when they heard it they recognized themselves in it. That is the function this chapter has been describing in neurological terms. Jenkins did it in eleven words.

The pit at a Third Eye Blind concert is a diverse group. Different demographics, different economics, no obvious unifying visual. People with 3eb-inspired tattoos standing next to people who look like they have never been to a concert before. You could not predict, from the outside, what this crowd has in common.

What it has in common is interior. These are people who, at some formative point in their lives, found an album that articulated something they thought was private. Something they thought was only theirs. And then they found out, in the pit, sweating through their clothes and singing every lyric of every deep track, that it was not only theirs at all. It was everyone's. The obsession they thought was singular turned out to have a whole congregation.

The crowd does not look like anything. It feels like church. A glorious, profane, mood-altered church.

The description is deliberate. The chapter on awe already covered what churches are actually engineered to do: produce specific states in people through acoustic design, collective synchrony, and the deliberate use of organized sound to dissolve individual self-consciousness into something shared. What happens in the

pit at a Third Eye Blind concert is the same mechanism, secular and sweaty and loud. The heartbeats converge. The self-referential noise quiets. For the duration of the songs, the people in that room are not separate. They are the music's one audience, made of many people who got there by different roads and arrived, for this specific hour, at the same place.

The conversations in those pits, before and after, are their own thing. You can talk to a stranger about almost anything and find traction, because the credential has already been established. You have shown each other the inside. What follows from that is easy.

That changes something. The obsession you thought was living a comfortable solo life turns out to have always been communal in nature. There were always other recipients. You were just in separate rooms.

# Chapter 6: The Instrument You Are

I should tell you something about how I hear music before we go any further.

I see it.

Not in a metaphorical sense, not the way a person might say a piece of music is vivid or that it paints pictures. I mean it produces actual color in my visual field. Arpeggios have hue. Chord progressions shift the palette. Dense harmonic passages can produce something complex enough in my visual field that it becomes, briefly, a lot to process simultaneously. I am a synesthete, specifically a chromesthete, which is the variant where sound produces color, and this is simply what music has always been for me. Fully auditory, fully visual, simultaneously.

I did not know this was unusual for longer than I care to admit.

The first memory I have of recognizing that something specific was happening was Things Can Only Get Better by Howard Jones. There is an arpeggio before the verse, a rapid ascending sequence of notes, right before he sings And do you feel scared? I do, and what arrived with it was rose pink, orange, and fuchsia. Not as an impression. Not as a feeling described in color terms. As color, occupying the same space as the sound, arriving and departing with the notes.

I was young enough to assume this was what music looked like for everyone. The idea that other people heard that passage and saw nothing, that the sound arrived for them as only sound, didn't occur to me until years later. It is the same mechanism by which people with perfect pitch don't immediately realize others can't hear what they hear. The experience is native enough that its exceptionalism is invisible.

I just described an arpeggio as colors. To me, that is a normal sentence.

The colors are not chosen. They are specific to each piece of music and they arrive already assigned. I do not decide that a particular chord is blue or that a melody should be warm yellow. It arrives that way, consistent on every listen. John Mayer's 3x5, a song built around a simple fingerpicked guitar pattern and a plainly told story, produces teal, yellow, and lavender in my visual field. I have no explanation for why those specific colors and not others. I cannot account for the assignment mechanism. I can tell you it is consistent, specific, and that the experience of hearing that song is inseparable from the experience of seeing it.

The neuroscience has a name for it, which helps.

Synesthesia, the blending of senses where one sense triggers another automatically and involuntarily, is more common than most people assume. Conservative estimates put it at roughly 4 percent of the population, and some researchers argue the true number is higher once mild and inconsistent forms are counted. Many synesthetes go years or decades without knowing, because the experience is so native they assume it is universal.

The most widely accepted neurological explanation is cross-activation: in synesthetic brains, pathways between adjacent processing regions are more numerous, more active, or less inhibited than in others. The auditory and visual systems communicate more freely. The signal doesn't stay in its lane. It bleeds over, and the result is an experience the recipient cannot easily distinguish from ordinary perception, because neurologically it is ordinary perception. Just with additional routing.

Synesthesia may be a louder, more visible version of something all brains do. Music processing is never purely auditory, even in brains wired the standard way. It consistently activates motor regions, which is why your foot taps before you decide to tap it, emotional regions, and visual regions in people who see no colors at all. In synesthetes, those cross-connections are turned up past the point where they can be ignored.

What I experience isn't some exotic neurological anomaly sitting outside normal music processing. It's normal music processing with the volume knob past the normal range. Every time you feel that a bass line has weight to it, or that a certain song feels warmer than another, your brain is doing a quieter version of what mine does loudly. That is the metaphor I find most useful, anyway. The neuroscience has not confirmed it in those terms, but the cross-modal processing that underlies synesthesia does appear to be a more pronounced version of something all brains do when they encounter music. Mine just does it loudly enough to see.

Even if you're not a synesthete, you've probably noticed something adjacent: certain songs feel warm or cold, some musical keys seem brighter than others, a particular bass line has physical weight to it in a way that is not quite a metaphor. That is not imagination. That is the brain doing what it does with music.

And there is a category of sound that sits in a different register from all of this. What synesthesia and the haunting both point at is the same thing: music processing is never purely auditory. It runs through the whole body, activating visual, motor, and emotional systems simultaneously. The people who experience this most intensely are not outliers. They are the clearest version of what is happening in everyone.

There is a category of sound that doesn't have a good name yet. Not beautiful, not ugly, not sad exactly. The closest word is haunting, but that word has been so thoroughly worn down by overuse it's become decorative. Something more specific: sounds that feel like they're coming from somewhere just outside the frame of normal human experience. Sounds that produce a response before you've identified the source.

The musical saw is one of these. A handsaw played with a violin bow, the blade bent to produce a singing tone. The reason it affects people the way it does is specific: its overtone profile is nearly identical to a human voice. Your auditory system hears it and files it under person before the conscious brain can correct the record. By the time you've figured out it's a bent piece of hardware, some older part of your brain has already responded to it as if someone were singing.

The erhu does the same thing. Two strings, a bow trapped between them, no fingerboard, no frets. The sound is so close to a human voice in distress that street performers playing erhu in Chinese cities have caused pedestrians to stop and look around for whoever is crying. The instrument is exploiting a processing shortcut that evolution built over millions of years. You feel it before you understand what you're feeling.

The Mellotron plays recordings of real instruments on tape loops, which means every note is already dying when you hear it. The samples have a finite length. Hold a key long enough and you hear the tape run out, the brief mechanical stutter of something that was supposed to sound alive admitting that it isn't. The Beatles used it on Strawberry Fields Forever and it sounds like a memory trying to sustain itself past the point where memory can hold.

The musical saw appears in the Neutral Milk Hotel song In the Aeroplane Over the Sea, and it does exactly what a musical saw does: arrives in the auditory cortex as a human voice before the cortex has time to correct itself, which means it produces the pre-conscious emotional response of hearing a person before you realize it is metal. The lyric running over it is: and one day we will die and our ashes will fly from the aeroplane over the sea. I am aware this is a lot. But that combination, the instrument that sounds like a person in distress, carrying a lyric about mortality and grace simultaneously, is one of the cleaner examples I know of music doing several things at once to the nervous system, none of which were decided consciously by the listener. The saw does one thing. The lyric does another. Together they do a third thing that neither could do alone. That is the haunting, when it works. It is not one element. It is the collision.

Then there are instruments that are haunting not because of their physics but because of what they got attached to. The pedal steel in He Stopped Loving Her Today by George Jones. The song is about a man who loved a woman his entire life and only stopped when he died. The pedal steel doesn't underline that. It doesn't dramatize it. It just sits in it with you, bending notes the way pedal steel bends notes, which is to say without resolution, everything sustained and sliding, nothing landing cleanly. The instrument and the grief have become the same object.

Jay Ungar wrote Ashokan Farewell as a slow waltz in 1982. Ken Burns used it throughout the Civil War documentary. It sounds like it was written in 1864 by someone who had just lost someone and was writing to keep from stopping. Some instruments acquire context that becomes permanently part of the sound. You cannot hear Ashokan Farewell without the weight of every use it has ever been put to.

Practice builds toward this, which is not what most people are told when they start.

Every musician who has practiced long enough has had the experience of music feeling like a place. Of returning to a piece the way you return to a room, not just remembering it but arriving in it. Of certain keys having emotional personalities that function almost spatially: the weight of D minor, the brightness of E major, the unresolved tension of a suspended chord that feels, with eyes closed, like standing in a doorway.

The world becomes musical after long enough. Not as a poetic stance, not as something you decide to believe, it happens structurally. The part of the brain that parses pattern starts finding pattern everywhere it looks: the rhythm in a city block of footsteps, the accidental chord when three conversations overlap, the interval between a door closing and an elevator arriving. You can't turn it off. You stop trying to. The world is a rough draft of music, full of good ideas that haven't been arranged yet.

Because that is what a musician is: not a person who makes music the way a carpenter makes furniture, but a system tuned to receive and transmit. The world is a rough draft and the musician is the editor, not adding anything that wasn’t there, just finding the parts that were waiting to be arranged.

# Chapter 7: The Question Underneath

After enough repeated exposure to organized sound, the nervous system stops processing it from the outside in. The neural pathways that process music, the auditory-emotional network, the prediction machinery, the memory systems that light up with it, they integrate over time. They become infrastructure rather than apparatus. The music stops going through a process and starts going through a person.

* * *

At what point do we stop calling that a coincidence?

* * *

My favorite song is Just Like Heaven by The Cure. It's not the most technically ambitious song Smith ever wrote. Because it has been exactly right at exactly the moments I most needed it to be. Because it has never once failed to do what music at its best does. Because thirty-some years after I first heard it, it still arrives in full, carrying everything it has always carried, the way a room stays furnished even when you haven't been in it for years. It is a door, and it still opens, every single time.

* * *

September 9, 2003. I was twenty-two, working enough to cover my bills, spending Friday nights the way single twenty-two-year-olds spend Friday nights in Arkansas, which is to say badly and happily. I had a ritual: payday Friday, Best Buy, whatever had dropped that week. Heavier Things was a first-day purchase. I was driving home in the dark with the CD playing when it happened.

Track two. Clarity. The song moves through its verses and choruses in a way that feels comfortable, familiar, well within the territory Mayer had established on Room for Squares. And then the bridge arrives. The chords shift: Fmaj7, Bbmaj7, Ebmaj7, Dbmaj7, a series of descending major sevenths that move through harmonic territory the verse never visited, each chord landing with the mellow horns floating over a jangly piano. It is jazz-adjacent in a way that could have felt jarring but instead felt inevitable, like a room you didn't know was in the house that turns out to be exactly the room you needed.

I gasped. Not metaphorically. An involuntary physical intake of breath, alone in a car in the dark, because a key change hit me like a wave. I wasn't thinking about music theory. I wasn't analyzing what was happening. Something moved through me before I had time to have an opinion about it.

I have thought about that gasp for twenty-plus years now. The body registered it before the brain got involved. What I think about now is that I didn’t choose to gasp. The music did something to me, and the gasp was the evidence. I was the receiver. The signal came through.

* * *

There is a version of this that happened the other way, not receiving something through another person's music but discovering something through my own hands, through limitation rather than mastery.

I have myasthenia gravis, a rare neuromuscular disorder that causes extreme muscle fatigue. I also have neuropathy in my fingertips, particularly my left hand. I haven't been able to play guitar for over three years now, which is its own loss that I will get to in a moment. But before that loss there were days of playing through significant physical difficulty, days when my hands were fatigued past the point where technical execution was reliable.

I had been working on a song for a while (it remains untitled) that was waffling between F#, C#, and Ab. Something was missing and I couldn't find it by looking for it. Then one day, near the end of a session when my hands were done, my left hand sitting on the bottom half of an F# chord, my index finger slipped off the Bb and landed on the B. Everything else stayed home in F#. What I had accidentally played was Bsus2.

I knew immediately. The way you know when something arrives rather than when you've constructed it. The conduit opened for a moment, or the disorder was briefly a doorway instead of a wall, and the missing piece was there. I had to rest. But I came back and knew exactly where the song was going, and landed it quickly once I had that chord in hand. It's one of my favorite pieces to play.

The finger didn't find Bsus2 by searching. It found it by failing to stay where I'd put it. The limitation was the discovery. I don't know what to call that except receiving, the same mechanism as the gasp in the car, just accessed through the body breaking down rather than the ears opening up.

* * *

I want to say something about the people who would scoff at the gasping-at-a-key-change story, because I know they exist and I have encountered them and they are exhausting in a specific way.

There is a kind of person who reduces a musical experience to a judgment about the artist and calls that analysis. You're moved by John Mayer? The John Mayer? The guy from Your Body is a Wonderland? And the eye rolls begin, and the experience you had (real, involuntary, physical) gets dismissed by association with someone else's aesthetic preference. This is not music criticism. It is tribal signaling dressed up as taste.

I think you're born into music the way you're born into a religion. Religion is technically elective, but the choice is often made for you early, by geography and family and the specific frequency of whoever was in the room when you were forming. You can revise it later. Many people do. But the imprint runs deep. Music works the same way, except I would argue the imprint goes deeper. The religion you're raised in sits on top of the music. The music is underneath everything.

The person who gasps at a key change and the person who can't understand why anyone would are not disagreeing about John Mayer. They are living in different neurological configurations of the same world, shaped by different encoding histories, tuned to different frequencies. Neither chose it. The channel was built before the opinion arrived.

# PART II: REVERENCE

**The philosophical lens**

# Chapter 8: The Architecture of Awe

Nearly every culture we've found evidence of built something to make music louder than it needed to be.

A speaker amplifies sound. That is not what these spaces were doing. What the Greeks carved into hillsides at Epidaurus, what the Cistercian monks engineered into the stone vaults of their abbeys, what whoever painted those bison on cave walls in Lascaux understood about which specific walls to paint them on, that was something different. Those are acoustic spaces, designed to hold sound the way a bowl holds water. The reverberation at Epidaurus is so precise that a performer at center stage can be heard in the back row, unamplified, in a theater that seats fourteen thousand. The cave walls at Lascaux with the paintings are, in nearly every documented case, the walls with the strongest natural resonance. That correlation does not prove deliberate acoustic selection, but it makes intention a stronger possibility than coincidence.

The Lascaux detail is not isolated. Researchers studying Paleolithic cave sites across France and Spain have found that the surfaces with the densest concentrations of painted animals are consistently the surfaces with the strongest acoustic resonance. Not sometimes. Consistently. The caves used most intensively for symbolic expression are the caves where sound behaves most dramatically, where a voice bounces back from the walls in unexpected ways, where a struck stone produces a tone that seems to come from inside the rock itself.

Steven Waller, an archaeoacoustics researcher, has documented this correlation across multiple sites. The argument he makes is careful: the paintings may have been placed where the sound pointed. Whoever made them followed the acoustic signature of the space and marked the walls where the sound told them something was there.

I want to be careful with this one. The acoustic correlation is real and documented. What it means is genuinely uncertain. But here is what is not uncertain: the people who made those paintings, forty thousand years ago, in the dark, by firelight, were paying attention to what sound did in those spaces. They were not acoustically naive. They had been living inside sound their entire lives, the same way every human being always has. And when they found a wall that did something interesting with sound, they painted on it.

The oldest human art is acoustically sited.

And then there is the Temple of Kukulkán at Chichén Itzá, which does something the caves and the amphitheaters do not. If you stand at the base of the pyramid and clap your hands, the echo that comes back does not sound like a clap. It sounds like the call of the quetzal, the bird the Maya considered sacred, a god of the air. The staircase acts as a diffraction grating: each step scatters the sound at a slightly different distance, and because the time between later reflections is longer than the early ones, the frequency drops about an octave over the course of

the echo. A sharp percussive clap becomes a drawn-out falling chirp. Acoustician David Lubman documented the phenomenon in the late 1990s and confirmed that the chirp closely matches the quetzal's call. Whether the Maya designed the pyramid to do this or discovered it after construction and refined it is still debated. What is not debated is that the temple is dedicated to a feathered serpent deity, that the quetzal was its sacred bird, and that a priest standing at the base clapping during a ceremony would have heard the voice of the god answering from the stone. The same researchers noticed that footsteps climbing the stairs produce echoes that sound like rain falling into a bucket of water. The rain god Chaac was central to Maya life. Two acoustic signatures, two gods, one building. If that is coincidence, it is coincidence that knew exactly what it was doing.

The question that takes a second to land is: why did that matter so much? What were they trying to get closer to?

I've stood in spaces that made me understand the question differently.

Not Epidaurus, I haven't been there, but I've been in a cathedral in the American south that was old enough and stone enough that the acoustics did something unexpected. The place was nearly empty. I wasn't there for a service. I was killing time on a work trip in a city I didn't know, and I walked in because it was raining and the door was open. I sat in a pew near the back. A maintenance worker somewhere in the building dropped something metal, and the sound that came back from the walls took so long to return, and came back so changed from what it was, that it felt briefly wrong. Not a mistake. More like the room had become more alive than the sound that caused it. Like the room had an opinion about what you did in it.

I sat there longer than I planned. Nobody asked me to. I didn't feel religious. I felt something in the vicinity of small, which is not usually the thing I'm going for on a work trip.

The people who built that room knew it would do that. They had seen it do that in other rooms. They built it on purpose. The question of why they thought that effect was worth the effort, worth the centuries it took and the resources it required, is the question this chapter is about.

* * *

Sound is a physical force. We keep forgetting this.

In 2023, the FDA cleared a procedure called histotripsy for treating liver tumors. The way it works: focused ultrasound waves are aimed at a precise point inside the body. When they hit the gases inside cancerous cells, they generate tiny bubbles that expand and collapse rapidly enough to mechanically shred the tumor at the cellular level, turning it into fluid the body reabsorbs. No incision. No radiation. No chemicals.

Just sound, targeted with enough precision to destroy tissue on one side of a boundary while leaving tissue on the other side intact. Clinical trials for pancreatic tumors are underway now.

The cathedral builders couldn't have told you any of that. But they understood the premise. Sound does something to a space, and to the bodies inside it, that goes beyond what the ear picks up. They engineered for that.

The connection between the cathedral and the tumor-destroying ultrasound isn't purely metaphorical. Both are applications of the same basic principle: organized frequency acts on biological matter. The cathedral just does it gently, at the scale of a nervous system looking for a feeling it can't quite name, rather than at the scale of a malignant cell looking at its last afternoon. The frequency range is different. The physics is the same.

I keep thinking about this because it means the people who built these acoustic spaces were, in some sense, doing what the MIT researchers are doing now. They were trying to use organized sound to change the state of a biological system. They didn't have the instruments to measure what was happening. They had the result. Cathedrals made people feel differently. Every culture that built them knew this. They kept building them.

They don't look efficient. If you were trying to solve the engineering problem of fitting the largest number of people into a space where they could all hear a performance, you would not build Epidaurus. You would build something rectangular, with parallel walls, maximizing the floor space. What you'd get is an arena, which works fine but which nobody ever built specifically to make the sound do something to the people inside it.

Epidaurus is a semicircle, carved into a hill, oriented so that the acoustic focal point lands at the center of the stage. This is not the shape a Roman engineer builds when they're optimizing for capacity.

It's the shape they build when they've noticed that certain shapes do something to sound that other shapes don't, and they've decided that doing that thing to the sound is worth more than fitting in more seats.

The cathedrals are the same. Gothic cathedrals are structurally ambitious to the point of dangerous. The flying buttresses, the vast interior volumes, the enormous windows that strip away the mass-bearing capacity of the walls, all of it was required by the decision to build a space with a reverberation time of several seconds. A modern acoustical engineer would tell you that a reverberation time of several seconds is terrible for intelligibility. You can't understand speech in it.

Syllables blur into each other before the ear can sort them.

But you can sing in it. And what happens when several hundred voices sing in a room with a reverberation time of three to four seconds is that the voices blend into something that no individual voice could produce alone. The room becomes an instrument. The people inside it become, briefly, one thing.

They built it that way on purpose. They knew it worked. They kept building it, for centuries, across dozens of different countries and architectural traditions. The acoustic effect was not a side product of some other goal. It was the goal.

Which means that what the cathedral builders and the Epidaurus engineers had in common was this: they understood that organized sound in the right space could change what people felt and thought and believed, and they committed enormous resources to building the right space. They were, in the most literal sense, engineers of human experience. Sound was their material. Awe was their product.

They weren't building answers. They were building conditions under which the question could be properly felt.

A skeptic would say they were building conditions under which the nervous system was manipulated into feeling something the architecture selected for. I have not been able to find a meaningful difference between those two descriptions.

* * *

Every major religious tradition on earth uses music as one of its central vehicles for the sacred. Not decoration. A vehicle. I do not think this is a coincidence, and I do not think it is a cultural accident. The question worth asking is why every one of them, independently, arrived at the same conclusion: that organized sound is the most direct path to whatever they were trying to reach.

The answer each tradition gives is different in its theology and nearly identical in its mechanics.

Gregorian chant, which the Catholic Church codified around the ninth century but which draws on traditions far older, is built on specific modal scales and sung in unison, no harmony, no rhythm in the modern sense, just voices moving together in pure melodic lines. The acoustic effect in a stone space is a near-continuous wash of resonance. The theology says the chant dissolves the boundary between the human and the divine. Research on group singing and chant suggests forms of physiological and attentional synchronization that practitioners have long described in spiritual terms: expansion, dissolution, presence, contact with something larger than the self. Sustained unison singing in a reverberant space appears to reduce the default mode network's self-referential chatter and produce measurable shifts in brainwave activity, though the research is still mapping how much of the effect comes from the singing, how much from the acoustics, and how much from the shared intention of the participants. The theology and the neuroscience are not contradicting each other. They are describing the same effect from different angles.

Hindu classical music is built around the concept of raga, which is not simply a scale but a mood, an emotional and spiritual territory that a particular combination of intervals and ornaments is understood to create. The tradition holds that different ragas have different effects on the listener depending on the time of day,

the season, the emotional disposition of the musician. This sounds like aesthetics until you look at what research on musical expectation and emotional response has confirmed: that interval content, mode, and melodic contour reliably produce specific affective states in listeners across cultural backgrounds. The tradition was mapping this terrain centuries before the imaging technology existed to verify it. Three traditions, no contact, same conclusion: organized sound changes what happens inside a human body. That's not theology. That's a finding.

The Psalms are songs. Not poems that were later set to music. Songs, written as songs, intended to be sung. The most widely distributed text in the history of Western religion is a songbook. The Hebrew tradition understood something that every subsequent religious tradition has had to relearn: that language spoken and language sung are different cognitive events. The sung version encodes differently, lands differently, persists differently. There is a reason every culture in every era has had specific music for the sacred moments of life: birth, marriage, grief, the turning of the year. The reason is not sentiment. It is function.

* * *

The common understanding, across theology and geography and centuries of independent development, is that music does something to human consciousness that other forms of communication do not. They disagree about why. They have never disagreed about the fact.

What they were engineering was contact. They understood that contact required preparation, that the nervous system needed to be set to a particular condition before the encounter could happen. Music was the preparation. The room was the instrument. The human body was the thing they were trying to tune.

I am not saying they were right about what they were trying to contact. I am saying they were right about how to get there. The preparation worked. The states it produced were real. The people who came through those doors were changed in measurable ways before the service began, before a word of doctrine was spoken, because the room had already done something to them.

A tradition of knowledge, distributed across every major religion on earth, that organized sound in the right space changes human consciousness in specific and reproducible ways. Science is beginning to measure why.

Chapter 9: Notes in a Larger Score

There is a version of this idea that sounds insane, and I want to say that clearly before I say the idea.

The idea is that music was here before we were.

The skeptic's version of all of this is worth stating before we go further, because it is not a stupid position and it deserves a real answer.

The argument goes like this: everything you feel when you hear music is learned. The minor key sounds melancholy because your culture told you it does. The chord resolution feels like coming home because you've heard it resolve that way since before you could speak. The goosebumps are a conditioned response to patterns you've internalized, and if you'd grown up somewhere else, different patterns would produce the same response. Music is technology, not discovery. We built it to do what it does, and it works because we were all trained the same way. There's no physics here. There's only culture.

That argument is partially right. Conditioning is real. It shapes which specific patterns trigger the strongest responses in any given nervous system. But it cannot be the whole story, and the evidence that breaks it is already in this book.

Newborns respond to consonance over dissonance before cultural conditioning has had time to operate. The pentatonic scale shows up independently across dozens of cultures that never contacted each other, which means every one of them was conditioned by a different cultural tradition and arrived at the same intervals anyway. Sea lions bob to a beat without having grown up in a musical culture. Sparrows activate the same neural reward system as humans when they hear organized sound that matters to them, and they have been evolutionarily separate from us for hundreds of millions of years.

If the response were purely learned, none of those things would be true. The learned component is real and significant. But below the learned layer, something else is operating that precedes the learning, crosses the species line, and shows up wherever nervous systems and organized sound meet.

Not recorded somewhere, not waiting in a vault. Just present, the way gravity was present before Newton had the bruise to prove it. The relationships between frequencies, the intervals that feel resolved and the ones that feel unresolved, the reason a chord lands differently in your chest than a random cluster of noise, none of that required human invention. We found it. We keep finding it. Every culture with ears appears to have found pieces of it, in the same places, independently.

The octave is not a musical convention. It is what you get when a string vibrates and produces, as a natural byproduct of its own motion, a second frequency at exactly twice the rate of the first. 440 cycles per second makes 880 cycles per second automatically, as part of the same physical event. The note contains its own octave before anyone decides to play one. You cannot vibrate a string and not produce harmonics.

Physics does not give you that option.

The perfect fifth, 3:2, the interval that sounds more like agreement than any other two notes can manage, falls out of the same series. So does the major third. So does every interval that the human ear has independently reached for, across cultures that never spoke to each other, across centuries that never overlapped. They all landed in the same valleys. The physics had valleys in it, and we fell into them.

So what is a composer doing? The most honest answer I have is: finding.

Not inventing. Reporting back. The melody that wrecks you when you hear it was always available. Someone had the ears and the patience and maybe the particular kind of restlessness to go looking in the right direction. That sounds like it diminishes the work. It does not. Finding something real is harder than making something up. Anyone can make something up.

* * *

I learned the Circle of Fifths in my forties.

I had been playing music for thirty years before I understood the map I had been navigating by feel. This is either evidence that the physics works whether you understand it or not, or evidence that I was not paying attention. Probably both. I had written hundreds of songs. I had played in keys and moved through chord progressions by instinct, by what sounded right, by some internal sense of where the music wanted to go that I couldn’t explain and didn’t try to. The theory existed. I just hadn’t learned it. There was always something else going on.

Then I sat down with it, finally, and spent a few weeks actually understanding what it was describing. And what happened when it clicked was not the feeling of learning something new. It was the feeling of being handed a map of a place I had already been to many times. Every transition I had made by feel was in there. Every key change that had worked without my knowing why it worked was in there. The relationships that sounded inevitable were in there, with explanations for why they sounded inevitable.

The interval relationships the Circle of Fifths maps are not invented, but the circle itself is a human model for describing them. The interval of a fifth is pleasing because of a mathematical ratio baked into the physics of vibration. The keys that are adjacent on the circle are adjacent because they share the most notes. The modulations that feel smooth are smooth because the harmonic distance between those keys is small. None of this was decided. All of it was discovered.

What I felt when the map finally made sense was something close to what I imagine a navigator feels when they discover that the stars they've been using to find their way home are not random. That the patterns they've been relying on have a structure that someone worked out, that there is a reason the sky looks the way it looks, and that the reason is not random and is not accidental and was not waiting to be invented. It was waiting to be found.

I know the Circle of Fifths now. I use it consciously. It has not changed anything about the music I make, because the music was already finding the same valleys by feel. But it has changed something about how I understand what I'm doing when I make it. I'm not making choices.

I'm finding the places the physics already prepared.

There is a specific thing Dave Stevens was trying to show at Harmony College in 1983 that took me years to actually hear, which is either a commentary on the depth of the idea or on my particular attention span.

Stevens was the Barbershop Harmony Society's arranger and publications director, a man who spent his professional life in the middle of the specific harmonic tradition that makes four voices lock into a chord and ring like a struck bell. His keynote that year was called What Are We Trying to Preserve, and in eight minutes he demonstrated that the entire harmonic vocabulary barbershop is built on: every chord progression, every resolution, every move that makes that sound do what it does, runs through essentially all of Western popular music. Liebestraum and Five Foot Two. Bach chorales and Tin Pan Alley. He played the same chord relationships in wildly different songs and let the room notice that they were the same chord relationships.

What he was really showing, without quite framing it this way, is that all of it is built around one idea. One organizing principle that sits underneath the entire tradition like a foundation nobody drew plans for.

Home.

The Circle of Fifths is a map of distances from home. Your home key, the tonal center a piece of music is organized around, sits at the top. Every other key is a specific number of steps away, clockwise or counterclockwise. The keys right next to yours share almost all their notes with yours. Small harmonic distance. Easy to get there, easy to get back. The key directly opposite you on the circle shares almost nothing with yours. Walk into that key in the middle of a piece and the listener feels maximum distance, maximum tension, maximum lostness. They do not know why. They just feel like something has gone wrong and needs to be fixed.

Which is, musically speaking, the whole point.

The dominant seventh chord (the V7, built on the fifth degree of your home key) is the circle's homing beacon. It contains a tritone, the most dissonant interval in Western music, two notes that sit exactly half the circle apart, pulling in opposite directions. When they resolve, they resolve inward. Toward home. The tritone in the V7 chord collapses toward the tonic the way a compass needle drops to north. You can feel it before you understand it. Most people have felt it ten thousand times before they know what it's called.

What Stevens was demonstrating is that barbershop chord progressions are built on this mechanism, stacked. Dominants resolving to tonics that immediately become new dominants and resolve again. The ear is led in one long arc away from home and back, step by step around the circle, the harmonic tension accumulating like pressure, each unresolved dominant adding to it, until the last chord lands and the voices ring and the sound expands into the room and something in the body says: there. That's it. We're back.

The map was never mine to invent. It was mine to find. I just found it late, which is fine, because the music had been finding it for me the whole time, and neither of us told the other.

* * *

In 2009, Bobby McFerrin walked onto a stage at the World Science Festival and did something that should not have worked.

He didn't explain anything. He stood at one end of the stage and sang a note, then jumped to a spot a few feet away and sang a higher one, assigning each position on the stage to a pitch, using his body like a key on a piano. Then he started moving and pointed at the audience to fill in the notes he wasn't singing.

They did it. Immediately. A thousand people who had never been told what was happening, who had never agreed on anything, sang the right notes.

When he skipped a spot they anticipated it correctly. When he jumped to an unexpected position they laughed, because they'd already predicted where he was going and he'd subverted it. He hadn't taught them a scale. He'd revealed one they already had.

He has done this in cities all over the world. The result is always the same. Different languages, different musical traditions, different ages.

Everyone fills in the same notes. The scale they're filling in is the pentatonic. Five notes, no half steps, no dissonance, all the intervals sitting in the physical valleys where frequency relationships resolve cleanly. It is the scale that emerges when the physics of vibration meets a nervous system and nobody interferes.

The oldest known instrument, a bone flute from a cave in Germany dated to roughly 40,000 years ago, plays pentatonic tones. China built a musical tradition on a version of it. So did the Scottish Highlands, West African drumming culture, and the American blues, none of which consulted each other. So did Indigenous musical traditions across North America. So did ancient Greece. The distribution of this scale across unconnected human cultures is not statistical noise. It is statistical signal pointing toward something that is not entirely cultural.

The simplest explanation, and often the right one, is that the pentatonic scale sounds the way it sounds because it maps directly onto the intervals that emerge from the physics of vibrating strings. The notes that feel like home feel like home because they are physically stable. They sit at places where the frequency ratios are simple, where the harmonics of two notes align rather than clash, where the ear doesn't have to work to resolve the relationship. They are not home because we decided they were. They may be home because the physics of vibration made them home before anyone was listening.

A 2015 paper in the Proceedings of the National Academy of Sciences analyzed 304 recordings from cultures worldwide. Where pentatonic scales appeared across cultures with no contact with each other, they showed strikingly similar interval structures. The same five notes, the same intervals, the same spacing.

The same five notes, spaced the same way. The conclusion that paper was building toward was careful and limited, as academic papers are required to be, but it pointed in a direction that this book is not required to be as careful about: the intervals humans consistently find beautiful may be beautiful because they are mathematically simple, and they are mathematically simple because they reflect the underlying structure of the physical universe.

One more piece of evidence, from a different angle.

Kamraan Gill and Dale Purves found something worth sitting with. The intervals people keep reaching for across cultures may be the ones that most closely match the natural harmonics of the human voice. Not speech in general.

The specific frequency ratios that appear in vowel sounds, the resonances produced by the shape of the human vocal tract when it forms the sounds that all human languages share, which is itself a strange thing to sit with: that the throat is already a resonating instrument before it becomes language.

The intervals that feel like home might feel that way because they sound like us. The vocal tract is a resonating tube. Resonating tubes produce harmonics. Those harmonics land in the same ratios as the intervals we keep calling beautiful. The music that hits us hardest may hit us because it is built, at the mathematical level, from the same frequencies we use to talk to each other. We are moved by the sound of our own nature, which is a sentence I did not expect to write and cannot stop thinking about.

Which raises a question I don't have a clean answer for: did music evolve to exploit the sounds we already respond to? Or did we evolve to respond to sounds that have always been in the universe, and music and speech are both downstream of the same underlying physics?

I suspect the second one. I could be wrong. Either way, the intervals that feel like coming home are not an accident of culture. They're something else.

Music may be what happens when pattern finds an ear.

The reductive version of everything in this chapter is that humans are pattern-detecting animals and music is what happens when we detect pattern in sound. That version is not wrong. It is incomplete in a way that the rest of this book tries to describe, but I want to be clear that the reductive version is a defensible position and I have spent time inside it.

I was invited to attend a Southern Black church once. I was nervous. Not about being welcome, they were gracious, but about keeping up. I had heard things about what happens in those rooms and I was not sure I had the range for it. Holy shit was I wrong.

The music hit different. Not because of the volume or the energy, though both were considerable. Because of how it was built. Gospel music, real gospel music, is harmonically sophisticated. Psalm 33:3 says to play skillfully and with a loud shout, and whoever wrote those arrangements had clearly read that. The chord changes were classy. Unexpected resolutions. Key lifts at exactly the moment the room needed them. The kind of moves that make a musician stop and think: wait, how did they know to do that there.

Here's what I can't explain and have stopped trying to. If you played me a hundred rock songs without any lyrics and one of them was about God, I'd find it fast. I can't tell you exactly why. Something in the construction announces it. Some combination of chord choices, melodic movement, the particular way the dynamics breathe. I just know. And I don't think that's a party trick. I think it's information.

What is inherently spiritual about a chord change? Why does a certain key lift feel like the ceiling opening? I don't know. But I notice it, consistently, across traditions that have never heard of each other. The gospel choir. The Sufi ceremony. The Gregorian chant filling stone. The call to prayer at dawn. The Buddhist monks in frequencies so low they seem to come from the floor. These are not the same music. They are the same mechanism.

What is doing that? Is it God? Is it the music? What if those are not two different answers? What if God isn't a being who speaks in propositions but a pattern, a patterned pulse of pressure that the nervous system was built to receive, and music is just the most direct way we have of turning up the signal?

Religion exists because humans looking for answers were told by other humans that they found them. Those answers are believable, the belief gets inherited, and where you are born predicts your religion more reliably than almost any other factor. One species. Hundreds of theologies. Almost no overlap on the details.

But every one of them sings. That's not nothing. That's the one place the map is the same regardless of who drew it. If God is in the gospel choir, God was also in the shaman's drum ten thousand years before that. The frequency may predate the theology. Whether the theology has always been an attempt to put words to the frequency is a question I find more productive than any answer I've heard.

## Chapter 10: Creation as Participation

The question that follows is: what exactly are musicians doing? Nobody owns a note.

I mean that literally, not as a spiritual metaphor. The note was there before you found it. The chord progression you built your song around existed in the physics

of frequency relationships before you were born, before the instrument existed, before the culture that shaped your ear had formed any opinion about anything. You didn't invent it. You found it. Most musicians know this and don't talk about it, because it complicates the part where you sign the copyright paperwork.

But the ones who've been doing it long enough, who have stopped performing humility and started actually having it, tend to stop pretending otherwise. And when they talk about where songs actually come from, they use the same language. The language of arrival, not construction.

Yesterday was waiting at the piano when McCartney woke up. Fully formed. Already there. He spent weeks asking everyone he knew if it was someone else's song, because it felt too finished to be something he had made. That's not a humble-brag. That's a man trying to accurately describe an experience that didn't feel like authorship.

Beethoven assembled the Ninth Symphony from decades of melodic fragments that arrived without invitation, and he was completely deaf by the time he finished it. Whatever he was hearing by then, it was not coming through his ears.

One morning in 1965, Keith Richards woke up with a tape recorder running next to his bed and thirty seconds of music on it he had no memory of making. The opening riff to Satisfaction. He listened to it, thought it was great, and went back to sleep. That's it. That's the story. Some people are apparently so open to the signal that they receive things unconscious and just leave them somewhere they'll find them. That's either a gift or a personality type. Probably both.

The Get Back documentary catches the same thing from a different angle.

There is a scene in the Beatles' Get Back documentary where McCartney is in the studio early. John is late, which is a theme throughout this film for reasons that by January 1969 have less to do with traffic. Paul is there, Ringo is there, George is there, doing what musicians do while they wait. Warming up. Coffee. The comfortable silence of people who've been in rooms together for a decade.

Then his hands find something on the bass.

A gallop. A forward-rolling figure with a kind of inevitability to it, the kind of riff that sounds like it was already there and he just happened to find it. He starts humming over it. Not words yet, just the shape of words, placeholder sounds feeling out where a melody might live. Na na na. La la la. The whole thing assembling itself out of nothing, on camera, while presumably someone's coffee got cold.

Those placeholders would eventually become Jo Jo and Sweet Loretta Martin and Tucson, Arizona and California grass. John showed up later and the song took shape by lunch.

What the footage captures is something no finished record can show. McCartney's face doesn't look like someone solving a problem. It looks like someone paying attention to something they didn't put there. The antenna was

tuned. Something came through. Whether that something originated in Paul McCartney or arrived from somewhere else is a question I keep coming back to, and I notice I keep landing in the same place.

No band in American music built their whole operation around the conduit the way the Grateful Dead did. No setlist, no repetition, an explicit commitment to playing songs differently every night. Not as a gimmick. Because the whole point was to stay open rather than retreating into a known performance.

Jerry Garcia talked about improvisation as listening. Not playing. Listening to what the music wants to do next, and getting out of its way. At their best, the Dead weren't five musicians playing together so much as five musicians listening together, and the music that came through in those spaces is the thing that kept people following them around the country for decades, sometimes literally following them, city to city, which is a level of commitment that says something about what people felt they were receiving.

Bobby Weir called himself a compulsive music maker. Not artist. Not rock star. A compulsive music maker, someone who couldn't not do it. He died January 10, 2026, at seventy-eight, from lung complications following a cancer diagnosis the previous summer. His family described his choice to keep performing through treatment as an artist choosing, even then, to keep going by his own design. He played Golden Gate Park in August 2025 for the Dead's 60th anniversary. He was still talking about a three-hundred-year legacy for the songs. Not for himself. For the songs.

That distinction was important to him. He understood himself as a keeper of something that didn't belong to him, and the job was to hold it carefully and pass it forward. When Mayer spoke at the memorial he said Bobby took a chance on him, staked his reputation on it, gave him musical community. What Weir understood, and spent sixty years demonstrating nightly, is that the music comes through you. Your job is to stay available.

* * *

John Mayer is a guitar god. That stopped being a subjective take a while ago. The playing says it, the catalog says it. Clapton said it out loud. Buddy Guy said it out loud. A lot of people's mental file on him starts and ends with Your Body is a Wonderland, which is like knowing Stevie Ray Vaughan only through Pride and Joy. Great song. Wrong conclusion.

The reason he belongs here isn't the guitar work. It's what he said in an Instagram Q&A when someone asked what advice he'd give to new songwriters. His answer: a song is one part divine inspiration, three parts homework and code cracking. Never skip the code cracking. Do it as a show of respect to the new guest that has joined you from another world.

A new guest that has joined you from another world.

That's not performance. That's someone trying to describe their actual experience as accurately as they can. And standing in Joni Mitchell's old studio at the Chaplin lot he bought to keep it from disappearing, he told CBS Sunday Morning that songwriting is mining. That the work left in a room by the people who came before is there for the next person. Hand-me-down. Nothing is stopping you.

When musicians talk like this, using words like received or arrived or guest from another world, they're not being poetic for the camera. They're reporting on something that most people who make music recognize immediately and can't quite explain to anyone who hasn't been in that room. It's a specific frequency. When you hear another musician speaking it, something in you just goes yes. That's the whole handshake.

From McCartney finding the riff, to Richards and the tape recorder, to Dylan taking dictation, to Mayer’s guest from another world, to Weir walking onstage through a cancer diagnosis because he was a compulsive music maker and couldn’t not, is the same basic thing. The music isn’t theirs. They are the place it came through.

I have ADHD. I may be on the autism spectrum. I have dozens of copyrighted songs to my name. Not because I’m exceptionally talented, but because the music kept coming and I needed a place to put it. Sometimes it happens fast and easy. Most often, it takes tinkering to fully realize what the signal is. It’s like decoding a secret ring. An idea floats by, I grab it, and I feel the spirit of it but can’t understand what it’s saying without some work.

But the admirer in the audience is not outside the music. You can practice scales in an empty room for twenty years and the music will never go anywhere. It becomes music when it reaches someone. The musician played the note. The listener completed the circuit.

The conduit and the receiver are not a hierarchy. They are the two halves of the thing.

Creation in this reading isn’t invention. It’s participation. Some figure out how to hold the door open without losing themselves, and they make music for a long time. Some go all the way open and leave behind something the rest of us can’t reach on our own. The difference is what the transmission costs.

Weir spent sixty years answering that question the same way every night. Walk out. Open the channel. See what comes through. Sometimes it was a song he'd played a thousand times that arrived new. Sometimes it was something he hadn't touched in years that suddenly made sense. He wasn't performing. He was listening.

His family said there is no final curtain here, not really. Only the sense of someone setting off again.

# Chapter 11: Time as Movement

Here is something I think about more than is probably healthy: music may be the only art form that dies when it ends.

A painting doesn't do that. A painting sits on a wall and waits for you whether you show up or not. A novel is sitting on a shelf right now, completely intact, not going anywhere. Architecture just exists, surrounding you whether you're paying attention or not. These things persist. They don't need you present to continue existing.

Music is different. The moment it stops, it is gone. What you have left is a recording, which is a photograph of an event that no longer exists. A score, which is instructions for something that has not happened yet. And memory, which as we have already established is neither stable nor reliable. The actual thing, organized sound moving through air and into a body, required time to exist, and when the time was gone, so was the music.

* * *

The technical term for what a composer does with this is temporal architecture, which sounds like something a music theory professor says to make simple things complicated. What it actually means is: the beginning of a piece shapes how the ending feels. Full stop. You can't have the resolution without the tension that preceded it. You can't have the reunion without the separation. The third act only lands because of everything the first two acts built.

The things that happened early determine how the things that happen later feel. That’s not philosophy, it’s just pattern recognition applied to personal history. A good year after a bad stretch hits differently than a good year after another good year. The reason certain moments feel like resolution is because your nervous system has been keeping track of everything that came before them, cataloging the tension, waiting without knowing it was waiting. Music doesn’t create that feeling. It mirrors it. It knows the same thing your life knows, which is that meaning lives in the relationship between moments, not in any single moment alone.

I have spent a lot of time thinking about why certain albums hit differently at different points in a life. The same record at twenty-two and at forty-four is not the same record. The notes are identical. The tempo is identical. What has changed is everything you bring to it, every year of additional tension that has accumulated behind you, every previous listen layered in the memory of the piece. The music hasn't changed. You have. And because you have, the music means something it didn't mean before. It was always capable of this meaning. You just weren't ready to receive it yet.

There are albums I wasn't equipped for in my twenties that are now permanent furniture. There are albums I loved then that I can't access the same way now because I've moved past the specific emotional frequency they were operating on. That's not loss exactly. It's more like the way certain views are only available from specific elevations.

You can't get the view from the valley that you can get from the ridge.

But you can't get the valley view from the ridge either. The music exists in time, and so do you, and the combination of those two time-dependent things produces a specific experience available at that particular intersection and nowhere else.

* * *

Beethoven is the obvious place to go here and I'm going there anyway because he earns it.

The man spent his whole life learning how time worked in music. How to stretch the space between tension and resolution until the listener was uncomfortable, then more uncomfortable, then desperate for the release, and then delivering it in a way that hit harder for the wait. He got extraordinarily good at this. And then he went deaf.

The tool he'd used to build everything, his ability to hear what he was constructing in real time, was gone. He kept composing anyway. The Ninth Symphony was written in total silence. He gathered fragments across decades and assembled them into something that most people consider one of the greatest pieces of music ever made, and he never heard a note of it with functional ears.

I don't fully know what to do with that. I've sat with it for years.

The most I can say is: whatever he was hearing, it wasn't coming through his ears. He had spent so long inside the structure of how time moves in music that he could operate inside it without external input.

The understanding had become internal.

Not an inspirational poster about perseverance. Something stranger. That's a man who had so thoroughly internalized something that the physical apparatus that originally built the understanding was no longer required to use it.

That is either a strange fact about Beethoven specifically or a stranger fact about what music actually is. I think it’s both, and I think they’re the same thing.

* * *

There's a thing music does with time that clocks don't do, which is make duration feel variable. You know this. Thirty seconds in the wrong song is

interminable. Thirty seconds at the right moment in the right piece is over before you can register it happened. Time in music is not clock time. It's experienced time, which is shaped by attention and expectation and emotional density.

Memory does the same thing. A summer that mattered takes up more interior space than a year that didn't. The minutes before something important are longer than months of ordinary time. The brain doesn't store the past as an even timeline. It stores it weighted by significance, which means your personal history is less a chronology and more a piece of music, some passages enormous, some compressed to almost nothing, organized around a handful of moments that gave everything else its shape.

When a song puts you back in a specific period of your life, it's not just returning you to a memory. It's returning you to how time felt then. The specific texture of that period. The particular weight of that season. The song is a portal not just to content but to the quality of time itself as it was then. That's why it feels like time travel in a way a photograph almost never does. The photograph shows you the scene.

The song puts you back inside the clock.

Music is not just about time. Music is time, organized and made portable. A piece of music is a duration, a specific shape of time with a beginning and an end and an interior structure. When you hear it, you are not just perceiving sounds. You are inhabiting a duration that someone else built, moving through a shape of time that was constructed for you to move through. And when you finish, you have been somewhere.

Not in the way that a movie puts you somewhere, but in a more fundamental sense: you have inhabited a different time, organized by someone else's understanding of how time works.

* * *

I came to Chris Thile through a dear friend named Dee, who is gone now and who I still think about every time I put on Not All Who Wander Are Lost. She was as obsessed with him as I was. We fed each other's fixation the way good friends do with things that actually matter. That album is still my first call when I'm feeling nostalgic. Instrumental music that says more without words than most songs manage with a full lyric sheet. For a synesthete it's almost unfair. The colors it produces are specific and consistent and I couldn't tell you why that particular combination of notes produces what it produces, only that it always does.

Dee and I had the kind of friendship where we talked about music the way other people talk about the people in their lives. Who the songs were, what they wanted, what they were trying to say. We both had that quality where we couldn't hear music without caring about it, where it got under the surface and became part of what we were thinking about for days afterward. Finding someone who does that

too is rarer than it sounds. Most people enjoy music. Very few people are in conversation with it.

Nickel Creek was something else entirely. I caught them early, when they were still at the beginning of what turned out to be a long peak. I remember tossing a football with Sara Watkins in Fayetteville, maybe thirty minutes after they had absolutely nailed a show. That is a real sentence about my life and I'm still not entirely sure how it happened.

She was completely normal about it, which tracks, because people who are genuinely that talented usually don't need to make a thing of it.

Thile holds a MacArthur Genius Grant, which is the kind of credential that sounds made up until you watch him play, at which point it reads more like an understatement. He hosted what became Live from Here, the successor to A Prairie Home Companion, for four years until the show ended in 2020. He's been back out with Nickel Creek since their 2023 record Celebrants, staying busy the way some people just are.

What matters for this chapter is simpler than any of that. The mandolin in Thile's hands doesn't accompany a story. It tells one. No words, no singer, no scaffolding. Just the instrument saying something specific enough that you know what it said. The music has a narrative arc. It has tension and resolution. It has the temporal structure of a story, moving through time with intention, building toward something, and then landing. Without a single word.

Dee heard it. I heard it. We talked about it the way you talk about things that don't quite fit into normal conversation but that need to be said out loud to somebody. That's what this chapter is really about.

Music moves through time and leaves something behind. Sometimes that something is a conversation between two people that outlasts one of them.

I still have that conversation. I still run into the music and think: Dee would have had something to say about this. And then I say it myself, to myself, in the way you continue talking to the people who were important enough that their absence doesn't entirely silence them.

The music carries the conversation forward. It refuses to stop.

# Chapter 12: The Space Between

There is a jazz episode of The Simpsons where Lisa tells Bart to listen to what Miles Davis isn't playing.

It's a throwaway line in a cartoon. It is also one of the most precise descriptions of musical intelligence I have encountered. What Miles Davis isn't playing is the space. The rest. The silence that makes the note that follows it land like a fist instead of a finger. You cannot hear what Davis is leaving out unless you understand what he could have put there. The absence is only legible if you know the vocabulary well enough to feel the missing word.

This is what ghost notes are.

A ghost note is a drummer's note that is almost not there. It has rhythmic value but no real pitch, played so softly between the main beats that you feel it more than hear it. On paper it's notated in parentheses, which is appropriate. A note in parentheses, a sound that functions more like a suggestion than a statement. Jeff Porcaro's shuffle on Rosanna by Toto is built almost entirely on this principle. The half-time feel that makes that song breathe the way it does comes from notes that most listeners cannot consciously identify. They just know the groove is different from other grooves. They know it moves differently in their body. They couldn't tell you why because the reason is the thing they almost can't hear.

Ghost notes make you move your hips instead of tapping your feet. That’s the difference.

The rest in music is not the absence of music. It is music made of absence.

It is a structural claim, not a poetic one. A note only has duration because it ends. A phrase only builds tension because of the silence it's moving toward or away from. The silence at the end of a measure is not a gap in the pattern. It is part of the pattern. Remove it and the pattern collapses. The silence is load-bearing.

Beethoven understood this at a cellular level. The fifth symphony opens with three short notes and a long one. Three Gs and an E-flat. Four notes. What most people don't notice is that the pattern begins with silence. Before the first note there is a rest, an eighth rest, barely perceptible, but it is there. The famous motif doesn't start on the beat. It starts just before it and falls onto the beat, which is why it hits the way it hits. The silence before the first note is what gives the first note its momentum.

The silence is the runway. The note is the takeoff.

Garbage recorded a song called Supervixen in 1995. During mixing, the tape machine kept malfunctioning, parking instead of looping, dropping the audio into dead air for a moment. Complete silence. No cymbal decay, no amp hum, nothing. The band listened to the accident and kept it. Butch Vig later described it: basically it goes to dead air, and in a way it's just silence, but that also becomes a hook. The silence that became a hook was not composed. It was discovered by accident and recognized for what it was. A hole in the sound that the ear rushed to fill, and the rushing was pleasurable, and the music that returned after the hole was louder for having disappeared.

There is a live version of My Stupid Mouth by John Mayer where you can hear exactly what a silence does to a crowd.

The song is built as a confession. He ruined a dinner date by talking too much, said the wrong thing at the wrong moment, and the song is the aftermath of that. It moves through verse and chorus and verse and chorus until it arrives at what sounds like a conclusion: I'm never speaking up again. Starting now. The guitar resolves. The melody closes. Every signal the song sends says: we are done here.

Then silence.

The crowd at the concert cheers. They heard ending. They felt the completeness of it. The song said it was finished and their nervous systems agreed, and the cheer is the proof of that agreement.

Then Mayer comes back in, almost quietly: One more thing.

And what follows is a hidden verse where he tries to justify himself one more time, explains that it was not entirely his fault, that he just wanted to be liked. The joke is that the song about a man who cannot stop talking ends by proving it. He swore he was done. He was not done. The silence was not an ending. It was a setup.

What bothers me about the crowds cheering is not that they were wrong. They were responding correctly to what the silence signaled. The problem is that they had stopped listening at exactly the moment the song did something interesting. The silence fooled them into thinking the song was over, and because they thought it was over, they missed the part that made the silence matter. The silence was only a punchline if you stayed through it. The crowd turned it into applause.

I have watched this happen dozens of times at concerts. The song reaches what feels like its end. The instruments drop. Some percentage of the crowd cheers, or applauds, or turns to say something to the person next to them. And then the song comes back, and those people have to catch up to where everyone else already is. They missed the moment because the silence looked like a door and they walked through it.

The musicians who understand silence know that this is the most dangerous and most powerful tool in the set. A silence that reads as ending but functions as continuation is a trap the whole body walks into. The brain says done, the body responds to done, and then the note arrives and the body has to reverse course in real time, and that reversal is physical, visceral, unmistakable. It is a different sensation from hearing a note in sequence. It is being surprised by the return of something you had already let go.

That is what Mayer built into that song. Not a pause. A test of whether you were still listening.

The same principle is what makes the a cappella passage in Bohemian Rhapsody work. The opera section is not dramatic because it is operatic. It is dramatic because of the silence that brackets it. The full band stops. The voices

appear from nowhere. The ears recalibrate. When the guitars return, they are returning to a listener whose nervous system has been reset by the absence. The silence did that. The silence is not the break between the parts. The silence is one of the parts.

John Cage argued this more extremely than anyone. In 1952 he composed a piece called 4'33". Four minutes and thirty-three seconds. A pianist sat at the piano. He did not play. For the entire piece, he did not play. The audience became increasingly uncomfortable, and their discomfort, the shuffling and coughing and whispered arguments and eventual walkouts, was the music. Cage's point was that absolute silence does not exist. When you remove the organized sound, you do not get nothing. You get the unorganized sound that was always there underneath it. You get the room. You get the people. You get the sound of your own attention.

Most people think Cage was being provocative. He was also being precise. The silence in music is never empty. It is full of the expectation of what comes next. It is full of the memory of what just ended. And it is full, Cage would say, of the ambient sound that organized music had been drowning out. When the music stops, the world does not stop. The world was always there. The music was just loud enough that you had forgotten.

Japanese traditional music has a word for this. Ma. It means the meaningful pause, the pregnant space, the gap that is not a gap because it is doing something. In Japanese aesthetics ma applies to architecture as well as music, the space between objects in a room, the emptiness that gives the objects their presence. It is not the absence of something. It is a form of something. The silence between the notes is not where the music is absent. It is where the music is held.

Western music notation never quite developed the vocabulary for this. We have rest symbols, but a rest is defined as the absence of a note. It is a placeholder. In the Japanese understanding a rest is not the absence of a note. It is the note the silence plays. The distinction matters because it changes what you hear when you listen. If you are listening for the rests you hear the shape of the silence. If you are only listening for the notes you hear half the music.

The drummer hears the rests. That is what separates the drummer who plays correctly from the drummer who grooves. Groove is the relationship between the notes and the silence. It is the specific shape of the space around the beats. Two drummers can play the exact same notes at the exact same tempo and one will groove and the other will not, because one of them is shaping the silence differently. The ghost notes. The placement. The tiny delays and anticipations that make a beat breathe. You cannot write this in notation. You can only feel it.

The best musicians know this in their bodies without ever having been told. Miles Davis did not play the silence as a choice between performances. He played it as part of every phrase. The silence was not the rest between notes. It was the counterpart of the notes. The notes needed it to mean what they meant.

The thing about silence that took me longest to understand: The listener feels the silence before they know they feel it. The prediction machine that processes music is also tracking the absence of music. When a note is expected and does not arrive, something happens in the nervous system before the brain has processed the absence as absence. The pause in Supervixen works because the nervous system flagged the missing sound before the conscious mind registered the silence. The gap opened and the whole body leaned toward it, and the leaning is the hook.

Cage said that the sounds we make are not separate from the sounds that exist without us. They are organized portions of the same thing. The silence between the notes is not the border between music and the world. It is the place where they touch.

The note that isn't being played is still in the room. You just have to learn to hear it.

* * *

The physics side of this is clear enough. The patterns are in the universe regardless of us. The harmonic series doesn't need an audience. The octave relationship between frequencies exists whether or not any biological system ever evolved to perceive it. Ratios don't require a witness. The mathematics of vibration was here forty billion years ago and will be here forty billion years from now, and the universe doesn't appear to be waiting for our approval.

But music, as we experience it, as the thing that makes the hair stand up on your arms and returns you to a Tuesday afternoon you hadn't thought about in decades, that doesn't happen in a vacuum. It happens in a body. It happens when organized pattern meets a nervous system that has spent millions of years evolving to find pattern in sound. Without the nervous system, you have physics. The physics is interesting. It is not music in the sense this book has been using the word.

So maybe what we're really asking is: where does the physics end and the music begin?

And I think the honest answer is: at the moment of contact.

* * *

There is a useful parallel in quantum mechanics, not as an explanation but as a shape to hold onto. The observer effect says the act of measurement changes what is being measured. The system exists in multiple possible states until something interacts with it.

Organized sound might exist in a similar potential state until it meets a listener. The frequencies are there, the intervals, the relationships. But the specific meaning, the reason this song makes this person cry and leaves someone else cold, only happens in the encounter. The listener is not passive. The listener is part of what the music becomes.

Same notes. Different people. Different music.

I never walk into a room where music is playing and don’t notice it. This is not a choice. The music arrives before I decide to receive it. I have thought about this as a data point for this chapter’s argument: if the encounter between organized sound and a listener is where music actually happens, then what does it mean that for some people the encounter is involuntary and immediate, and for others it apparently isn’t?

I have been to concerts where people talked through the whole thing. Loud, sustained conversation, the kind that drowns out what you paid to hear. I have a

specific and visceral reaction to this that I've tried to understand. It is not just annoyance. It is something closer to offense.

The artist arranged their life around that show. Rehearsed. Traveled. This is their livelihood and their calling. The people talking in the third row did not pay for the right to be a persistent wrong note in the room. They paid for a ticket. The ticket gets you in the door. What you do with the music once you're inside is a different question and it has an answer.

What bothers me is not that they're having a good time. It's that they're using something irreplaceable as backdrop. They're in the room but not in the encounter. The sound waves are reaching them at the same amplitude as everyone else. The music isn't getting through. Which means they are standing inside something and experiencing something else entirely.

This is what I mean when I say the listener is not passive. The listener is part of what the music becomes. And when the listener opts out, the music in that seat doesn't happen. The physics is fine. The sound waves are there. But the music, the specific thing that requires contact, doesn't occur. There is a version of presence that is not listening. I have watched it happen from three rows back and found it enraging.

My friend James has a funny habit of occasionally taking calls during shows. It's almost always spam. It's become a running joke between us, and I know he is actually there for the music. That's different. I know the difference. The people I'm describing are not James. James is listening. The phone is just a glitch in an otherwise open signal.

Jack White closed the show at Cain's Ballroom in Tulsa with a cover of Goodnight Irene. Leadbelly wrote it. Everyone knows the words.

He was at the front of the stage, solo, playing to the room the way you play to a room when the night has gone well and you're in no hurry to leave it. His eyes were moving across the crowd. I knew the words. I'd known them since I was a kid. And I had not been singing them.

I hadn't been singing them because earlier that week I'd read something about Jack White being displeased with his crowds. The phone thing was building into something he cared about publicly. There was an energy around his shows that said: this man has standards for the room, and the room should know it. I had internalized this, probably more than was warranted, and decided that the safest version of being a Jack White audience member was to be intensely present and completely silent, like a very attentive piece of furniture.

Then he looked at me.

Not a general scan across the crowd. At me. Held it for a moment while he sang. His eyes said, plainly, that this was an invitation.

I did something in between. Half a nod. A kind of mouthing that wasn’t quite singing. The facial expression of a person who is definitely participating but can’t fully commit to the evidence.

He looked elsewhere.

I have thought about those three seconds more times than I can justify. The moment was there. The song was Goodnight Irene, which requires nothing of you, which was written to be passed between people. He was passing it. I fumbled the handoff because I had talked myself into the wrong posture based on hearsay about what Jack White wanted from a crowd. What he wanted, it turns out, was exactly what I didn’t give him. He wanted the room back. He wanted someone to sing Goodnight Irene with him in a small venue in Tulsa at the end of a good night.

I was there. I let him down. It is the most awkward three seconds of my concertgoing life and I have never fully forgiven myself for it.

* * *

There is something eerie about music playing with no one there to hear it. An empty office bathroom at two in the morning, the overhead speaker still running its rotation. A hotel lobby after the last guest has gone up for the night. The music keeps going. The sound waves keep moving. They are looking for ears and there are none.

I find this genuinely strange to think about. Not sad, exactly, though it has that quality. More like the particular feeling of a phone ringing in a room where the person who used to answer it is gone. The mechanism is still working. The occasion has passed.

I ran into Jewel in a hotel hallway once. Not literally. I was walking to the ice machine at whatever hour people go to ice machines, having locked my key in the room, and You Were Meant For Me was playing from somewhere in the ceiling. It stopped me. Not because I was in a receptive mood for it. Because the song was there regardless of my mood, doing its thing in an empty corridor, and I was the only thing available to receive it.

Jewel had no idea when she wrote that song that it would one day become the soundtrack to my walk of shame to the front desk with a melting bucket of ice. But there it was, offering itself to whoever happened to be in the hall. I hope she reads this someday and understands that she was not wasted on me. It’s a lovely song. She’s a brilliant writer. I just wasn’t ready for it at that particular moment in that particular corridor, and the song didn’t care.

That’s the thing about music playing to an empty room. It isn’t waiting for the right listener. It isn’t waiting at all. It just goes. The sound waves wander around looking for somewhere to land, and if you happen to walk into the hallway with a bucket of ice, you’re what they find.

I've thought about this specifically in the context of making music.

There is a version of a song I write in the room where I wrote it, which has a particular meaning to me because of what was happening in my life during that period. And then there is the version of the song that exists in the experience of whoever hears it, which is shaped by their own history and emotional state and whatever they were carrying into the room. Those two versions of the same song are genuinely different objects. They share a structure. They don't share a meaning.

For a long time I found this slightly depressing. Like the song was never going to be what I thought it was, because what I thought it was lived in me and couldn't be transmitted. But I've come around on it.

The song being an occasion for meaning rather than a container of meaning is actually better. It means the song is not finished when I write it. It finishes differently for every person who hears it, every time they hear it. That is not a limitation. That is how it works, and it works at all, and the fact that it does is something I have never fully gotten over.

* * *

Eddie Vedder wrote the soundtrack for Into the Wild, and the best song on it is “Guaranteed.” Simple song. Major key. Patterned arpeggios that just pace and climb. It is the best back porch album of all time and it is not particularly close.

I have a strong reaction to this song that I have never been able to explain well. It feels like depression. Not sadness. Depression. Like it uses a magnet to suck the thing from somewhere deep in my core and make me wear it on the outside. It can change my mood quickly, but it is too good to avoid, and that is the problem. It is in the rare class of song for me that makes you scratch the poison ivy really hard. Damaging. Oddly relieving in the moment. Hard to shake without medication.

The picking pattern never changes. Every chord gets the same arpeggiated figure, the right hand doing the same thing start to finish. Your body syncs to it the way you sync to someone’s breathing when you fall asleep next to them. You stop hearing the pattern and start being inside it, and that is when the harmony starts doing its work.

G to B minor is the first move. One note shifts and the whole thing darkens. Still the same song. Just less light in it now. G7 drops in a flat seven, which is a note that does not belong in the key and knows it. It leans hard toward resolution the way a question leans toward its answer. The C chord catches it and walks the bass down through E. That descending bass against a rising tension is what gets your chest. You are being pulled down and forward at the same time.

Then the D at the end of each verse adds a sus4, which is the home note of the entire key hiding inside the chord that is supposed to be taking you away from

home. It is the song calling itself back. The whole progression is a loop, and every time it completes, that sus4 is the reason you do not notice it restarting. You just go again.

The bass across the full progression steps down: G, F sharp, F, E. Chromatic descent. Your ear hears it as walking. The picking pattern on top does not change. So you feel movement underneath something that is not moving, which is exactly what depression feels like, and maybe that is why this song finds that frequency in me so precisely.

*I knew all the rules but the rules did not know me. Guaranteed.*

* * *

I was sitting in a doctor's waiting room, doing what you do in waiting rooms, which is stare at things and wait and try to look like you're not trying to calculate whether other people arrived before you. There was a clock on the wall. Old school, the kind with a second hand that actually moves. There was ambient music playing through a speaker somewhere.

Something made me pay attention to both at once, and I stopped.

The song was on the downbeat. Every second. Not just the rhythm section keeping approximate time, not a loose correspondence you could talk yourself into. The entire song was locked to that clock tick for tick.

The tempo was exactly sixty beats per minute, meaning one beat per second, meaning the second hand and the song were perfectly synchronized.

I said to my wife, who was with me: do you hear that?

She gave me the look. If you are married to someone who notices things like this, you know the look. It is patient and slightly wary and means: what is it this time.

But she listened. And after a few seconds she heard it too.

We sat with it for a while. Not long. But for those few measures, in a waiting room in a doctor's office, everything was in time. The clock, the song, the room, the two of us. One pulse. It didn't mean anything in the sense that I could tell you what it meant. It just was.

And I thought: this is the thing. This is what the book is about. A random moment in an ordinary room, where organized sound happened to align with an organized measurement of time, and for a few seconds everything was in the same structure. No one made it happen. No one designed it. The song was already playing. The clock was already running. The coincidence arrived and departed without leaving any evidence except in the two people who happened to be sitting there paying attention.

Gloria Estefan warned me when I was a child that the rhythm was going to get me. She was right. She is always right.

* * *

If music requires a listener, then maybe what we're really saying is that meaning requires a listener. That the universe, for all its patterns and ratios and harmonic series, is a collection of potential meanings waiting to be completed by something capable of receiving them.

# PART III: RESOLUTION

**The scientific breakdown**

# Chapter 13: Everything Vibrates

We have been playing music for animals for a long time. Farmers who pipe Beethoven into their barns. Shelter workers who put on classical radio to calm the dogs. People who sit at pianos in fields and watch horses wander over. If you've spent any time around animals and music, you've seen it. Something happens. They respond. The response is specific enough that it's hard to chalk up to coincidence or wishful thinking.

The science has caught up to the observation. Dogs exposed to classical music show measurable reductions in stress, lower cortisol levels, slower heart rate. They lie down. They stop barking. Play them heavy metal and they get agitated, which, fair enough. Dairy cows produce more milk with slow music than fast music. Not a little more. A measurable, documented, reproducible amount more. A study at the University of Leicester found a three percent increase with slow tempos. Cows apparently preferred R.E.M.'s Everybody Hurts and Beethoven's Pastoral Symphony to Supergrass. I don't know what to do with that except respect it and admit that the cows have reasonable taste.

Cats, predictably, are more complicated. Play them human music and most of them ignore it completely, which is exactly what you'd expect from cats. But researchers at the University of Wisconsin-Madison developed music specifically built around feline frequencies, the pitch range of cat vocalizations, the tempo of purring and suckling. Play them that and something changes. They move toward the speaker. Some rub against it. The music was speaking a language they actually use, and they recognized it.

Tamarin monkeys played species-specific music, songs modeled on their own calming calls, relaxed and ate more. Songs modeled on their threat calls produced the opposite. The mechanism isn't mysterious. Music built around the frequency and rhythm of an animal's own communication system activates the same neural pathways that their natural communication activates. The response to organized sound isn't a human invention. It's a feature of any nervous system with an auditory system, which is to say: most things that are alive.

The sea lion data upset a theory that had felt settled.

Sea lions can synchronize their head movements to a beat. That sentence is worth sitting with for a moment, because of what it upended.

The theory for a long time was that beat synchrony, the ability to lock onto an external pulse and move to it, required vocal learning. Only species capable of imitating sounds could do it. The thinking was that the neural machinery for vocal mimicry and the neural machinery for rhythmic entrainment are so closely linked that you can't have one without the other. Songbirds can do it. Parrots can do it. Humans can do it. That's the list, the theory said.

Then a California sea lion named Ronan showed up at UC Santa Cruz. Ronan is not a vocal learner in any technical sense. Sea lions don't imitate sounds the way parrots do. And yet when researchers played her a metronome beat and then music, she bobbed her head in time. Precisely. Across tempos. The theory needed updating, which in science is the polite way of saying it was wrong. Ronan's ability suggests that beat synchrony may be tied to general neural timing mechanisms rather than specifically to vocal learning. Which widens the circle considerably.

If the capacity for rhythmic entrainment doesn't require vocal learning, then it's much older than we thought, much more widespread than we thought, and much more fundamental to how nervous systems work in general. Ronan is still alive, still bobbing her head to music at UC Santa Cruz, and the researchers who work with her describe her as enthusiastic about the sessions. That word, enthusiastic, is doing a lot of work in a scientific paper. But they used it.

The sparrow data is where the argument gets strange.

Female white-tailed sparrows listening to male birdsong show activation in the part of their brain analogous to the human amygdala, the same region that lights up in people listening to music they love. The neural reward system isn't unique to humans processing music. It shows up across species lines in animals that have been evolutionarily separated from us for hundreds of millions of years.

The goldfish study is the one I keep returning to.

Goldfish were trained to distinguish between Bach and Stravinsky. I want to be precise about what that means: they could tell the difference between two composers, reliably, in controlled experimental conditions. They have no concept of European classical music. They have no cultural context whatsoever. They don't have the neural architecture for anything resembling aesthetic appreciation in any sense we'd recognize. What they have is an auditory system that detects pattern, and Bach and Stravinsky produce sufficiently distinct patterns that a goldfish brain can sort them.

The researchers in that study tried to determine whether the fish were using surface features, tempo, average pitch, or whether they were detecting something more structural. When they manipulated the recordings to remove the obvious distinguishing features, the fish could still sort them. They were picking up on something deeper in the pattern. Something about the way the notes related to each other, the internal logic of the musical structure, that a goldfish brain could track even without any of the cultural scaffolding we bring to music.

I find this clarifying more than humbling. We inherited the capacity to respond to pattern in sound, and we share that inheritance with goldfish. The arrogance was always misplaced.

The whales were doing this long before we arrived.

Humpback whales have been composing since before we had the cognitive machinery to appreciate it. Their songs are not calls. They are structured, layered,

complex vocal performances that can last for hours, built from distinct themes arranged in a specific order, with internal logic that researchers have spent decades trying to fully decode. The songs evolve. New phrases emerge and spread through a population. Old ones get dropped. Over time a song becomes something different from what it was, through a process that looks, when you describe it clinically, a lot like cultural transmission.

And then there are the revolutions. A new song type emerges in one whale population, spreads to neighboring populations, and within a few years has replaced the established song across an entire ocean basin. Not gradually. Rapidly. Wholesale. One song in, old song out, carried west to east across the South Pacific. The songs are learned as segments, similar to how humans learn language, not note by note but chunk by chunk, themes absorbed and recombined.

There is definitely a hipster whale out there who was really into the old stuff before it went mainstream.

That's a real sentence about real whale behavior, which is one of the more disorienting things I've written in this book. But the point is serious: whales are not just making sounds for communication or mating. They are composing. The songs are elaborately structured performances that change over time through learning, spread through populations through cultural transmission, and get replaced when something new arrives that's apparently better. The only things separating what they do from what human musical cultures do are scale, self-awareness, and the ability to write it down. It's not obvious that any of those is the thing that makes music music.

Consider what a whale revolution actually involves. An individual whale, somewhere in the western Pacific, starts singing something new. Not a mutation. Not an accident. A new arrangement of themes, a new structural logic. Other whales hear it. They learn it. They sing it to other whales. Within years, the dominant song across thousands of miles of ocean has been replaced. No radio. No streaming. No industry. Just whales, listening to each other across an incomprehensible volume of dark water, adopting what sounds better.

We think we invented the concept of a hit song. We didn't. We just built the infrastructure to do it faster.

Which forces the harder question.

If the response to organized sound is a feature of nervous systems generally, not just human ones, then what exactly is music? Is it something humans make? Or is it something that happens when any sufficiently complex auditory system encounters organized pattern in sound?

Every attempt I make to draw a line between what the whale does and what we do runs into the same problem: the mechanisms on both sides of the line are more similar than different. The neural reward activation looks the same. The cultural transmission looks the same. The evolution of songs through a population over

time looks the same. The capacity for rhythmic entrainment exists in sea lions who never learned to imitate a sound in their lives.

# Chapter 14: The Neuroscience of Being Moved

The short version: when music produces frisson, your brain is doing something it does almost nowhere else. It is releasing dopamine in anticipation of a reward that hasn't happened yet, and then releasing more dopamine when the reward arrives. Two separate releases, two separate brain structures, the same chemical. Anticipation and fulfillment both rewarded, neurochemically, in sequence. The brain is treating the arc of a musical phrase the way it treats the arc of something genuinely important. It is taking music seriously at the cellular level in a way most of our conscious minds have not caught up to.

The longer version requires us to talk about prediction.

Your brain is a prediction machine. It is a description of the brain’s primary function, not a philosophical position. At every moment, your brain is building a model of what is about to happen based on what has happened before, and comparing incoming sensory data to that model. When the data matches the prediction, not much happens. When it doesn't, something very much does.

Surprise is the currency of attention. The brain pays attention to things it didn't predict, because unpredicted events are either opportunities or threats, and the brain evolved in an environment where the difference mattered a lot. The brain also generates a positive signal when a prediction turns out to be correct in a satisfying way.

When you anticipate something and it arrives better than expected, the reward is larger.

Music exploits this system with almost unfair precision.

The moment in Just Like Heaven where the clean guitar comes in to play the main riff. The song opens with a rumbly tom beat from Boris Williams, who added that fill himself and in doing so inspired Robert Smith to introduce each instrument singularly and in sequence. A single crash cymbal introduces Simon Gallup’s bass line while the drums snap and crash into the rhythm guitar, then synths, then in comes the lead guitar riff, descending down the A major scale on a single string in step-wise motion, no interval jumps, just one note falling into the next. It runs down nearly the entire fretboard, then slowly climbs back up, then descends again until Smith starts in. That riff. One could argue it serves as the actual chorus of the song, more memorable than any lyric in it, and Smith himself has called it the best pop song The Cure ever wrote. The first time I heard it was in the 1980s and I could only describe it to people by referencing that it was the man singing show me show me show me how you do that trick, and they got it. My internal description was different: the one with the guitar that has some sort of authority to make the hair stand up on the back of my neck. It still does this to me, no matter how many times I hear it. It makes me think of my wife. It makes me think of watching that song live with her on an absolutely perfect night in Kansas City, outdoors, while feeling my son kick in her belly. A song that already stimulated a

biological response. Now it conjures an emotional one too. And both responses are happy and fulfilling. Just Like Heaven, indeed.

A composer builds expectations through repetition and pattern, then violates them in ways that are surprising but in retrospect feel inevitable. The unexpected key change. The instrument that enters when you weren't waiting for it. The moment of silence right before the crescendo. Each of these is the music saying: you thought you knew where this was going. Here is where it actually went. And the brain, primed for exactly this kind of information, lights up.

The frisson is the physical overflow of that neural response. In people whose auditory-emotional connections are dense enough, the signal spills from the reward system into the autonomic nervous system, and you feel it on the outside of your body. You didn't decide to have goosebumps.

Your prediction machinery decided that what just happened was important enough to mark physically. In plain terms: your brain just decided that moment mattered. It didn’t consult you. It marked it anyway.

Frisson is not a reaction to what just happened. It is a reaction to the gap between what you expected and what arrived, weighted by everything the song had been building before that moment. The goosebumps show up in the crack between surprise and understanding, maybe a tenth of a second, while the brain is still sorting out what went wrong with its prediction. The body has already been notified. The opinion hasn’t formed yet.

Frisson is not an aesthetic judgment. It is a physiological event that fires before your opinion has had time to show up for work. Sometimes you end up loving what triggered it. Sometimes you think it was a bad compositional choice. The goosebumps don’t care either way.

But the goosebumps don't wait for the opinion. They arrive on the timing of the surprise, not the quality of the resolution.

I have gotten frisson from music I did not enjoy. I have gotten it from a passage that, when I analyzed it consciously, I thought was a poor compositional choice. The physical response was indifferent to my critical assessment. Something happened that my brain had not predicted, and my body marked it, and then I sat there in the curious position of having goosebumps for something I was about to decide I didn't like.

M83’s Reunion does the opposite. The synths and drumming and Anthony Gonzalez’s vocals are all in their own distinct lane, but together they are anthemic and big and shimmery. Then the interlude arrives and the music slows to a near halt and a floating voice comes in on a child-like pre-bridge that breaks everything the song had been building. The sixteenth-note snare eventually pulls it back on track, but the damage is done. Cool song, but what the hell was that bit in the middle? My prediction machinery flagged it as wrong before I had formed the opinion. The goosebumps and the agitation used the same neural pathway. What

does it mean that the body's alarm system and the mind's review board are on different schedules?

The prediction machinery is indifferent to your taste. It just wants to know if what happened was what it expected. You carry the map. The music reads it.

Frisson is a response to meaningful surprise within a structure the brain has already internalized. It often depends on learned expectations, and familiarity tends to amplify it. But unfamiliar music can still produce chills through other routes, including an arresting timbre, an unexpected harmonic gesture, or a vocal performance that bypasses prediction entirely. The prediction machinery is one path in. It is not the only one.

There is a reason people cry at songs they have heard a thousand times. Everyone says it is sentimentality. The mechanics run deeper. A person who has lived with a piece of music for fifty years has built a more precise internal model of what that music is about to do at every moment. When it does something that defies that model, even something it has always done, heard from a slightly different angle on a Tuesday when your defenses were down, the violation is more precisely calibrated. The surprise is more specific. The response is larger.

You do not get more emotional about music as you age. You get more accurately emotional. You have been tuning the receiver for decades. You can pick up frequencies you could not reach before.

What makes this visible, literally visible, is neuroimaging. When researchers put people in an fMRI scanner and play music, the brain lights up in a way that almost nothing else produces. Not one region. Many regions, simultaneously. Auditory cortex, motor cortex, prefrontal cortex, cerebellum, amygdala, hippocampus, nucleus accumbens. Listening to music activates networks responsible for hearing, movement, memory, emotion, and reward all at the same time. No other stimulus does this with the same breadth. Language activates some of these. Exercise activates others. Music activates all of them in concert, which is why the word concert may be more accurate than we realized. This distributed activation is the reason music survives neurodegeneration longer than almost any other cognitive function. When Alzheimer's has destroyed the pathways for names and faces and recent memory, the musical pathways are often still intact, because the music was never stored in one place. It was stored everywhere. There is nothing else the brain does that is quite this distributed, and the imaging makes it impossible to argue that music is a minor cognitive event. The scans show a brain doing something it considers important.

Prediction and reward explain frisson. They explain why surprise matters, why familiarity amplifies the response, why the body marks certain musical moments as physically significant. They do not explain why this system exists at all. They do not explain why the brain treats organized sound as though it matters at the level of survival, or why the reward pathway responds to music with the same chemicals it uses for food and sex and staying alive. The how is getting clearer every year. The why has not moved.

The question the research is now moving toward is whether this mechanism can be used therapeutically. The dopamine release from frisson uses the same neural pathways as dopamine releases from other rewarding stimuli.

Parkinson's disease involves the degeneration of dopaminergic neurons.

Depression involves dysregulation of dopaminergic signaling. Addiction involves the hijacking of dopaminergic reward systems.

The question isn’t whether music can replace medication. It can’t. The question is whether it can work alongside it. The early results say yes, but the asterisks are real. Not any music. Not just pressing play. The right structure, aimed at the right neural state, with intention behind it. The doctors are paying attention. That should tell you something.

There are researchers at Stanford and Johns Hopkins who are trying to turn this into something a doctor could actually prescribe. Not music therapy in the soft sense, where you play something calming in the background and hope it helps. Something with teeth: match a piece of music to a brain state and measure what happens. The clinical version of what the cathedral builders were doing, except with data and the ability to iterate.

That is both exciting and a little terrifying. The idea that someone could engineer a piece of music to produce frisson in a particular type of brain at a particular moment in a therapy session is either the most humane application of everything in this chapter or the beginning of something that needs guardrails immediately. Probably both. That is usually how it goes with things that actually work.

Why does frisson happen in some people and not others? The dense auditory-emotional connections are part of it. But why do some people have those connections and others don't? Honestly, we don't fully know yet. The research points toward a combination of factors, genetic predisposition, early musical exposure, personality traits that correlate with openness to experience. It is probably not one thing. It is probably several things that interact.

There is some suggestive evidence that musical sensitivity clusters in families. If one of your parents gets frisson from music regularly, you may be more likely to as well. Whether that reflects shared environment, shared playlists on the same long drives, or something genuinely heritable is not established. It is a reasonable hypothesis, not a confirmed finding.

But the idea that some people are built to receive music more fully than others, structurally, is something I keep coming back to. The evidence is preliminary and the mechanism unclear. What seems less controversial is that the variation is real, consistent, and not simply explained by listening history or openness to experience. Whether the architecture is inherited, developed, or some combination is an open question. One I find worth asking.

I don't know if that makes me feel better or worse about myself.

It does make the experience feel less random, which is either comforting or just more responsibility.

## Chapter 15: Synesthesia and the Crossed Wires

I want to try something different, which is to talk about what synesthesia actually feels like from the inside, because the clinical description never quite captures it.

It's not a hallucination. A hallucination is a perception with no external stimulus. Synesthesia is a perception with an external stimulus, just processed through additional channels. When the Howard Jones arpeggio produces rose pink and fuchsia, the arpeggio is real. The color is also real, in the sense that my visual cortex is actually activating. It's not imagined. It's just not coming from photons.

The closest analogy I have is this: imagine if every time you tasted something sweet, you also heard a faint high note. Not that you associated sweetness with high notes, not that the word sweet makes you think of high notes. That when the sweetness registers on your tongue, your auditory cortex fires simultaneously, automatically, without your involvement. That's what synesthesia is. A second sensory channel activating in response to a stimulus in the first channel.

Not association. Actual concurrent perception.

Most synesthetes don't know they have it for years. Because if rose pink shows up every time you hear that arpeggio, you assume rose pink shows up for everyone. The idea that other people hear music in black and white, so to speak, doesn't occur to you until someone says something.

I was probably in my mid-twenties before I really understood that what I was experiencing was unusual. Even then I wasn't entirely sure. It's like trying to describe the color blue to someone who was born without the capacity to see blue. You can gesture at it. You can't hand it to them.

Looking back, I think I first understood I was different in fifth grade. Our music teacher, Mrs. Moore, ran an end-of-year trivia game where she played songs on piano from every year of elementary school and tested our memory. Song after song, I hit the bongo, the game buzzer, so fast and so hard that nobody else had a chance. Eventually she made me stop responding to give the other kids a turn.

I didn’t understand why I was faster. I just was. Every song she played arrived with its colors, and the colors carried the memory with them. I wasn’t recalling a melody and then searching for context. I was seeing the whole thing at once: the

song, the color, the year, the room I was sitting in when I first heard it. Two channels of information where everyone else had one.

Here is the thing about synesthesia that I don’t think gets discussed enough: it is a memory weapon. Think about how eyewitness identification works. Authorities ask what the person was last seen wearing. Color and memory are already tightly linked in every brain. When you add a second sensory dimension to every piece of music you’ve ever heard, you are effectively doubling the retrieval cues. The song plays, the color arrives, and the memory attached to both of them surfaces whether you ask for it or not.

That became a party trick over the years. My friends would watch as cable TV music channels scrolled through artist, album, composer, label, year of release. I could pull it all because I remembered the song and the song triggered the colors and the colors triggered everything else. It was a cascading recall system I didn’t build and couldn’t turn off.

It isn’t always accurate. Sometimes the same song will produce different colors on different days, usually tied to my mood or to whether I’m subconsciously suppressing a memory associated with the song in order to keep things pleasant for whoever is listening with me. The system is powerful but it is not a machine. It has weather.

Let me try to be more specific about what it actually looks like, because I’ve found that descriptions of synesthesia tend to be vague in ways that make people think it’s more mystical and less neurological than it is.

The colors don't appear as objects. They don't float in front of me or interfere with my visual field in the way that, say, a migraine aura does. They are more like a quality of the sound itself, an additional attribute that arrives with the note the way timbre arrives with the note. If timbre is the texture of a sound, the quality that makes a middle C on a piano sound different from a middle C on a violin, then what I perceive is something like a color-temperature analog to timbre.

It's a dimension of the sound rather than a visual overlay on the world.

This is why it's hard to describe. Most people have an intuitive understanding of what it means for a sound to have a certain timbre, even if they don't use that word. What I'm describing is a similar additional dimension, but one that's routed through the visual system rather than processed as purely auditory information. The closest I've gotten to communicating it is: it's the way you experience the difference between warm and cool lighting in a room, except it's attached to sound.

The colors are stable and consistent across decades. The Howard Jones arpeggio has always been rose pink, orange, fuchsia. John Mayer's 3x5 has always been teal, yellow, lavender. Tom Waits produces dark purples and deep browns that look, subjectively, like old wood. Certain intervals are specific colors regardless of what key they're in: the major seventh has always been a particular shade of dusty gold. A minor third is almost always some variation of slate blue.

I do not know why these assignments exist. I cannot reverse-engineer the relationship between the frequency relationships and the color assignments. They arrived with the music and they have not changed. They are, in some sense I cannot fully account for, as much a part of the music as the notes.

* * *

The neuroscience of synesthesia has gotten considerably clearer in the last two decades, partly because neuroimaging finally gave researchers a way to see what was actually happening rather than just taking synesthetes at their word.

What they found is cross-activation. In synesthetic brains, the connections between adjacent processing regions are more numerous, more active, or less inhibited than in typical brains. The auditory cortex and the visual cortex are neighbors in the brain, separated by a relatively thin border. In most people, the signals stay on their respective sides. In synesthetic brains, the signal bleeds over. The auditory input activates visual processing. Sometimes the reverse.

This happens automatically and involuntarily. I cannot choose to hear the Howard Jones arpeggio without the colors arriving. I also cannot choose to make the colors arrive without the music. The link is hardwired. It is not a skill. It is not something I practice. It is just how the wiring is arranged.

There is a related form called mirror-touch synesthesia, where observing someone being touched produces a tactile sensation in the observer.

People with this form of synesthesia experience physical sensations in their own body when they watch other people be touched. They feel it.

The nervous system processes the observed touch as if it were received touch. Which is, when you think about it, just an unusually powerful version of empathy, a word that comes from the Greek for feeling into, which is what mirror-touch synesthetes are doing literally and neurologically.

I mention this because it suggests that synesthesia is not an isolated quirk. It is a general category: the tendency of the nervous system to route signals through additional channels, to let perception bleed across the boundaries that typically contain it.

The senses are not as separate as we experience them being. The brain is doing cross-modal processing constantly, in everyone. Synesthetes just have the volume on certain channels turned up high enough to notice.

Here's what I find more interesting than the description of my own brain, which is admittedly a limited sample size: synesthesia appears to be a more pronounced version of something all brains do.

Music processing in non-synesthetic brains is already cross-modal. It activates motor regions, which is why you tap your foot without deciding to. It activates

emotional regions, obviously. It activates visual regions even in people who don't see colors. It activates memory regions in ways that other sensory inputs often don't. Music is already a multi-channel experience for everyone. Synesthetes just have the volume on one or more of those channels turned up past the point where it becomes consciously noticeable.

Which suggests that the wall between senses is thinner than we think, and music is particularly good at finding the gaps in it. The reason certain songs feel warm or cold, the reason some musical keys seem brighter than others, the reason a bass line has physical weight, is that the brain is doing something real when it assigns those qualities.

It's not being poetic. It's processing the sound through multiple systems simultaneously and reporting the results.

Synesthesia makes the hidden processing visible. What you see in a synesthete is the ordinary multi-channel nature of musical experience, amplified to the point where it breaks the surface.

* * *

Does it ever get overwhelming? Yes. Sometimes. A live show with a dense wall of sound at high volume can produce enough simultaneous visual complexity that it becomes difficult to track both streams at once.

I've described it before as trying to read while someone projects a movie onto the page. The information is all real. There's just a lot of it.

The other thing it occasionally does is make it hard to listen to music casually. Most people can have music on in the background, as wallpaper, without being particularly engaged with it. I find this difficult. The colors show up whether I'm paying attention or not. A song playing in a restaurant produces a visual field I'm aware of whether I want to be or not. I have at various points in my life found this annoying, which is I think a reasonable response to a neurological feature that does not have an off switch.

But mostly it's just what music looks like. And the honest thing is, I don't know what I'm missing by not hearing music without it, because I've never had the experience of hearing music without it. You can't compare your experience to an experience you've never had.

What I can say is this: music has always been more than sound to me.

More dimensional. More present. I don’t know if that’s synesthesia or if it’s just what it feels like to care about music this much. The colors are consistent across decades of listening. They are, in some way I can’t fully articulate, part of what those songs are to me. The music and its colors are the same object. I cannot hear one without the other.

Which is, I suppose, just a more literal version of what music does to everyone.

I should say something about what this means for the rest of the book, because it means something. When I describe Sturgill Simpson’s voice producing a response before I’d processed a single lyric, or Pat Metheny overloading my visual field, or a tritone registering as physical pain, I am not being poetic. I am reporting what a second sensory channel showed me. The synesthesia gives me a readout that most listeners do not get: a visible, involuntary, real-time display of how organized sound is landing in a nervous system. It is not objective data. It is one brain’s translation. But it is a translation that has been consistent across decades, and it has shaped the way I listen, the way I evaluate what music is doing, and the conclusions I draw throughout this book. You should know that. The lens I’m looking through is not the standard-issue model. It has an extra channel, and that channel is part of what led me here.

* * *

I never heard anyone talk about it, so I didn't either. I wasn't sure what to assume, that others experienced this too, or that they didn't. The question felt unanswerable from the inside. You cannot compare your inner experience to someone else's inner experience. You can only compare reports, and I wasn't making any.

Then I watched a news magazine segment, 60 Minutes or 48 Hours or CBS Sunday Morning, something like that, probably twenty-some years ago, where a reporter followed a group of children to a place where they were illustrating on a computer what they saw when they heard music. The colors. The shapes. The automatic translation of organized sound into visual information that nobody had taught them and that they couldn't turn off.

I was on the couch. I remember the specific quality of the recognition. Not discovery exactly, I already knew what I had. More like the particular relief of finding out you are not alone in something you had carried quietly, the same relief as when you describe a symptom you thought was yours alone and the doctor says yes, that has a name, other people have this. Oh my God. There are others.

What I did not expect was that the segment would also introduce me to the other form mine takes, the one I had not thought to name.

* * *

I see time spatially. Not metaphorically, as an actual roadmap that I navigate when I think about age. Imagine a drone following a skier downhill, the camera shifting angle around gates and turns. That is how I perceive the progression of human age. Ages one through fifteen run in a fairly straight line. Then an uphill

climb toward twenty-one. A hard, unruly right turn toward twenty-eight. A slight downhill to thirty-six. Sharp uphill to forty. A plateau from forty to fifty, then a sharp left. From fifty to eighty, another long straight line. Past eighty I have never visualized anything, which I try not to read too much into.

I am forty-five. I am in the middle of the plateau, my camera angle looking ahead toward fifty. I can see the sharp left coming. I did not choose this view. It is just where I am when I think about it, the same way the rose pink shows up without my permission when the Howard Jones arpeggio plays. Involuntary. Consistent. Not under my control.

I do not believe this is predictive. I do not believe the shape of the course corresponds to anything meaningful about what those ages actually feel like or what happens in them. It is perception, not prophecy. But it does mean that when I think about someone's age (mine, yours, anyone's) I locate them on the course, and the course orients me toward them spatially. I see everyone in relation to it.

I don't know if this is synesthesia in the strict clinical sense or something adjacent. I don't know if it's genetic, environmental, or something else. What I know is that it is involuntary, consistent, and has been there as long as I can remember. A little notch of difference. I have mostly learned to accept the sensory overload and try to parse the signal from the noise.

* * *

The noise, when it comes, is unpleasant.

When notes clash, like a tritone, an unresolved dissonance, two frequencies fighting rather than resolving, what I experience is not a visual version of the harmonic tension that listeners without synesthesia feel. It is more like static. Like blending every soda at a fountain dispenser into one cup. A non-distinct, sugary, indistinguishable mess with no redemptive quality. It is gross. It becomes physically unbearable at sufficient volume or duration, and I will remove myself from the room.

This is worth sitting with for a moment, because it connects to something the earlier chapters were arguing. The tritone, the interval that sits exactly halfway across the Circle of Fifths from your home key, the one that creates maximum harmonic tension, resolves toward the tonic when the music gives it permission to. The ear wants the resolution. The nervous system tracks the tension and waits. When the resolution comes, something releases.

For me that release is also visual. The static clears. The colors that were fighting each other find their lanes. What was a fountain-soda mess becomes distinct and readable again. The harmony of the sound and the harmony of the colors arrive at the same moment, which is either a remarkable coincidence or evidence that they were never separate phenomena to begin with.

I can appreciate a wide range of notes, songs, styles, instruments, voices. The palette is broad. But the wrong combination, the four wrong chords, the voice that sits in a frequency that clashes with the melody, the production choice that puts two things together that fight each other, registers in me as something close to physical pain. I am not being precious about this. I am describing a real sensory event.

I apologize to Karen Carpenter fans. Her voice was, by any technical measure, extraordinary. The specific frequency of it clashes in my visual field in a way I cannot account for and cannot override. The music knows what it knows. I have learned to work around it.

## Chapter 16: Music in the Dark

Organized sound as a technology for altering human consciousness is not a recent discovery. The recent discovery is that we can measure it.

There is a playlist at Johns Hopkins University that researchers have spent years developing, refining, and testing in ways that most playlists never get subjected to. It runs about five hours. It begins gently, grows in emotional complexity through the middle, and resolves slowly toward the end. It is designed not as background music but as architecture. The music is the container for the experience. In the clinical psilocybin trials at Johns Hopkins and NYU, this playlist is playing for the duration of the session. Participants wear eyeshades. They lie on a couch. And for the next five to seven hours, the music navigates.

The people who designed that playlist include some of the most careful and serious researchers working on psychedelic therapy. Bill Richards, a psychologist at Johns Hopkins who has been working in this field for decades longer than it was fashionable to work in it, has described the music in these sessions as something like a river: the participant gets in and is carried. The therapist is on the bank, available, not directing. The music moves. The participant goes where it goes.

Richards has also said that music acts as emotional permission. People who might resist certain feelings in the absence of any external structure find that music gives them something to hold onto while going somewhere difficult. The music is not producing the emotions. It is providing a container in which the emotions the psilocybin is surfacing can be felt without becoming overwhelming. This is the same thing a good therapist does in talk therapy, except it is organized sound doing it rather than a trained human being.

The fact that organized sound can serve as an emotional container in a clinical context tells you something about what music actually is. It is not decoration, and

in these conditions it is not merely stimulus. It is more like a nervous system in the room, responding to the person, holding a space, doing something that a lot of humans struggle to do for each other.

The neuroscience of why this works is specific and worth understanding.

Psilocybin works primarily by disrupting the brain's default mode network, the system responsible for self-referential thinking, the inner narrator, the part of your brain that is always running the story of you. Under psilocybin, that system quiets. The usual traffic patterns are disrupted. And without the default mode network running interference, sensory processing changes dramatically.

Cross-modal connectivity increases. Significantly. The walls between senses that are already thinner in synesthetic brains become thinner still in most brains under psilocybin. Sounds acquire visual dimensions. Music becomes something the whole nervous system participates in rather than something the ears process and forward to the emotional centers. The experience is, in neurological terms, closer to synesthesia than to ordinary hearing.

Which may explain why music during psilocybin sessions has a quality that participants struggle to describe. Not louder. Not more beautiful necessarily, though sometimes that. More present. More three-dimensional. More like an environment than a soundtrack.

I find the synesthesia parallel clarifying. What psilocybin appears to do, neurologically, is temporarily increase the cross-modal connectivity that synesthetes have as a baseline. The walls between senses that I experience as relatively thin become thin for everyone under psilocybin. Which would mean that the psilocybin experience of music is, in some neurological sense, closer to how I always hear it than to how most people hear it. I don't know what to do with that except note it and feel slightly vindicated.

* * *

The drumming traditions are where this gets strange, and where I want to spend more time than the clinical literature usually does.

Sustained rhythmic drumming as a method for shifting consciousness has been documented across dozens of unrelated cultures with no common ancestor and no apparent contact. Siberian shamans drumming themselves into trance. West African griots whose percussion is not entertainment but a technology for crossing between states of awareness. Native American ceremonial drummers working at tempos that researchers now know correspond to neural oscillation frequencies. The Sufi whirling dervish, for whom the spinning and the music are inseparable from the dissolution of ordinary self-awareness. Brazilian candomblé ceremonies, where particular rhythmic patterns are associated with particular orixás, particular states, particular thresholds.

These traditions developed independently. They share no theology, no geography, no common musical heritage. What they share is the discovery, arrived at through centuries of observation and iteration, that repetitive rhythmic sound at the right tempo does something real to human consciousness. They found it without EEG data, without fMRI, without any of the tools that modern neuroscience uses to measure what is happening. They found it the hard way: trying things, noticing what happened, refining the approach across generations until it worked reliably.

The mechanism varies by tradition, but the thread is the same: rhythm at the right tempo, sustained long enough, shifts the balance of neural activity in ways that change what is accessible to awareness. Boundaries that normally feel fixed become permeable. The ordinary self-referential noise quiets. Something opens.

The researchers are now measuring what the shamans were describing. Sustained rhythmic drumming in the theta frequency range, roughly four to seven beats per second, is associated with hypnagogic states, the ones at the edge of sleep and waking where dreamlike imagery and loosened self-boundaries are common. Faster tempos in the alpha range produce arousal without agitation. The Siberian shaman sitting in a yurt ten thousand years ago, drumming at a tempo that modern neuroscience now confirms induces theta oscillation, had no vocabulary for what was happening. What that shaman had was the map, drawn from direct experience across thousands of repetitions, and the willingness to go where the rhythm led. They were doing neuroscience before there was a word for it, using the oldest technology available: organized sound.

* * *

The Johns Hopkins researchers and the Siberian shamans would have nothing to say to each other. Different frameworks, different vocabularies, different everything. But put them in the same room and describe what they each observed: that sustained organized sound at the right frequencies produces reproducible changes in human consciousness, that these changes open access to material that ordinary waking awareness cannot reach, that the experience has measurable and lasting effects on how people relate to themselves and to mortality and to grief, and you would be describing the same observations from both directions.

Bill Richards has said that the psilocybin experience, properly supported, gives people evidence of something. Not proof. Evidence. The experience is not interpretable as nothing. You come back from it with the sense that whatever happened was real in a way that subsequent analysis cannot fully account for. You don't always know what to do with it. But you know it was something.

The shaman said the same thing. Different language. Same report. I am not claiming equivalence of explanation here, only a striking overlap in reported effects and in the practical use of organized sound.

What music does in those contexts is serve as a thread, something the participant can hold onto while traveling somewhere that ordinary orientation doesn't work. It is not the destination. It is the thing that makes the journey navigable. The fact that it can do this is not a feature of psilocybin specifically. It is a feature of music. The clinical trials revealed it because the conditions were controlled enough to see it clearly. But musicians and listeners and anyone who has ever had the right song arrive at the wrong moment already knew it.

The shaman used a drum and a song to hold a person together while they traveled somewhere dangerous. The clinician at Johns Hopkins used headphones and a playlist to do the same thing, in a room with an fMRI machine and a consent form. Eight hundred years apart. Different explanations. Possibly the same tool doing the same job.

# Chapter 17: Frequency as Medicine

Sound destroys things.

The healing and the destroying are the same mechanism. A kidney stone is dissolved by focused ultrasound aimed precisely at it, the same way histotripsy destroys a tumor. The sound wave hits the target with enough energy to break it

apart. Too much energy, wrong frequency, wrong targeting, and you damage the surrounding tissue. The difference between medicine and harm is specificity.

This has always been true. Infrasound, sound below the range of human hearing, causes nausea and disorientation at sufficient intensity. The military has spent money on this. So have some buildings, accidentally: certain architectural configurations can produce infrasound that makes occupants feel watched, anxious, uneasy, in ways that led some people to conclude those buildings were haunted before anyone figured out the frequency. The ghost was a standing wave.

Sound is a physical force. We keep having to relearn this because the delivery mechanism is pleasant and the mechanism underneath it is not optional.

Histotripsy is the clearest version of what precision actually looks like here.

Multiple ultrasound beams aimed at the same point, sub-millimeter targeting, real-time imaging. Where the beams converge they create pressure intense enough to generate microscopic bubbles inside the cells. The bubbles expand and collapse in microseconds, and the force of that collapse shreds the cellular structure from the inside. The dead tissue liquefies. The immune system hauls it away. No heat. No radiation. No incision. Just sound, pointed correctly.

The FDA cleared it for liver cancer in 2023. By the end of 2024, more than a thousand patients had been treated commercially, and the twelve-month data showed ninety percent local tumor control. Trials for pancreatic cancer are running now, which matters particularly because pancreatic tumors are notoriously resistant to almost every other treatment approach. The geometry of the pancreas makes surgical access difficult and the tumor's microenvironment tends to block chemotherapy. Focused ultrasound doesn't care about either of those problems. It passes through tissue without harming it until the beams converge at the target. The boundary between damaged and undamaged tissue is sharp enough to measure in millimeters. Kidney trials are enrolling. Prostate and sarcoma are next. The pipeline is not slowing down. It is accelerating, and almost nobody outside of oncology has noticed.

The people who developed this spent decades on it. The basic physics have been understood since the mid-twentieth century. What took so long was precision: the ability to aim sound well enough that you could destroy a centimeter of cancerous tissue without harming the centimeter next to it. When I read about this I keep thinking about the cathedral builders and their acoustic engineering, people who also understood that sound could be shaped and aimed and that the shaping and aiming produced different effects depending on how you did it. They were after something completely different. The underlying intuition, that organized frequency does things that unorganized noise does not, is the same one.

* * *

The plants are doing something with electricity, and I want to be honest about what this means and what it does not, because the internet has had some bad ideas about plants and music. Plants conduct electricity. Electrical signals coordinate activity within plant cells in ways that are genuinely analogous to, though not identical to, what happens in animal nervous systems. When a Venus flytrap closes, it is responding to an electrical signal. Plants do not have neurons. They have something that serves some of the same functions through different mechanisms.

Researchers have recorded these electrical signals and run them through algorithms that map them to musical notes. The result is called plant music, and it is interesting to listen to, and the plant is not composing it. The plant is producing electrical signals in the course of being a plant, and a human algorithm is translating them into notes. The music is real. The plant’s awareness of it is not established. I include this not because I think plants hear music but because the line between organized electrical signaling and organized sound turns out to be thinner than most people assume, and the question of where that line sits is worth noting even if this book cannot answer it.

The Parkinson's data brings this back into the clinical.

Parkinson's disease freezes movement by disrupting the basal ganglia's ability to generate the motor signals that initiate and regulate movement. The basal ganglia is also deeply involved in rhythmic processing. Rhythm provides an external timing signal that can, in some patients, temporarily substitute for the disrupted internal one. When the music plays, the body can move to it. When the music stops, the freezing returns.

Rhythmic auditory stimulation is what it's called clinically, and it is currently used in Parkinson's rehabilitation. Not as an experiment. As a treatment. The rhythm of the music provides a scaffold for movement that the damaged basal ganglia can no longer provide internally. The patient borrows the rhythm from outside and uses it to organize movement from inside.

Here is what the data is pointing at: this works not just because the basal ganglia responds to rhythm, but because the entire motor system locks onto rhythmic input in ways that bypass the damaged pathway. The external rhythm becomes a parallel highway. The original road is out. The music builds a detour.

Oliver Sacks described this in his own experience. He tore a tendon in his leg during a hiking accident and found that his injured leg would not cooperate with his attempts to walk. The motor instructions were there. The execution wasn't. Then a piece of music came into his head, the Volga Boatmen's Song, specifically, and his leg began to move in time with it. He hummed it the rest of the way down the mountain. When he stopped humming, the leg stopped cooperating. When he hummed again, it moved again. He was using music as a prosthetic nervous system, in real time, on a mountain, before the clinical literature had a name for what he was doing.

He later used the same principle deliberately with a patient who had a paralyzed leg. She mentioned that her leg had sometimes moved on its own when she heard jigs. He played her Irish jigs. Her leg moved. She was not doing it consciously. The music was doing it for her, reaching the motor system through the auditory pathway and producing movement that the damaged direct pathway could no longer produce.

This is not music therapy in the soft sense of providing comfort and emotional support, which is also real and valuable. This is a clinical mechanism in which organized sound substitutes for a broken neurological function. Frequency as medicine, in the most direct possible sense.

Music has a way of arriving uninvited and doing exactly what a nervous system needs in the moment.

Starving in a very rural town somewhere in southern Illinois late one night on a work trip, I rush through a parking lot during a severe thunderstorm with hail, jacket over my head, into a Waffle House. It was warm and dry inside, a beacon of hope and shelter with no patrons and immediate service, and playing “Tonight She Comes” by The Cars. The frequency just showed up and did what it does: stabilize a nervous system that was losing its footing.

The thing itself, arriving uninvited, working on contact.

I want to be clear about what sits on which shelf. Rhythmic auditory stimulation for Parkinson’s is clinical, replicable, and currently in use in rehabilitation settings. Histotripsy is FDA-cleared and being tested for cancers that resist other approaches. The 40Hz gamma work is promising, well-designed, and early. These are not the same tier of evidence. Entrainment is a treatment. Histotripsy is a procedure. The 40Hz research is a hypothesis being tested with real equipment. Treating them as equivalent would be the kind of overclaiming this book is trying not to do.

The 40Hz research sits in a different category and deserves honest treatment. The finding is real. The application to humans is early and uncertain. What happened in the mice is extraordinary enough that it warrants taking seriously without overclaiming.

Li-Huei Tsai's lab at MIT found that exposing mice genetically engineered to develop Alzheimer's-like pathology to flickering light at 40Hz reduced amyloid plaques in the visual cortex. The 40Hz frequency corresponds to gamma oscillations, a brain wave frequency associated with attention, perception, and higher cognitive function. Alzheimer's brains show reduced gamma oscillation. The hypothesis was that inducing gamma oscillation artificially might restore some protective function.

The light worked. Then they tried sound. Forty Hz clicks and tones, administered for an hour a day, produced measurable reductions in amyloid throughout multiple brain regions, not just in the auditory cortex but in areas responsible for memory and cognition. The mechanism appeared to involve

microglia, the brain's immune cells, which became more active in clearing amyloid debris when gamma oscillation was induced. The sound was not destroying the plaques directly. It was activating the brain's own cleanup system by getting the neurons to oscillate at the right frequency.

Human trials began around 2019. Early results have shown that the 40Hz stimulation is safe, well-tolerated, and produces measurable changes in gamma oscillation in human brains. Whether those changes translate into meaningful clinical benefit is still being established. The field is moving carefully, which is the right way to move when the stakes are high and the mechanism is incompletely understood.

The part that stops me is not the clinical application. It is what it implies about frequency and biology. The brain’s immune system can be activated by sound. Not by a drug that mimics the signal. By the signal itself, delivered through the ear. The frequency does what the pharmaceutical equivalent would do, through a completely different delivery route. The idea that the ear is a legitimate input channel for therapeutic frequency is not fringe anymore. It is being tested in clinical trials at MIT and Stanford.

While the mice were getting their gamma oscillations tuned at MIT, something bigger was happening in the clinic that I did not find out about until later, and it stopped me cold.

Focused ultrasound can open the blood-brain barrier. Temporarily, precisely, and on purpose. The blood-brain barrier is the reason most drugs for brain diseases do not work very well: the barrier exists to keep things out of the brain, and it does not distinguish between a toxin and a treatment. Focused ultrasound, combined with microbubbles injected into the bloodstream, can loosen that barrier at a targeted location for a few hours and then let it close again. That alone would be a significant clinical tool. What happened next was the part nobody expected.

In a clinical trial published in the Journal of Neurosurgery in early 2025, a team in South Korea led by Jin Woo Chang opened the blood-brain barrier in six Alzheimer’s patients using focused ultrasound alone. No drugs. No antibodies. Just sound aimed at the brain with microbubbles to help the barrier open. Four of the six patients showed reduced amyloid plaque. Five of the six showed improvement in neuropsychiatric symptoms. The treatment volume was twice as large as any previous trial. Nobody got hurt.

I need to say that again because I had to read it three times. Sound, aimed at the brain, reduced the plaques that define Alzheimer’s disease. Without medication. The sample size is small. The findings are preliminary. The researchers are careful to say so. But the direction of the result is not ambiguous, and the next trial is already funded to go larger.

A separate trial at West Virginia University combined the ultrasound with aducanumab, one of the new Alzheimer’s antibodies, and found that amyloid clearance was greater in the brain regions where the barrier had been opened by

sound than in the regions where the drug arrived on its own. The sound made the drug work better. That result was published in the New England Journal of Medicine in 2024, which is not where fringe ideas go to get published.

Meanwhile, focused ultrasound for movement disorders has gone from experimental to standard care faster than almost anyone predicted. The FDA approved it for essential tremor in 2016 and for tremor-dominant Parkinson's in 2018. In 2021, the approval expanded to cover rigidity, slowness, and dyskinesia. In July 2025, bilateral treatment was approved, meaning both sides of the brain can now be treated in staged procedures. More than twenty-five thousand patients have been treated worldwide. No incision. No anesthesia. The patient is awake, inside an MRI, and the improvement is often visible before they leave the room. An Arkansas woman treated at Oregon Health and Science University in August 2025 walked out with dramatically reduced symptoms barely an hour after the procedure began. Sound waves, aimed through her skull, had ablated a tiny target in the brain region responsible for her movement symptoms. The seven years of tremor she walked in with did not walk out.

And then there is neuromodulation, which is the version that keeps me up at night. At lower intensities, focused ultrasound does not destroy tissue. It changes how the tissue behaves. Researchers at NewYork-Presbyterian are preparing trials using low-intensity focused ultrasound aimed at the brain regions responsible for addiction, reward, and craving. Other teams are testing it for depression, anxiety, and PTSD. The sound does not cut anything. It does not burn anything. It temporarily shifts the activity of the targeted neurons, and in early results, the patients report feeling different when they leave. A Nature Biotechnology piece in early 2025 called it a new wave of ultrasound-based technologies with the potential to treat conditions deep inside the brain without incisions.

I want to keep the shelves separate here. Histotripsy destroys tumors. That is proven and FDA-cleared. Focused ultrasound for Parkinson's tremor is proven and FDA-cleared. The Alzheimer's blood-brain barrier work is real but early and small. The neuromodulation for addiction and depression is still in trials. These are not the same tier of evidence and I am not treating them as the same. What they share is a direction, and the direction is unmistakable: sound aimed at biological tissue, with increasing precision, is doing things that five years ago would have sounded like science fiction and ten years ago would have gotten you laughed out of a grant meeting.

The clinical possibilities are real and the funding is finally starting to arrive, though not at the scale the evidence warrants. The question of what organized frequency can do for a damaged brain is not mysticism. It is an engineering problem that is just now getting adequately staffed, because the people with budgets are starting to take the premise seriously.

Not all of it is joyful. That needs to be said, because a book about what music does to people has to account for what it does when the doing is unwelcome.

Some sounds just wreck us. My mother cannot stand the sound of a loud trumpet, even an objectively excellent one. I have a physical reaction to a certain singer who was half of The Carpenters, and I know she was talented, and it doesn't matter. Excellence is not the point. How a sound lands in a particular body is the point, and that probably applies to more than music.

When we need to feel a certain way, humans tend to find something to escape into. But when we are standing graveside, when we are watching the worst scene in the movie, we don't escape. We turn toward music. We lean into it. If you have never been to a funeral in the American South and heard Go Rest High on That Mountain, then you have never stood in a room where every single person is crying and nobody is embarrassed about it. It is a staple. It is always gutting. And it always reminds you of someone specific. If you know, you know.

But music doesn't just play after people die. It can be played so repetitively, so loudly, or so deliberately that it makes people want to.

At Guantanamo Bay, Abu Ghraib, and Bagram, the U.S. military played music at detainees for days at a time. Not as background. As a weapon. Detainees were shackled in blacked-out rooms with Metallica or Drowning Pool or the Barney theme song blasting at volumes that made thinking impossible. The playlist was deliberate: heavy metal for aggression, children's music because the repetition is maddening, pop with sexual content to offend religious beliefs. An FBI memo noted one interrogator bragging he could break someone in four days with sixteen hours of music and four hours of silence. Binyam Mohamed, held for nearly seven years, said the music was worse than the beatings. He could hear other prisoners banging their heads against walls trying to make it stop.

The same thing that makes music heal is what makes it destroy. It gets past the part of you that reasons. It doesn't ask permission. And it doesn't leave marks, which is exactly why the military liked it.

Governments have understood this for as long as there have been governments. The Nazis didn't just censor music. They built an entire propaganda ministry around controlling what people heard, promoting Wagner not because he was the best composer but because his mythology fit the ideology. The Soviets did the same thing in reverse: composers were told what to write, and the ones who didn't comply lost their careers or worse. Shostakovich spent decades writing symphonies that had to be two things at once, art and political insurance, and everyone involved knew it.

You don't build a state apparatus to control entertainment. You don't torture someone with a hobby. The people who weaponize music are telling you exactly what it is. They just use that information for different purposes than the rest of us.

I am a musician. I have been making organized sound with my hands and my voice for most of my life, without a full understanding of what I was actually doing to the bodies in the room, including my own. I do not think I would have done

anything differently if I had known. But I think I would have done it with more respect.

# Chapter 18: Nature Freestyles

Consider the wind chime.

Nobody taught the wind anything. Nobody composed the sequence of notes that happen when a breeze sets the tubes of a wind chime moving. The intervals that emerge are not chosen. They happen because of the physics of the tubes, and what gets produced is organized sound that lands in the human ear as beautiful. The wind doesn’t know it’s playing music.

And we are sitting here listening.

Every time you hear a wind chime and think: that's nice, you are experiencing patterned sound being registered by a biological system well suited to detect and enjoy it. The chime didn't do anything special. You didn't do anything special. The physics between you did. Nature is freestyling, and you are built to hear it.

The refrigerator hums in something close to G. A fluorescent light oscillates at 60 Hz, which is a B-flat. Rain on a metal roof is in whatever key the rain is in. Most people pass through all of this the way they pass through wallpaper, processing the frequency without naming it.

And then there is Charlie Puth.

In the middle of an NPR interview in 2017, a construction crew was working next door. The reporter didn't notice the drill. Puth turned his head and said, mid-sentence: that drill is a B. Not approximately a B. Not somewhere in that neighborhood. B. The way you'd read a word off a page.

The reporter paused. There was a beat of silence that meant: I'm sorry, what? And Puth seemed genuinely puzzled by the pause. He has been this way since he was a child, and the world's consistent failure to hear what he hears has never entirely stopped surprising him.

What Puth has is called absolute pitch, also known as perfect pitch, and the science of it is stranger than the label suggests. It is not that he hears better. The auditory apparatus of an absolute pitch listener is physically identical to everyone else's. The ears are the same. What differs is what happens after the sound arrives, in the parts of the brain that process and categorize it.

Brain imaging shows that people with absolute pitch have unusually tight wiring between the auditory cortex and the dorsal frontal lobe, and the connection is live even when nothing is playing. The two regions are already talking before the sound arrives. So when a note comes in, it doesn’t get processed and then identified. It lands as an identity. Puth doesn’t figure out that a drill is a B. He just hears B, the same way you just see that a wall is white. No computation. The label is already there.

He described this himself to Jimmy Kimmel in terms that are almost exactly what the neuroscientists would use. It's like looking at your desk and knowing it is brown, or looking at a piece of paper and knowing it is white. You are not doing a calculation. The identity is just there.

The estimated rate varies by study but runs roughly one in every ten thousand people in Western populations. Some studies put it higher among musicians, some studies suggest it may be learnable under the right conditions in early childhood, but the working figure is: vanishingly rare. In the general population, the person who hears a construction drill and immediately knows it is a B is a biological outlier of a high order.

What makes this more interesting than a party trick is what Puth does with it every moment of his life without trying to. The morning dove outside his window sings a B-flat, and he knows it, and that means every morning dove he has ever heard has been singing the same note, and now that information is part of his relationship with morning doves in a way it cannot be for most people. His cell phone vibrated once on a table and he heard it as an A-flat. Pre-millennial airplane engines drone in F-sharp. A light switch click has a rhythm. A sigh from an exasperated executive in an adjacent room is a melodic fragment he recorded and used. The environment is not ambient to him. It is scored. He is living inside a piece of music that never stops playing.

He has also said that he hears the note before it finishes arriving. The pitch identity shows up before the sound is done being a sound. The imaging backs this up. The wiring between his auditory cortex and the labeling system is so tight that the answer starts forming before the question is finished. It is not prediction. It is recognition running ahead of the input.

The church story is the one I keep returning to because it demonstrates what this kind of hearing actually means in practice.

He was eleven years old. The Sunday organist at his church in New Jersey either got sick or, as Puth has said with great specificity, drank too much and was subsequently fired, which is the detail that makes the story feel true. Eleven-year-old Puth was called on to fill in. He had never rehearsed the mass. He had never been asked to play the mass. His feet couldn't reach the pedal boards. He played forty-five minutes of liturgical music from memory, all of it, because he had been sitting in those pews every Sunday hearing the same songs repeated, and his brain had filed every note at its exact pitch. He didn't learn the mass. He just remembered it, in a way that most people's memories cannot do, because the notes had arrived in him as identities rather than approximations, and identities stay.

Research by Jenny Saffran at the University of Wisconsin suggests that Puth's hearing is not an anomaly that arrived with him. It is, instead, a retention of something all humans are born with. Infants demonstrate absolute pitch in the first months of life. They recognize specific notes rather than intervals, they track the exact pitches of sounds in their environment, they operate the way Puth operates

now. And then, gradually, between roughly six months and the age of six or seven, the ability fades. The brain lets it go.

Why. Because it is, as Saffran put it, too fine a form of categorization for functional daily life. The world requires us to generalize. We need to know that this melody is the same melody in a different key, that this voice sounds angry regardless of what pitch it's operating in, that this word means the same thing whether spoken by a man or a child or someone with a cold. Absolute pitch, if retained into adulthood without the cognitive apparatus to work alongside it, would make generalization difficult. The brain trades exact pitch identity for relative pitch flexibility, and most people make that trade without knowing it happened.

Puth's brain kept both.

His brain kept the infant version and built the adult version on top of it. He hears the exact note and understands where it sits relative to every other note, at the same time. Most brains run one of those systems. His runs both. That is probably why the world is so loud for him. He said he grew up hearing everything at what felt like 200 percent volume. The sonic environment that most people treat as wallpaper is, for Puth, always in the foreground, always insisting.

The wind chimes are just the obvious version of this. The rest of us live in the same scored world Puth does. We simply lack the translation layer. The notes are there. The physics does not stop because our brains traded the ledger for the map. The morning dove is still singing B-flat. The fluorescent light is still humming B. The rain on the metal roof is still in whatever key the rain is in today.

We may be hearing it too. We just don't have his vocabulary for what it is.

# Chapter 19: Who Sings

Somewhere along the way, most people stopped singing.

Not because they lost the ability. The ability doesn't go anywhere. Human beings are built to sing in the same way they are built to walk. It is a natural function of the vocal apparatus in a body with functioning lungs and a larynx. The mechanism doesn't require training to operate. It requires training to operate well, but operating and operating well are different standards, and most of us gave up at operating when we should have kept going.

What happened, in almost every case I have ever heard described, is that someone told them they couldn't. Not always with words. Sometimes with a look. Sometimes with the quality of silence that followed a childhood attempt. Sometimes with a grade in a music class, or a seat assignment in a choir that put them in the back where the sound got absorbed before it reached anyone. Somewhere, a person who was made to make sound got the message that their sound was the wrong kind, and they accepted it, and they stopped.

This is, I think, one of the more reliable ways humans have found to diminish each other.

I hear voices differently than most people. This is partly the synesthesia, partly the musician's ear, partly something I can't fully account for. I hear tones and layers in a speaking voice that most people aren't consciously tracking. Resonance, overtone content, the particular quality of breath support, the ratio of chest register to head register. I hear these things the way a sommelier might smell a wine. Not always accurately, and not always consciously, but often enough that I have developed a habit that I will sometimes mention to people and they will look at me like I've said something either very strange or very nice.

I can usually tell whether someone can sing before they sing.

Not because of their speaking voice exactly, though that’s part of it. A speaking voice with good natural resonance and control, where the person isn’t doing anything to produce it, is a signal. Someone who speaks in pitch rather than monotone. Someone who hums absent-mindedly with actual melodic content, not just a neutral drone. Someone whose voice changes quality when they’re telling a story they care about, when the emotional stakes push the resonance into a different register. These are all telling you something.

When I hear those things I will sometimes ask people if they sing. Not whether they have training. Not whether they perform. Whether they sing. The answer is almost always no, delivered with some combination of embarrassment and self-deprecation. Can't carry a tune in a bucket. Tone deaf. I'll spare you. The usual arsenal of preemptive self-disqualification that people deploy when the subject comes up.

And I almost always push back, because I don't believe them. And I'm usually right not to.

The research on tone deafness is interesting in this context. True amusia, the clinical term for the inability to perceive or reproduce pitch, affects roughly 4 percent of the population. The self-reported rate of people who believe they can't sing, variously measured, is somewhere between 15 and 20 percent. The math points in a clear direction: the clinical inability to perceive pitch is far rarer than the cultural belief that one cannot sing. Not having amusia does not automatically mean intact singing ability, timing, or confidence. But it does mean the neurological barrier is probably not the issue. The barrier is more likely history, feedback, and a decision made at some early age to stop trying.

I should address the 4 percent directly, because it is a real challenge to the argument of this book. If music is an operating system and not entertainment, what do you do with the people whose hardware cannot run it? The honest answer is that the existence of amusia is evidence that pitch perception is a specific neurological capacity, built into the architecture, not evidence that the capacity is optional. Vision is biologically foundational and roughly 1 percent of the population is born without it. Amusia tells you the system is real enough to break. It does not tell you the system is decorative.

This is not a moral failure. It is a completely predictable response to how we're socialized around music. Children sing without thinking about it. Then they get older and singing in public becomes vulnerable in a way that most other childhood activities don't. Singing exposes the voice, which is intimate. It invites comparison and judgment in a way that, say, drawing or running doesn't, at least not at the same visceral level. A bad drawing is external to you. A bad singing voice sounds like it's coming from inside your body. The exposure feels personal in a way that makes the retreat to silence seem rational.

But here's what I believe, and what years of paying attention to voices has convinced me of: most people who tell me they can't sing have a voice that is built for something. Not necessarily for the concert stage. Not necessarily for anything public. But for something. A particular kind of sound that belongs specifically to them and that would be genuinely moving to hear if they would stop being terrified long enough to produce it.

Some of the most affecting voices I have ever heard in my life were not trained. They were unpracticed, unpolished, technically imperfect voices doing something that technical perfection often fails to do, which is transmit something real. There is a quality in an unguarded voice that no amount of training can manufacture. You either have it or you've been coached out of it. Sometimes the untrained voice is the more honest instrument.

This brings me, somewhat unexpectedly, to Metallica.

Metallica and Nine Inch Nails are not usually chapters in books about the spiritual dimensions of music. But the neuroscience of why certain brains respond

to heavy metal the way they do is genuinely interesting and also, frankly, describes my own experience as a musician with ADHD more accurately than I initially wanted to admit.

The basic finding: people with ADHD tend to prefer high-intensity, high-arousal music at rates higher than the general population. Some research suggests that people with higher ADHD symptom scores tend to prefer high-intensity music for concentration more often than peers, though the literature is limited and not all studies agree on the mechanism or the consistency of the preference. The qualitative picture is even more specific. People with ADHD describe using loud, aggressive music to relieve agitation, to create an intense focus state before demanding tasks, to regulate emotional states that are otherwise difficult to manage without pharmaceutical assistance.

One person describing their experience with ADHD and metal said it as plainly as anyone could: ADHD is like your brain is in constant motion, war, fast, full of information. Heavy metal gives me or allows me to go through these states better.

Their internal state has a certain quality. They find external sound that matches and channels that quality. The energy doesn't get suppressed. It gets organized. The music provides a structure for the intensity that the brain was already producing, and within that structure the intensity becomes functional rather than overwhelming.

This is not a feature exclusive to metal. This is how music as emotional regulation works generally. You find the music that meets you where you are and either moves you through it or gives you somewhere to put it. The specificity of metal for ADHD brains has to do with dopamine. ADHD involves chronically underactive dopaminergic signaling. The brain isn't producing enough of its own. Heavy metal, with its high tempo, dense sonic information, unpredictable rhythmic patterns, and emotional intensity, triggers dopamine release in a way that lower-intensity music often can't match in these brains. The music is essentially doing pharmacologically what the medication does chemically. It's hitting the same receptor sites, through a different delivery mechanism. The analogy has a limit: medication delivers a calibrated dose to a known target; music delivers an unpredictable dose to a system that is also processing emotion, memory, and sensory input simultaneously. The overlap is real. The precision is not the same.

Stimulant medication and Master of Puppets can be solving a similar dopaminergic problem in an ADHD brain. That is a functional analogy, not a pharmacological equivalence claim: the pathways overlap, the dosing does not. I’m not suggesting you replace your Adderall with Metallica. But both are raising the dopaminergic signal to a level where the executive function system can actually operate.

The gallop is the mechanism. Master of Puppets runs on a picking pattern that is two sixteenth notes followed by an eighth, repeating, the rhythmic equivalent of a horse at full sprint that has no intention of stopping. Down up down. Down up down. Down up down. A straight eighth note pattern would be steady and your

brain would tune it out in half a minute. The gallop will not let you tune it out. The uneven subdivision keeps the ear just off balance enough that you have to stay with it. You cannot zone out during a gallop. You are either on the horse or on the ground.

I feel it in my core. Not my chest, not my head. My center of gravity, the place where your body makes the decision between fight and sit still. The gallop grabs that spot and the decision is made for you. There is a horse race energy to it that I do not think is accidental. Hetfield and Ulrich built that song to be a machine, and the machine does not have a neutral gear. The tempo is fast, but the gallop is what makes it feel faster than it is. Three subdivisions per beat instead of two. Fifty percent more rhythmic information per second than a straight pattern at the same speed. My brain, which has spent my entire life starving for input and inventing its own when the world does not provide enough, locks onto that density the way a man lost in the desert locks onto water. It is not preference. It is relief.

Trent Reznor, who built Nine Inch Nails on the specific intersection of industrial precision and raw emotional expression, has described the NIN recording process as an attempt to create music that feels like internal states that don't have names. The fragmented rhythms, the sudden silences, the way the dense sound builds and then drops, these are not stylistic choices made to seem edgy. They are structural descriptions of how certain minds experience time and attention and emotion. People with ADHD who respond strongly to NIN are not responding to darkness or aggression for its own sake. They are hearing a precise description of the territory they live in, organized into something coherent and beautiful.

The connection between the metal ADHD research and the voice conversation is this: both are about finding the music that matches your internal frequency and using it to function better in the world. The person who discovers metal at fourteen and builds their concentration and emotional regulation around it is doing the same thing as the person who discovers they can actually sing and builds a relationship with their voice around that. They are both finding the specific sonic territory that their nervous system can use.

The difference is that one of those discoveries gets socially discouraged. Nobody told the metal fan at fourteen that their music was wrong. They got some eye rolls from parents, maybe some jokes, but the core activity of listening to loud music was not culturally policed in the same way that the act of singing in an imperfect voice is culturally policed.

There is another version of this silencing that is subtler and nearly as damaging. Taste policing. Telling someone the music they love is simple, or juvenile, or not real music. Writing this book changed something in me. Exposure matters, it shapes everything, but somewhere along the way I decided it is wrong to criticize other people’s taste. What they love is not a failure of discernment. It is a clue about who they are and where they came from, which is a different thing entirely.

The sorting happens early and it is efficient. Choir tryouts, school musical auditions, the talent show where a teacher decides who gets a microphone. These are the moments where people learn whether they are musicians or audience. Most of the ones sorted into audience never come back.

If you told someone at fourteen that they can’t run properly, most of them would shrug and find another sport. If you tell someone at fourteen that they can't sing, most of them stop singing for the rest of their lives. Something about the voice feels more intimate, more exposed, more essentially connected to who you are. The rejection of the voice feels like a rejection of the self in a way that the rejection of most other activities doesn't.

Which is exactly why encouraging someone to sing matters more than most people realize. It's not about whether they'll perform. It's not about whether they'll develop a skill. It's about whether they will keep access to the most direct form of music-making available to a human body. The voice is the original instrument. It predates every other instrument by hundreds of thousands of years. Every bone flute and every guitar and every synthesizer are approximations of something the human voice does natively. Telling someone they don’t have access to their own voice is telling them they don’t have access to the original equipment.

Nobody auditions in a stadium. Nobody asks permission. The crowd decides it is time and the sound begins, and if you have ever been in a supporters’ section at a soccer match you know exactly what I mean. Men and women, mostly men, finding songs to sing aloud. Some are profane heckles. Most are anthemic, aimed at a player or a team or a coach, built to be shouted rather than performed. Nobody cares how good you sing in those moments. They care that you are loud enough to make an impact, and they care that everyone is there to rally. The sorting machine is not running. The only requirement is participation.

On July 1, 2017, at Hyde Park in London, 65,000 people gathered for a Green Day concert. Before the band took the stage, the PA played Bohemian Rhapsody. Green Day has done this for years, playing Queen before their sets, and what happens next has become one of the most reliable demonstrations of what this chapter is about. The crowd sang. Not the chorus. Not the parts everyone knows. Every word, for six minutes, including the operatic section, including the tempo changes, including the falsetto. No band on stage. No leader. No lyrics on a screen. Just a recording of a song written in 1975 by a man who had been dead for twenty-six years, and 65,000 people who knew every note of it. Green Day watched on their stage cameras from backstage. Someone who uploaded the footage wrote: for almost six minutes, the equivalent of a small city sang, with one voice, the beautiful song of a man who has been dead for decades.

That is what participation sounds like when nobody is checking whether you deserve to be heard.

When I ask someone if they can sing and they say no and I say try anyway, I am not being naive about the hard skill. The hard skill is real. Learning to use a voice well takes time and attention. But the hard skill is downstream of the impulse. You

have to be willing to use it before you can develop it. And most people who tell me they can't carry a tune in a bucket, when they actually try, produce something that is imperfect and unmistakably human and genuinely moving to hear.

# Chapter 20: The High Lonesome

In 1972, on what she described as a good writing day, Dolly Parton wrote Jolene and I Will Always Love You.

The same day. Not a good day for one song. Both songs. On the same day.

Jolene is about a red-haired bank teller who was flirting with Parton's husband Carl Dean. I Will Always Love You is about Parton's decision to leave the Porter Wagoner Show and pursue a solo career, a farewell to the man who gave her a platform and from whom she was now separating in a way that was clearly emotional and complicated. Two entirely different emotional territories. Two entirely different musical personalities. Two songs that would each become iconic in their own right, and that would collectively demonstrate something about what was moving through Dolly Parton's creative system in 1972 that we can't fully explain and probably shouldn't try.

She said in the Bobby Bones interview where the story surfaced: everybody said what were you taking, that was a good writing day.

Which is funny and humble and also obscures something. The question of what she was taking assumes that the output required some external catalyst, some unusual enhancement to the process. But Dolly Parton has written over three thousand songs. She is one of the most prolific songwriters in the history of commercial music. The question isn't what was she taking on that particular day. The question is what she always had access to that most people don't, and whether a good writing day is meaningfully different from a regular one or just a regular day where she wrote two songs that became famous instead of twelve that didn't.

She also turned down Elvis.

When I Will Always Love You reached number one, Elvis Presley indicated he wanted to record it. Parton was interested until Colonel Tom Parker told her that standard procedure required the songwriter to sign over half the publishing rights to any song Elvis recorded. Parton refused. She recalls: I said I'm really sorry, and I cried all night. I mean it was like the worst thing. It was like, oh my God. It would have been Elvis.

She did not sign. She kept her publishing. Twenty years later, Whitney Houston recorded it for The Bodyguard and it became the best-selling single by a woman in American history.

The creative instinct and the business instinct in Dolly Parton are apparently running off the same server. She said it herself: it's not like I'm a genius or nothing. She was making fun of her own lyrics. Two enormous songs, delivered with the self-awareness of someone who understood they were both a little ridiculous, and also that ridiculous things can be great, and also that she was going to keep her publishing no matter what.

I found Sturgill Simpson because of Jos. A. Bank.

I was boarding a plane for a work trip, wearing a shirt I'd recently bought there, when a man came down the aisle toward business class in the same shirt. We clocked each other immediately. There was a nod, the universal acknowledgment between men who have made identical decisions about clothing, and then he sat next to me, and we talked for most of the flight.

He was a professor at Oregon State University. My work at the time was in the environmental field. The science conversation came naturally, and then I did what I always do when science is on the table, which is eventually veer it toward music, and he indulged me. We spent an hour on the Grateful Dead. Two strangers in identical shirts at altitude, talking about what Jerry Garcia was actually doing when he played, which is one of the better kinds of conversations available to human beings.

Just before we landed, he brought up distinct musical voices as proprietary instruments. The idea that certain singers carry something so specific in the physical instrument of their voice that the voice itself becomes the argument, regardless of what the songs are doing. And then he said: have you ever heard Sturgill Simpson?

I had not.

He said even though Simpson is a country artist, it wasn't what I'd expect. He thought I'd probably like his voice.

He was right. I found Metamodern Sounds in Country Music and put on Turtles All the Way Down. The song opens on a traditional country guitar figure. Steel guitar, the whole thing, nothing that would surprise anyone who grew up with the genre. And then Simpson starts pulling in elements that have no business being there: airy synth tones drifting over the steel, a chord structure that's simultaneously honky-tonk and something considerably stranger, lyrics that work in DMT and Carl Sagan and the Higgs boson particle while riding a groove that your grandfather would recognize. The collision shouldn't work. It absolutely works.

But the frisson arrived before any of that registered. It arrived with the voice. Before I'd processed a single lyric, before the synth came in, before I had any context for who this person was or what he was trying to do, the voice hit something that said: pay attention. Some voices carry a frequency that finds you before your opinion forms. Sturgill Simpson's is one of those.

I was grateful for that encounter. Somewhere there is a professor at Oregon State who doesn't know that a conversation at altitude sent me down a path I haven't left.

Sturgill Simpson said something about this in an interview that I've been turning over since I heard it.

Sturgill Simpson said in an interview that as far as what you write about, that's kind of up to the wind.

He was explaining his songwriting process, or rather explaining that he doesn't have a process in the usual sense, that what comes out is country and he didn't choose that either, that there are larger forces operating and his job is to be available to them. That description fits the pattern this book has been tracing: musicians across genres using the same language of availability and reception, said in a Kentucky drawl by a man who also once said he looked up at a navy recruiter, thought she was attractive, and signed up on the spot.

Sturgill Simpson is from eastern Kentucky. He worked for Union Pacific Railroad before music. His grandmother played in the family's living room every Saturday night, and he rebelled as a teenager and got busted for selling drugs and joined the navy after walking past an enlistment center and making an impulsive decision. Then he made Metamodern Sounds in Country Music, which opened with a song called Turtles All the Way Down that referenced DMT, Carl Sagan, Stephen Hawking, and the Higgs boson particle while riding a traditional honky-tonk guitar lick, and which Garden and Gun magazine described as a social consciousness concept album disguised as a country record.

This is not a man who arrived at his artistic vision through a conventional path. This is a man who absorbed the Appalachian tradition at the cellular level, ran it through a decade of reading physics and philosophy and religious texts and Terence McKenna, cut the record in four days with a four-thousand-dollar budget, and produced something that people who love country music and people who had never cared about country music responded to with roughly equal intensity.

He also said: I saw Dolly Parton play at Glastonbury to about 120,000 people. I was a mile away from the stage and I swear to God I could feel her energy.

And there’s that word again.

In March 2026, Simpson released an album called Mutiny After Midnight under the name Johnny Blue Skies. It debuted at No. 3 on the Billboard 200. It moved 59,000 copies in its first week, entirely physical units. No streaming push. No playlist placement. No algorithmic boost. It was his best debut week ever, under any name, and one of the strongest physical-only chart performances in the streaming era. The wind told him what to write and 59,000 people drove to a store and bought it with their hands.

Chris Stapleton grew up in eastern Kentucky singing in churches. He spent fifteen years writing hit songs for other people before anyone knew his name. He tried to sound like Vince Gill for a long time before figuring out he couldn't, which meant that what came out was just him. He said: then you figure out that you have your own voice, whether you like it or not, and that's what you should stick with.

Whether you like it or not. Not whether it's what you planned for. Not whether it fits a format. Whether you like it or not, this is what your voice does, and the

only option that doesn't involve a slow grinding loss of something important is to commit to it.

His voice is a geological event. I don't know how else to describe it. It sounds like something formed over a long time under pressure, like it came out of the same mountains that produced the culture that produced him. When Stapleton sings Tennessee Whiskey, which is not a song he wrote but which has become definitively his in the way that certain songs become the property of whoever sings them most honestly, you are not listening to a performance. You are listening to a frequency. His voice has a specific quality that you can feel as much as hear, a resonance that seems to come from somewhere deeper than breath.

He spent years not knowing this was unusual. My parents always told me I was special, like any good parent would. I always sang, and I think at some point people only regard it as special when you start to have some kind of notoriety with it. Otherwise you're a dude that sings.

For fifteen years he was a dude that sings. Then one night at the CMAs in 2015 he performed with Justin Timberlake and people understood that they had been missing something, that something had been available and they hadn't been pointed at it yet. It's not that Stapleton changed. He was always that. The audience just finally got the information.

I did not grow up with it. I'm from Arkansas, which is adjacent to Appalachian culture but not inside it, and my early musical formation was the station wagon, the Moody Blues, the drum kit, the Strat, the things I've already told you about. I came to the Appalachian fiddle from outside, following a thread from bluegrass that led me somewhere I hadn't expected to end up.

And when I got there, something happened that I didn't have a framework for.

The Appalachian fiddle does something to me that I cannot fully account for by reference to anything in my personal history. It is not nostalgia. I have no memories attached to it. It is not cultural familiarity. I had no exposure to it growing up. It is something that feels more like recognition than memory, a response to something that seems to be operating at a frequency older than my own experience.

I have since learned some of the history and it's helped me understand what I'm responding to, even if it hasn't explained why.

The Appalachian fiddle tradition is a convergence. It descends primarily from Scottish and Irish immigrant traditions, specifically from a technique developed by an 18th-century Scottish fiddler named Niel Gow, whose powerful rhythmic short bow technique became the foundation of Appalachian mountain fiddling. But it also absorbed Cherokee and Melungeon influences, descending scales and modal qualities that have no European equivalent. And African American musical traditions, including syncopated rhythms and a call-and-response approach that changed how the music breathes. The result is something that doesn't belong to any single culture because it was built from the convergence of several, in isolated

mountains, over several centuries, into something that sounds like nowhere else on earth.

What I'm responding to when I hear it is not a genre. It is the sound of cultural convergence under pressure, of multiple traditions that didn't plan to meet finding a shared frequency in difficult terrain. The music carries all of it. You can hear the Scottish drone in the double stops. You can hear the African syncopation in the rhythmic drive. You can hear the modal quality, that particular relationship between the notes that makes it sound older than any of its component parts. The fiddle is doing what the best American music does, which is become something new from something old, without losing either.

The reason it produces a response in me that feels primitive is because it is primitive. Not in the pejorative sense. In the literal sense. It is reaching into something old. The modal scales it uses predate the Western tonal system. The ornaments and slides are related to vocal techniques that go back further than any instrument. The drone relationship between strings is a cousin of the drone traditions in music from cultures across the planet that never met each other. When the Appalachian fiddle makes the hair stand up on my neck, it's because something in my nervous system is recognizing a pattern that the nervous system has been recognizing, in various forms, for much longer than I have been alive.

I'm not from the mountains. I'm from the Arkansas Ozarks, which are not the same thing, though they're adjacent in the way that cousins are adjacent. Close enough that when I hear the Appalachian fiddle something in me leans toward it without my permission.

Dolly Parton in a Tennessee kitchen in 1972. Sturgill Simpson with a guitar and the wind making the decision. Stapleton discovering his voice was his whether he liked it or not. Me on the side of a road in the Ozarks with the fiddle coming through the radio. None of these are stories about a person producing something. They are stories about a person receiving something and figuring out what to do with it.

The music is not the musician’s alone. The voice is not the singer’s alone. The tradition does not belong to any single culture that carried it. These things feel like they belong to something older than any of the people who found them.

The high lonesome is what you hear when someone sings from a place they cannot fully explain and does not try to. It feels older than the genre. It will probably outlast it.

# Chapter 21: Talent as Torment

The cases in the chapter that follows (Cicoria, Ravel, the hallucination patients, the Williams syndrome children) all describe music arriving in people who couldn’t stop it. This chapter asks what happens to the people who were built to receive it at full volume, all the time, without a door.

People want it to be one of two stories.

The first story is the blessing. Extraordinary gift arrives, life becomes music, music becomes legacy. The suffering, in this version, is incidental. The price of admission to a world most people never enter. The torment is romantic, the talent is the point, and the cost is a footnote in an otherwise triumphant biography.

The second story is the curse. Normal person, unusual ability, world gets hold of them, the pressure of expectation and fame and the gap between what they can hear and what they can make breaks something that was already fragile. The gift becomes the instrument of destruction. The talent is the tragedy.

Both stories are wrong. Not because they get the facts wrong, but because they assume a before, some neutral baseline that existed before the music arrived, some version of the person intact and whole that the talent then either elevated or destroyed.

There wasn’t a before. That is how I read these lives, anyway.

Brian Wilson didn't have a mental illness and also have the ability to hear complete orchestral arrangements in his head. Those may not be two separate conditions that happened to occur in the same person. They may have arisen from the same underlying sensitivity. The same nervous system that couldn't tolerate the noise of the touring bus was the nervous system that could hold ninety hours of recorded fragments in working memory and assemble them, across seventeen sessions and four studios, into something that still sounds like it arrived from elsewhere. I am not a clinician and I cannot prove this. The honest counterargument is that co-occurrence is not causation: two conditions can live in the same nervous system without sharing a root. But the pattern, once you see it, is hard to unsee.

Syd Barrett didn't have a gift for whimsy and strangeness and an unfortunate susceptibility to LSD-induced psychosis. He had a mind that experienced the boundary between self and world as thinner than most people experience it, and that permeability is what made the music sound the way it sounded, and it is also what made him unable to hold himself together when the pressure and the chemicals hit the same place from too many directions at once. The gift was the vulnerability. The vulnerability was the gift.

Townes Van Zandt didn't love music and happen to be an alcoholic. The same capacity for feeling that made him the most precise chronicler of loneliness and love in the American canon was the capacity that made ordinary experience

unbearable to stay inside without assistance. The gap between how deeply he felt things and how they actually were had no bottom. He said he designed his life to run out before his work did. That's not resignation. That's a man who understood the terms of his own situation with a clarity most people never achieve about their own.

The framing of blessing or curse assumes you can take the talent and leave the rest. You can't. The channel is the whole thing. The openness that lets the music in is structural. It's not a feature you can upgrade while keeping everything else the same. It runs all the way through.

What changes between the ones who survive and the ones who don't isn't the presence or absence of the gift. It's the presence or absence of something that functions like a door. A mechanism, internal or external, chemical or circumstantial or relational, that lets you close the channel when you need to. Richards had it. McCartney had it. Sting had it. Not because their gifts were smaller, but because something in the architecture of their lives, or their nervous systems, or their particular relationship to whatever they were receiving, allowed them to step back from the threshold. To do the work and then go home.

Wilson didn't have that. Barrett didn't have that. Nick Drake didn't have that. And the music they made has a quality that is directly related to that absence. It sounds like it came from further in, because it did, because there was nothing stopping it from going all the way in, and the only way out was through.

Some people find it. The ones who do don’t have less of the gift. They have something else running alongside it: a structure, a practice, a life that can contain the channel without being consumed by it.

Bruce Springsteen has been clinically depressed for most of his adult life. He has written about this with the same directness he brings to everything else: the paralysis, the months when the music wouldn’t come, the years when it came but felt hollow. He has been in therapy for decades. He credits his therapist, his wife, his band, and a rigorous daily discipline for the fact that he is still here and still working. The opening is wide. Darkness at the Edge of Town, Nebraska, The River. These are not the work of someone with a manageable relationship to feeling. But he built a scaffolding around the opening, and he has been maintaining that scaffolding for fifty years. That is not a smaller gift. That is a different kind of survival.

Dolly Parton wrote Jolene and I Will Always Love You on the same day. Same day. She tells this story like it’s a funny thing that happened, which I appreciate, but if you actually sit with it for a second that is not a funny thing. That is the gift at full volume. Two complete songs in one afternoon from wherever songs come from. She was twenty-seven and she just had that day.

What she did with it afterward is what I keep thinking about. She built a business. She built a persona, the whole thing, the wigs, the outfits, the jokes about herself, and she has said pretty directly that she knows exactly what she’s

doing with it. She decided early that she was going to be in charge of the gift rather than the gift being in charge of her. Wilson didn’t make that decision. Barrett couldn’t. Van Zandt, I don’t think he wanted to.

She’s seventy-eight. Still writing. Turned down the Presidential Medal of Freedom twice because she said she hadn’t done anything to deserve it yet. That’s a person who still has a relationship with the thing rather than being owned by it.

The difference between the casualties and the survivors is not talent. It is not even luck, though luck plays a role. It is the presence of something outside the music that the music cannot touch, something the person maintains as separate, as theirs, as the thing they come back to when the channel closes. Family sometimes. Discipline sometimes. Therapy sometimes. A persona, carefully constructed and deliberately maintained.

The music needs a vessel. The vessel needs maintenance. That’s the part nobody talks about.

I want to be clear: I’m not romanticizing this, and I am not arguing the cost was worth it, or that suffering produces better art, or that we should be grateful for their pain because of what it gave us. I don’t think any of that is true and I think it’s a way of making ourselves comfortable with something that was, in individual human terms, a catastrophe.

What I am saying is that the question itself is the wrong question. Was the blessing a curse, or was it always a curse that became a blessing. There was no blessing and no curse. There was a condition. A specific configuration of a nervous system that received certain signals at a volume and with a fidelity that most people don't. Some of those people found a way to live inside that condition. Some of them couldn't. All of them made something with it that the rest of us needed, without quite knowing what we were receiving or what it cost to send.

The music got out. They gave it a way out, which is exactly what they were built to do, and some of them paid for it with everything else.

# Chapter 22: A Bolt from the Blue

Oliver Sacks spent fifty years in neurology watching the brain do things nobody had asked it to do. He had a gift for making the strange feel inevitable, and an even rarer one: he never tried to explain away the things that resisted explanation. He documented them. He sat with them. And then he wrote about them in language that made you feel like a fellow traveler in something genuinely mysterious rather than a student being corrected.

His book Musicophilia is where Sacks turned his full attention to music, and it is a book I read before this one existed, before I had words for what I was trying to say. What he documented, case by case, is a thing that should not be possible by any framework we have for how human beings work. And yet it kept happening, in his patients and in the documented literature, with a consistency that is either evidence of something profound or the most elaborate coincidence in medical history.

Music arrives in people who have no business receiving it.

* * *

Tony Cicoria was forty-two years old in 1994. Orthopedic surgeon. Former college football player. Rock and roll guy. He was at a family gathering at a lakeside pavilion in upstate New York when he walked to a pay phone to call his mother. He still remembers every second of what happened next.

A bolt of lightning came out of the phone and hit him in the face.

He was found by a nurse who happened to be standing behind him, waiting to use the phone. She performed CPR. He was technically dead for some portion of the interval between the strike and her intervention. He later described what happened in that interval: he was floating above his own body, watching the nurse work on him from about eight feet up, then flying upward through a sequence of images from his life, peaceful, bright, moving. He said he did not want to come back. He came back anyway, because bodies have pain and whatever he was in up there did not, and the pain announced his return before he could choose otherwise.

He recovered. He went back to work. A few weeks later, two or three days over which the craving arrived and intensified, Tony Cicoria developed an insatiable desire to listen to piano music.

Not rock and roll. Piano. Classical piano, specifically Chopin, which he had no previous relationship with whatsoever. He bought recordings. He listened constantly. Then he wanted to play. A babysitter called that week asking if she could store her upright piano at his house, and he said yes, and the piano arrived, and he began teaching himself. He got up at four in the morning to practice before work. He worked twelve-hour surgical days. He came home, spent an hour with his kids, went back to the piano until midnight when he literally could not see the keys. He started dreaming in music. He dreamed himself in a concert hall playing his own composition and woke up reaching for a way to write down what he had heard. He barely knew notation. He learned.

Sacks eventually asked Cicoria if he would be willing to undergo neurological testing to find the precise cause of this transformation. Cicoria thought about it, and then said he would rather not. His was a lucky strike, he said. The music, however it had come, was a blessing. Not to be questioned.

Sacks, to his enormous credit, left it there.

The neurological exams found nothing. EEG normal. MRI normal. No structural damage that would explain a near-death experience or a sudden obsession with Chopin in a man who had never cared about classical music. Sacks speculated, carefully, that the rewiring that accompanies a near-death cardiac event may have unlocked something that was already there. A dormant capacity. The lightning didn’t add anything. It opened a door that had been shut.

The question that follows from this, and that Sacks does not try to answer because answering it would require him to leave neurology and enter philosophy, is where the music came from. The music that Cicoria described arriving in his head was original. Not music he had heard. Not music that could be traced to a prior exposure. His own composition, arriving fully formed in dreams and then replaying insistently whenever he sat at the piano. He described it as a frequency. A radio band. If I open myself up, it comes.

Cicoria's description is word for word what professional composers describe when they talk about the experience of receiving music rather than constructing it, the same language of something arriving from outside rather than being assembled from within. Cicoria hadn't spent a lifetime in music. He had spent one afternoon being electrocuted. And the result was the same: a channel opened. Something came through.

His marriage didn't survive. The obsession was too consuming, too totalizing, too much a reorganization of his priorities. The music became the center and everything else adjusted around it. This is also a thing musicians recognize. The channel doesn't ask what it will cost. It opens and you deal with the consequences.

Sacks documented other cases that belong in this company, and I want to bring them here because they deserve more than a footnote.

Maurice Ravel spent the last decade of his life losing the ability to compose. Not the ability to hear music: he could sit in the audience at a performance of Boléro and know every measure, feel the shape of each phrase, know exactly what it wanted to do next. What he was losing was the connection between what he heard internally and the page. The music was still there. The door out was closing.

His letters from those years describe the experience with a precision that is painful to read: he could feel the form of a phrase, know what it wanted to be, and find himself unable to make his hands produce it. He had not lost his taste or his judgment. He had lost his tools. A sculptor going blind who can still feel the form in the stone but can no longer see to cut it.

By the time surgeons operated in 1937, hoping to relieve pressure on the brain, it was too late. He died two weeks later without having written anything new in years. His last unfinished work remained on the desk.

What Ravel lost is exactly specific enough to tell you what music is. He did not lose the capacity to appreciate. He did not lose the capacity to feel. He lost the

capacity to transmit. What lightning opened in Tony Cicoria, disease closed in Ravel, one door at a time, until the last one.

There is a class of patient Sacks described who develop musical hallucinations following hearing loss. The brain, deprived of auditory input, begins generating it. What these patients hear is not noise or static. They hear music, specific and detailed, often music from their past, hymns they learned as children, songs from the radio of their youth, melodies that play with the fidelity and completeness of a recording. They did not choose to hear it. They cannot stop it. The music plays whether they want it to or not, whether they are trying to sleep or having a conversation, whether the song is one they love or one they would prefer to never hear again.

Sacks was careful to distinguish these hallucinations from earworms, which are the milder, near-universal phenomenon of a song playing involuntarily in the mind for a few hours. Ninety-eight percent of people experience earworms. The hallucinations he described were different in kind, not degree: continuous, involuntary, often distressing, and operating at full perceptual intensity, not as a remembered tune but as a live performance apparently occurring in the room.

The hallucination patients didn't want this. Some found it maddening. But what it reveals is something the brain clearly believes: music is the default content. When the input pipeline goes dark, the brain doesn't generate silence. It generates music. It falls back on the patterns it has spent a lifetime absorbing and replays them. The brain, left to its own devices, chooses music. That is what it reaches for when there is nothing else to reach for.

I find this almost unbearably interesting.

The Williams syndrome cases are different in character and deserve their own moment.

They are also, almost uniformly, deeply and genuinely musical.

People with Williams syndrome respond to music with a force that researchers call hypermusicality, which is a clinical word for something that looks, from the outside, like being completely consumed by it. Their brains recruit regions for music processing that most brains barely use, including deep structures in the cerebellum and brainstem. Their IQs may sit below 60 on a standardized test. Their musical sensitivity is above almost anyone you could find on the street.

Sacks sat with a group of children with Williams syndrome listening to music and described a quality of attention he had never seen elsewhere: total, unguarded, full-body, the kind of presence that most adults bring to nothing. The music arrived in them and they were entirely in it. No part of them was somewhere else. They had not been taught to listen this way. They just did.

Williams syndrome kids hear music the way most of us hear our own name. It is just there, immediate, total. The music capacity survived intact, and in some readings was amplified, precisely because the genetic deletion changed the

architecture in ways that left the musical systems not just standing but unobstructed. If music were entertainment, this would be a footnote. If music is something the brain is built to receive, this is some of the strongest evidence we have.

When I read Musicophilia the first time I had been playing music my whole life and thought I understood what it was. Sacks reorganized something. Not the facts I knew, but the category. He was working in neurology. He was asking what happens to the brain when music enters it, or when music exits it, or when the machinery that handles music breaks down. But what the cases in that book collectively demonstrate goes past neurology. They are evidence of a relationship between human beings and organized sound that is deeper and stranger and more fundamental than the word entertainment can possibly contain.

Cicoria didn't want music. It arrived anyway. Ravel couldn't release his. The hallucination patients didn't choose theirs. The Williams syndrome children didn't learn to love it. In every case, the music was there before anyone asked for it and stayed after the choice was taken away.

He said it himself, at the end of Musicophilia: music is part of being human. Present from birth, available at the end when almost nothing else is, present in the damaged brain, present in the body hit by lightning that woke up reaching for a piano.

* * *

Sacks is gone now. He died in 2015. He wrote in his last weeks about what music had meant to him over a life spent in medicine, about the Schubert that interrupted his grief after his mother died and reached something that nothing else had reached. He was not a sentimental man. He was a scientist. The music got through anyway.

It almost always does.

# Chapter 23: The Architecture of a Hit

Here is the least romantic but most honest thing I can tell you about why your favorite songs are structured the way they are: your brain is running a prediction program, and good songwriters have been hacking it for a hundred years.

The verse-chorus-verse structure that dominates popular music in virtually every culture and era is not a convention that got handed down and stuck around through inertia. It works for a specific reason: the verse and chorus do opposite things, and the brain needs both of those things, in alternation, to stay engaged. The verse gives you information and variation. The chorus gives you repetition and resolution. The brain craves both and gets neither for long enough to get bored. That cycling, alternating between novelty and return, is what the brain calls enjoyable.

Professor Elizabeth Margulis at the University of Arkansas did an experiment that still strikes me as one of the more elegant in music psychology. She took recordings by composers who had explicitly avoided repetition, Luciano Berio and Elliott Carter, modernists who believed that structural repetition was artistically lazy. Then she spliced and looped sections of those recordings artificially, creating repetition that was never in the original scores. When she played both versions for listeners, including professional musicians in the Society for Music Theory, they preferred the spliced versions. The artificial repetition was preferred even by people who knew these composers and admired them for avoiding it. When asked why, participants described the looped versions as more human-sounding, more like music intentionally composed, less like something generated randomly.

Margulis's conclusion was precise: repetition is what signals humanness to the brain. We have apparently been listening to organized sound for long enough that repetition has become one of the brain's signatures for intentional musical structure. Music without repetition reads to us as accidental. Music with it reads as made. The brain finds the hand of a composer in the repetition and responds to it.

Which means the verse-chorus structure is not a convention. It is the brain's preferred delivery format for organized sound, discovered empirically over thousands of years of humans playing music for each other and noticing what made people stay and what made them wander off.

The earworm is where this gets personal.

Ninety-eight percent of people experience them. Which means essentially everyone you've ever met has had a song stuck in their head for no reason they could account for, cycling on a loop, immune to their attempts to dislodge it. Sacks called the earworm a special form of involuntary musical imagery that is out of control and can become quite unpleasant and intrusive. He is not wrong, but he is describing the worst-case version. Most earworms are mildly annoying at most,

and a significant portion are songs the person actually likes, cycling because the brain has decided it is not finished with that particular piece of information.

The neurological picture is this: music is organized in memory not as a continuous file but as a series of interconnected segments, pockets linked together by familiarity. When you hear part of a familiar song, the brain activates the next pocket automatically, the same way a word can trigger the next word in a phrase you've repeated often. Earworms happen when the brain activates one of these pockets, usually during low-engagement activity like walking or doing dishes, and then can't close the loop. The part of the brain that tracks how many times a chorus should repeat before moving on is offline. The part that likes the chorus keeps playing it. They're not communicating.

The chorus, specifically, is the most common earworm culprit. Not the verse, which carries different information each time. The chorus, which stays the same, which the brain has heard in the same form repeatedly, which sits in the deepest groove in the familiarity network. Choosing a chorus as the earworm prey is the brain choosing the most-worn path, the most-repeated segment, the one it knows best.

Earworms are a feature of musical memory, not a malfunction of it. They are the brain demonstrating that it has encoded a piece of music so thoroughly that it can reproduce it involuntarily. They are the brain confirming receipt.

The songs you've had stuck in your head the most are the songs you've absorbed most completely. Your brain isn't tormenting you with Call Me Maybe or Mr. Brightside or Baby Shark. Your brain is showing you what it has fully internalized. The earworm is the memory waving at you.

I have opinions about Baby Shark that I will keep to myself. But the argument holds.

Why do some songs hit and others don't? The honest answer involves two factors that are easy to underestimate: repetition and timing, in roughly equal measure, and they interact.

A study covering over 2,400 Billboard hits across fifty years found that the single most reliable predictor of a song's commercial success was repetition. Not chord complexity. Not lyrical depth. Not production quality. Repetition. Songs with more repetition, particularly chorus repetition, outperformed songs with less across genre and decade, controlling for other variables. The researcher's summary: repetition in music is better.

Timing is trickier. A song arrives into your brain during a specific moment in your life, and if that moment has emotional weight, the song gets encoded with it. The song is not just itself anymore. It is itself plus what you were feeling when it found you, plus where you were, plus who you were becoming. Two people can hear the same song and have completely different relationships to it, not because they heard different music but because they heard it in different lives. And both

relationships are real, both are inside the music as they experience it, neither is wrong. The song is flexible enough to hold all of them simultaneously.

This is what radio programmers and streaming algorithms are doing when they flood your ears with a song: they are trying to be present at enough of your moments that one of them sticks. Most of the songs that get played the most don't stick. You hear them, you recognize them, you move on. But occasionally the rotation engineers a coincidence, and a song that was just ambient noise becomes the soundtrack to something real. The industry doesn't know which songs will do this, which is why they flood the zone. They are buying lottery tickets at massive scale.

The songs that stick without flooding, the ones that find you once and become permanent fixtures, those aren't accidents of programming. Those are songs that were already alive before they arrived in you, already carrying enough of the right pattern to complete a circuit. What makes a song that kind of live is harder to quantify, and I've been a musician long enough to know that the people who claim to know the formula are either lying or writing hits for Max Martin, who is a genuine genius and who wrote twenty-two number ones in a row using a formula that he has never fully disclosed and probably shouldn't.

But the honest songwriter's description of it is closer to Mayer's guest from another world than to a production checklist. The songs that really find people feel discovered, not built. They feel like they were always there. The composer's skill is in the finding, not the fabricating. And the structural architecture, the verse that creates tension, the chorus that releases it, the bridge that disrupts just long enough to make the final chorus land harder, is in service of something that the structure itself did not create. The structure is the delivery mechanism. The song is the payload.

* * *

Sufjan Stevens is one of the clearest examples in modern songwriting of what this book has been arguing.

His album Carrie and Lowell, released in 2014, is a grief record about his mother. She left the family when he was young. She struggled with addiction. She died. He wrote about it with a specificity that most songwriters avoid.

“Chicago” is a song that could have been a bit of a hit for him if he didn’t tell such a long story. The first time I heard it was a full sensory event, colors arriving faster than I could sort them. The song feels like some sort of machine where every instrument is a moving part with its own job and its own timing, and when they all lock together the thing just goes. You came to take us, all things go. To recreate us, all things grow. We had our minds set, all things know. You had to find it, all things go. The song is about a road trip, about leaving and arriving, about the inevitability of forward motion. Everything passes. The music keeps going anyway.

Stevens isn't grieving and he isn't celebrating. He's making peace with the fact that nothing stays, and he finds that peace exhilarating rather than devastating. The music matches: it builds and builds and builds and never quite stops building, like the song itself refuses to accept that it has to end.

"Casimir Pulaski Day" felt simultaneously hollow and urgent. Hollow because there wasn't much to it instrumentally, just a tasty melody and a soft voice telling a story about a friend who ended up with bone cancer and died. The song walks you through the visits, the praying, the laying on of hands, the family gathered around believing that faith would be enough. And then it wasn't enough. She died anyway.

What the song never resolves is whether Sufjan is angry at God or still talking to God. The language could go either way. He describes the rituals of faith being performed sincerely and failing. That is either an indictment or the deepest kind of prayer there is, the kind that keeps going after the answer was no. One reading: he is furious at God but knows he cannot stay furious, because the same force that failed his friend is the force that rescued him from his own mother. You don't get to stay angry at the thing that rescued you, even when it takes something else away. That tension is in every note of the song, and he never resolves it, because it can't be resolved.

The energy lift at the end is the thing I keep coming back to. As the story implies ascension, so does the music in close alignment. The arrangement opens up, the instruments breathe, the sound rises. Whether that lift is hope or irony, whether the beauty of the arrangement is an act of worship or a record of what worship failed to do, I genuinely cannot tell you. I hear it differently depending on when I listen.

He does this on "Wallowa Lake Monster" too. The song is from The Greatest Gift, a collection of outtakes from the Carrie and Lowell sessions, and it is about his mother. Carrie left them in Detroit. She struggled with addiction. The song parallels her story with the myth of a creature in the deep of Wallowa Lake in Oregon, hiding her children, lurking beneath the surface the way family secrets do. When Stevens sings "when the dragon submerged we knew she had died," an ethereal chorus arrives. It sounds like something ascending. A character, an idea, a demon the character was possessed by, lifting out of the song and out of the story. The music does what the words describe. The sound becomes the event.

"Should Have Known Better" is the one where he decides to stay.

It is from the same album as "Wallowa Lake Monster," the same grief, the same mother. But this song does something the others do not. It starts in the black shroud and walks out of it.

*When I was three, three maybe four, she left us at that video store.* That line puts you inside the "us" and suddenly you are seeing the trouble through a child's lens. You are not observing Sufjan's grief. You are standing in it at his height, at three or four years old, watching your mother leave through the glass door of a

video store. The song conjures my inner empath in a way that is almost involuntary. It is deeply, specifically sad.

Until it is not.

Halfway through, there is a key change and an uplifting syncopated synth line that starts to sound curiously optimistic. The harmony, which had been unstable the entire song, finally finds its footing. *I should have known better.* Nothing can be changed. The past is still the past. The bridge to nowhere.

This is Sufjan's technique, and I think it is the clearest example in modern songwriting of what this book has been arguing. When the story needs to go somewhere the words can't take it, the music carries it the rest of the way. The sound meets the moment. The arrangement doesn't illustrate the emotion. It becomes the emotion. That is not decoration. That is music doing work that language cannot do alone.

Why do commercials sing their taglines? Same reason. A jingle is a virus. It's a tiny piece of music attached to a piece of information, engineered to use the brain's musical memory system to store commercial content. The brain will happily remember I'm Lovin' It or ba da ba ba baaaa for decades, delivering it on demand whenever the stimulus appears, because the brain's musical memory system is more durable and more accessible than the system we use for ordinary facts. McDonald's has known this since 2003. The brain has known it far longer.

## Chapter 24: The Door

Music knows about death before you do.

Not in a mystical sense. In the specific neurological sense that when a song arrives in your body and the body responds before the opinion forms, the response includes everything the song has ever been in you. Every person you heard it with. Every room it occupied. Every version of yourself that was present when the signal came through. You do not choose what the song carries. The song decides what it carries, and you find out when it plays.

I have heard songs I loved turn into something else entirely the moment someone I loved stopped existing. The song did not change. The container changed. And the container now held something different from what it held before, without warning, without permission, the way a room you've always felt comfortable in becomes unbearable after something happens in it. You can repaint the room. The room knows.

This is one of the things music does that nothing else does. It holds the people who aren't here anymore.

Not as a metaphor. As something closer to mechanism than metaphor. The neural encoding of a piece of music is not separable from the emotional context in which the encoding happened. If you heard a song with someone often enough, the song and the person are stored together in the same network. The song activates the person. The person arrives in the song. You are not remembering them. You are experiencing something that functions, neurologically, like their presence. Music can make memory feel uncannily present because it reactivates autobiographical and emotional networks with unusual force.

This is why people choose music for funerals with the same care they choose words for eulogies, usually more care, because they understand at some level that the music will do something the words cannot. The words describe the loss. The music can feel as though it contains the person. At a funeral, when the song starts, something happens in the room that was not there a moment before. The people who knew the person recognize something. Not just the song. The specific quality of what that person was, arriving through the speaker, audible in a way they cannot explain.

The explanation, to the extent there is one, is this: music is one of the brain’s deepest encoding systems for storing someone who is gone. Not the most efficient storage system for information about them. Language does that better. The most efficient system for storing the experience of them. The texture of who they were. The specific gravity they had in a room. That is what a song can carry that a photograph cannot and a story cannot and even memory on its own cannot, because memory fades and distorts and fills in the gaps with inference, but a song plays exactly the same every time, and every time it plays it re-encodes the person with the precision of the original.

I want to be careful here. I am not saying music cures grief. It doesn't. Sometimes it makes grief more acute, more precise, more physically present than you were prepared for. The song you cannot hear anymore because it is too fully them. The playlist you built for someone and cannot delete and cannot open. These are real. Music does not soften the loss. It keeps the channel open, and an open channel is not the same as comfort. It is the same as not having to let go all the way.

There is a version of this that happens at the species level.

Virtually every funeral tradition that has ever existed uses music. Not some of them. Nearly all of them. Blues, spirituals, dirges, keening, the New Orleans second line, the Gaelic keen, the Buddhist chant, the drum circles of West Africa, the Mozart Requiem. These traditions developed independently, across cultures with no contact, across centuries. They all arrived at the same conclusion: when someone dies, you make organized sound. Not because the sound does something supernatural. Because the sound does something neurological. It synchronizes the

people left behind. It gives the grief a container. It makes the loss communal instead of solitary.

The neuroscience of this is specific. Grief activates the same neural systems as physical pain. It is not a metaphor to say that loss hurts. The brain processes social loss through the same pathways it processes physical injury. And music, specifically music heard in community, releases oxytocin, the bonding hormone, and endorphins, the same chemicals that attenuate pain. The ritual is not symbolic. The ritual is biochemical. When the congregation sings together at a funeral, their heartbeats are synchronizing. They are literally sharing the pain, distributing it, making it smaller through collective processing. The music is not an accompaniment to the grieving. The music is how the grieving is done.

I saw a second line in New Orleans before I understood what I was watching. From the outside it looks like a celebration, and it sort of is. People dancing in the street, brass band playing, movement everywhere. And then you feel it and realize half the people dancing are crying. The celebration and the grief are not taking turns. They are happening simultaneously, in the same bodies, carried by the same music. The tradition understood something about mourning that the word mourning does not capture: that the body needs to move through it, not sit with it, and that the music gives it somewhere to go.

The blues understood this before neuroscience had the vocabulary. You sing about the loss to survive the loss. You make it into music because music is the one form that can hold the feeling at full size without shattering. Language reduces. Music contains. The twelve-bar blues progression is not decorative. It is a container engineered over generations to hold exactly the amount of weight that grief weighs, and it works because it has been refined by use, by the specific requirement of carrying the unbearable and making it bearable by making it shared.

Robert Johnson sold his soul at the crossroads, the legend says. What actually happened is that he went away for a few months and came back playing with a ferocity and precision that nobody could account for. He was nineteen. He recorded twenty-nine songs. He died at twenty-seven, cause disputed. What he left behind carries the specific quality of someone who understood, at a cellular level, that the music was the only thing that would outlast him, and who played accordingly. When you hear Hellhound on My Trail you are not experiencing Robert Johnson’s grief at a historical distance. You are in the room with it. That is what the music preserved. Not information about the grief. The grief itself, encoded in frequency and silence and the specific grain of his voice, available on demand across eighty-some years, to anyone who plays it.

Which means the dead do not feel as gone as they appear, if they left music behind.

* * *

My cousin Tim was one of those people who had the antenna. He was a working musician in the Memphis area for years, multiple bands, serious guitar player, the kind of player other musicians watched. We didn't live close and the years between visits were too long, which is the particular math of adult family life that nobody warns you about. But when he came through, I made it a priority. We talked about music the way people talk about something they can't fully explain but can't stop trying to.

Sometime in the mid-90s he showed up with a Pat Metheny CD and said, essentially, you need to hear this.

Pat Metheny is one of the most decorated musicians alive. Dozens of Grammy awards across more categories than most artists even work in. He plays jazz but the word doesn't quite contain him, he moves through it, past it, around it. He's invented instruments. Literally built things that didn't exist because the sounds he was hearing didn't have a vehicle yet. The most remarkable of these is the Pikasso guitar, built for him by luthier Linda Manzer in 1984. Forty-two strings. Four necks. She spent two years on it because he asked her to put as many strings on it as possible, and she took the request seriously. There is one in the world. He plays it.

Tim put that CD on and I sat there with my synesthesia running at full capacity, colors arriving faster than I could track them, the music so dense with information that my visual field was close to overloaded. I had never heard anything like it. I didn't have words for what I was experiencing. I just listened.

He got sick in his forties and died too soon. The specific unfairness of it still lands wrong when I think about it. We had something in common that went past preference or taste. I think we inherited the same strands of whatever DNA builds the antenna. Whatever makes organized sound land differently in some nervous systems than others, we both had it. It's part of why we got along like old friends even with the years and miles between visits.

A few years ago Metheny played a show as close to where I grew up as he's likely to get. I went. I thought about Tim the whole time. Not in a sad way, exactly. More in the way that people show up in rooms they never physically entered, because the music they gave you is already there. He'd have had a lot to say about that performance. I enjoyed it enough for both of us.

I still want to ask Metheny someday whether he built the Pikasso because he had sensory rooms that standard instruments couldn't open. Whether there was something like synesthesia driving the need for forty-two strings. Whether the instrument unlocked something in his nervous system that a six-string left locked. I suspect the answer is yes. I suspect he'd know exactly what I meant.

* * *

I want to tell you about Dee.

She was a septuagenarian white woman and I was a middle-aged man from Arkansas and we had almost nothing in common on paper except our whiteness and our town. My friend group has always ranged wide, from my youngest child up through friends well into their eighties, across races and backgrounds and beliefs. Most of the best ones I found through music, or found that music was the thing we'd both been following when we stumbled into each other. Dee was one of those. The age difference was vast. The soul recognition was immediate. I am convinced we had met before, somewhere prior to this particular arrangement of existence, and that we will meet again after.

She died, and her memorial was held on Mount Sequoyah in Fayetteville, Arkansas, a place so specifically her that if you had known her and someone described it without naming it, you would have known. All some level of hippie. All some level of in love with her. A man who may have been her brother, or her cousin, or her brother-in-law, I have never been entirely certain and it doesn't matter, played an acoustic version of As Tears Go By. Just him and a guitar, on a mountain, for the people who had loved her.

What happened in my chest when he played it I cannot fully account for. It wasn't grief exactly, or not only grief. The word I keep coming back to is lament. And lament is different from sadness in a way that is hard to explain but that I think matters. Sadness begins when the loss occurs. Lament goes back further. It is inward-facing in a way sadness isn't. It turns toward what you did and didn't do, the time you had and didn't use, the conversations you had and the ones you put off. Lament is laced with guilt. Not the crushing kind, but the specific kind that comes from knowing you had something rare and didn't treat every hour of it like it was rare.

I was lamenting the time. The visits I postponed. The calls I made shorter than they should have been. The assumption that there would be more Tuesdays. There are never as many Tuesdays as you think.

The song did something specific. It didn't make the lament smaller. It made it containable. That is what I mean when I say music holds the people who are gone, not that it softens the loss, but that it gives the loss somewhere to live that is not just inside you with no address. The song became a door. It has been a door ever since.

* * *

I still hang out with Dee.

Not the way I used to, not the big hug after hours of wide-ranging conversation that left me feeling like I'd been somewhere real. But I'll put on noise-canceling headphones and stream Chris Thile, or I'll find As Tears Go By, and I'll doodle over a cup of coffee and write down things I'd want to tell her. Catching her up. Saying things in my head as though she's there, and letting the conversation go both ways.

I don't know if it's my depth of knowledge of her, deep enough that I can predict what she'd say, that gives me her replies. Or if it's actually her. I believe both are plausible. I have not been able to find a reason to choose between them.

Existence exists in persistence. Keep a person with you. Let them knock on the door of your life through a song. Have them in for a cup of coffee and a silent conversation. Let them exist.

The encoding is precise enough that the person arrives with the music, not as a symbol of them, not as a reminder, but as something that functions, for the mourner, like the actual texture of who they were. And as long as you have ears, it works.

I know how that sounds. I am a person who believes in evidence and distrusts mysticism. The encoding is real. The neural mechanism is real. Whether what the mechanism produces is presence or the memory of presence, I have not been able to decide. The song holds them. When you play it they come back through the specific channel that music opens and nothing else does. For the duration of the song.

At every funeral, every burial, every vigil, someone chooses a song. They choose it because they know, without being able to explain why they know, that the song will do something the eulogy cannot. They are right. The eulogy tells the room who the person was. The song shows the room what the person felt like. And felt like is what grief is grieving. Not the information about the person. The experience of them.

The song is not a memorial. The song is a door.

And grief is what you find when you open it, and also what you find when you close it, and also what reminds you, in the years that follow, that you are still capable of opening it at all. That the channel is still there. That what you loved has not dissolved into silence but has been folded into sound, and the sound is still traveling, and as long as you have ears, it will find you.

Some doors stay open. That is not a failure of grief. That is the proof that what you lost was real.

I have already made the playlist for my own funeral. Every song on it is aimed at someone specific, and most of them will not know that until they hear it. Some are shared memories that only one or two people in the room will recognize as a nod to my time in this life with them. All of them devastate me, which I take as evidence that I chose correctly.

The song is not a memorial. The song is a door. And the door opens both ways. You can use it to reach the people who left. And if you plan it right, you can leave one open behind you on the way out.

# Chapter 25: Walk-Up Music

Baum-Walker Stadium in Fayetteville, Arkansas holds about eleven thousand people when it's full, and when it's full for a big game it is the loudest college baseball venue in the country. This is not me being a homer. It has been measured. The crowd is specifically that loud, in that specific park, and if you have been there for a Friday night conference game when the Razorbacks are playing at home in April and the season is on the line, you have heard it and you know.

I have been going there for decades. I have watched thousands of at-bats. And the thing I have always paid attention to, in addition to the at-bat itself, is the ten or fifteen seconds before it: the walk-up song.

Every batter has one. It plays from the moment they step out of the dugout to the moment they step into the box. Every pitcher has one. It plays when they emerge from the bullpen and make the long walk in from right field, which at Baum is a walk with an audience, a procession with a soundtrack. The university now releases the full walk-up playlists before each season. Fans follow them the way they follow the roster. The songs are how they know who these players are before they know their stats.

I have always been curious about what goes through a player's mind when they choose. Because the choice is not casual. You are picking the music that will accompany the most exposed moment of your athletic life, the moment before every single plate appearance, in front of eleven thousand people who are paying very close attention to you specifically. Whatever that song is, it will define you to the crowd. It will follow you through the season. It will be the sound that plays in people's memories when they think about you years later.

The possibilities, as I have worked through them over the years, divide into a few categories.

Getting your mind right. Some players clearly choose music that exists entirely for internal use, that has nothing to do with the crowd and everything to do with the nervous system. A specific tempo for a specific state. Something that pulls them down into calm if they're running hot, or something that ratchets them up if they're coming out of the dugout flat. This is the neurological application: using organized sound to modulate arousal toward optimal performance state. It's the same reason surgeons have particular music in operating rooms and athletes use specific playlists in warmup. The music is a tool for arriving at a particular internal condition.

Autopilot. Some players are trying to get out of their own head entirely. Baseball has an unusually brutal relationship with thinking. The swing happens in under half a second. There is no time for deliberate thought in the contact zone. The batter who is still deciding what to do when the pitch is released is already late. What the best hitters describe is a state of extreme presence combined with complete absence of analysis, a contradiction that is also a description of flow.

Walk-up music, in this reading, is a portal. It is the last piece of intentional thought before surrendering intentional thought. The song ends, the thinking stops, and something older and faster takes over.

Timing. A walk-up song at a particular tempo sets a physical rhythm the batter carries into the box. Their breathing is paced to it. Their footwork has its cadence from it. They step in already inside a rhythm, and the pitch arrives as a disruption of that rhythm, something to be measured against the beat they are already keeping. This is not theoretical. This is rhythmic auditory stimulation in a baseball uniform.

Crowd pleaser. Some choices are purely relational. They are a handshake with the eleven thousand people in the seats. A song the crowd knows and loves, one that arrives already charged with collective energy, a way of borrowing the crowd's emotional state rather than importing your own. When the crowd sings along, even for ten seconds, the player is not alone anymore. They are riding something communal. That is a different physiological state than walking to the plate in silence.

Intimidation. A small subset of walk-up music is aimed at the pitcher. The right song, played loudly, at the right tempo, communicates something directly. It says: this is who I am. It says: I am not nervous. It says: I have been in this moment before and I know exactly what I am doing. The song is a territorial claim. Whether or not it rattles the pitcher is less important than the fact that the batter believes it might.

Home. And then there are the players who choose something that simply reminds them of where they are from and why they are playing. A country song from eastern Tennessee. A regional hip-hop track. A song from the church they grew up in. Not performance, not strategy. Just a thread back to the ground they came from, a reminder of what the game meant before it was stakes, when it was just a field and some friends and a reason to be outside. Those songs usually produce the most specific fan reactions, because the fans from those same places recognize the thread and pull on it from their side.

What would my song be?

I have thought about this more than any non-athlete probably should. The honest answer keeps changing depending on what I need in a given moment, which I think is the correct answer to the question even though it is not a satisfying one to say out loud.

There are days when the answer is Master of Puppets by Metallica, because what I need is to be told by four thousand pounds of organized aggression that none of this is actually that serious and I should stop thinking and start swinging. There are days when the answer is Just Like Heaven by The Cure, because I need the reminder that some things are worth caring about and that caring is not weakness. There are days when the answer is something slow and specific that only I know the significance of, something I would not be able to explain to the

eleven thousand people in the seats, because the explanation would take longer than the at-bat and because some doors are private.

The question of what you would choose is worth sitting with. Not for the book. For yourself. What song, played for ten seconds before the most exposed moment of your day, would make you feel most like the version of yourself that is capable of what is about to be asked of you? What does that song know about you that you haven't said out loud? What has it been carrying on your behalf?

That song already exists. You already know what it is.

Every person reading this has a version of that moment. A doorway they walk through on their way to the plate. A song that was waiting before they knew they needed it.

The Arkansas Razorbacks release their walk-up playlist every season. and it is, as always, a specific document of exactly who these young men are and where they are from and what they are trying to feel when they step into that box. Country music from the Arkansas delta. Southern hip-hop with the cadence of the region baked into it. Classic rock that a father probably played in a truck somewhere. Pop music that sounds like being twenty-one and invincible. Each song a self-portrait in ten seconds.

Dave Van Horn has been coaching at Arkansas since 2002. In that time he has won more games than almost any coach in college baseball history, and he has watched thousands of players make this choice. When asked about walk-up music he has said that he pays attention to it because it tells him something about the player's state of mind that the player might not tell him directly. The song is a confession.

I believe him. I have watched the correlations over the years, the player who comes up to an aggressive song and takes aggressive at-bats, the player who comes up to something calm and quiet and waits for his pitch with a patience that borders on spiritual, the player who changes his song mid-season and changes his approach right along with it. Walk-up music may function less as a cause than as a revealing signal of how a player wants to enter the at-bat, in the way that all walk-up songs announce something that was already decided before the first note played.

The song is a confession. It is the ten seconds before the at-bat where a player tells eleven thousand people who he is, whether he knows that is what he is doing or not. The pitcher walking in from the bullpen with his song playing is not being accompanied. He is being announced.

Every crowd has its version of this. Mine goes: Woo Pig Sooie.

# CODA: REVERB

**Where the trail leads**

# Chapter 26: Fractal Music

Here is a chain of logic I want to walk through, and I want you to tell me where it breaks down, because I’ve been looking for the crack for years and I keep not finding it. This is not a proof. It is a pattern I keep finding, and I want you to see it before you decide what to do with it.

Physical reality is patterned. Atoms are in constant motion, not stillness interrupted by activity, but perpetual oscillation at the subatomic level. Motion at a regular rate is frequency. Frequency is measurable as a wave. None of this is philosophy. This is just how matter behaves at its most basic resolution. What it is not, automatically, is music. Vibration and sound are different things. Vibration is physical motion. Sound is what happens when that motion travels through a medium at frequencies a nervous system can detect. Music is what happens when a brain interprets patterned sound as organized and meaningful. Those are three separate events, and the distance between the first and the third is where most of the interesting questions live.

The chair you're sitting in is vibrating right now. You can't feel it because the frequencies are far outside what your sensory system was designed to detect. But the motion is real and the frequency is real and if you had the right instrument you could measure it. The difference between that chair and a cello string is not whether vibration is happening. It's whether the vibration falls in a range and pattern that a nervous system built for exactly this purpose can receive and interpret.

So physical reality is periodic, patterned, and measurable across scales. Music is one humanly legible form of patterned periodicity. The question is not whether everything has an acoustic dimension, because most of it doesn’t, not in any way that matters to an ear. The question is why the patterns that do reach us, the ones that fall in the narrow range a nervous system can receive, land the way they land. And why they keep showing up in the same mathematical neighborhoods as patterns that have nothing to do with ears at all.

Fractals are the most literal version of this.

Fractals are geometric patterns that repeat at every scale. Zoom into a fractal and you see the same structure you saw at the larger scale, repeated with slight variation, indefinitely. Coastlines, blood vessels, neural networks, the branching of a tree.

The branching pattern of your lungs, which gets finer and finer through the same self-similar mechanism at every scale, is optimized to present the maximum surface area for gas exchange within the minimum physical volume. The fractal structure is functional. The universe apparently keeps using this solution, because the problem it solves, packing maximum complexity into minimum space, keeps coming up.

Music has fractal properties. This was demonstrated mathematically in the 1990s and has been refined considerably since. The self-similarity of musical structure, where patterns at the phrase level mirror patterns at the section level mirror patterns at the movement level, is not an aesthetic choice composers make. It is a mathematical property that emerges from how humans generate and process organized sound. A musical phrase that works at four bars tends to work at sixteen bars with the same structure. The theme that opens a symphony often contains the germ of every subsequent development. The small structure and the large structure are made of the same stuff, organized the same way, at different scales.

The 1/f noise finding is even more interesting. 1/f noise, sometimes called pink noise, is a statistical pattern found in remarkably diverse natural systems. Earthquakes. Heart rhythms. Traffic flow. The fluctuation of stock prices. The fluctuation of light from distant stars. And music.

Here is the part I kept having to re-read because I thought I had misunderstood it. The loudness variations in music, when analyzed statistically, follow the same 1/f distribution as these other natural systems. Not because composers chose this. Because it is apparently what complex organized systems do when they are neither too random nor too regular.

Too random and there's no pattern to track. Too regular and it becomes monotonous. The sweet spot, the range where pattern and surprise are in productive tension, the range where the brain's prediction machinery gets something useful to work with, follows a mathematical distribution that also describes heartbeats and earthquakes.

* * *

There is a physics reason this keeps happening, and it is worth understanding before we go any further into why it matters.

Systems that last tend to find a sweet spot. Not locked into order, not dissolving into noise. Right at the boundary between the two, where a small push can ripple through the whole thing. Physicists call it self-organized criticality, and it shows up everywhere: avalanches, neural firing, wildfires, the extinction record in the fossil column. Nobody designed these systems to find that edge. They found it because the ones that didn’t are gone.

The 1/f distribution is the statistical fingerprint of a system at that edge. When music follows the 1/f distribution, and it does, across cultures, across centuries, in compositions that had no knowledge of each other, one possible reading is that enduring music often occupies the same statistical middle ground that shows up in other complex systems. Every genre that calcified into too much order stopped mattering. Every experiment that collapsed into pure noise stopped being heard. What remained was music that balanced on that edge.

I want to be clear about what this finding does and does not establish. What it shows: human music, across cultures and centuries, tends to occupy the same complexity band as other adaptive systems. Not too ordered, not too random. The brain prefers that balance of regularity and surprise, and music that lasts tends to sit in the zone where the brain's prediction machinery has something useful to work with. A heartbeat in 1/f keeps a body alive. A symphony in 1/f keeps an ear engaged. Both are complex systems finding the range where they function best. That is a serious and defensible observation. What it does not show: that music and heartbeats and earthquakes are doing the same thing at some deeper level, or that shared statistics are evidence of shared essence. Resemblance is not kinship. Two systems can follow the same distribution for entirely unrelated reasons, the way two rivers can have similar flow patterns without sharing a source. I find the convergence genuinely interesting. I am not able to tell you it means more than convergence.

There is a reasonable objection to all of this, and it deserves its best version before I continue. The 1/f distribution is so common in complex systems that some researchers argue finding it in music tells us nothing specific about music at all. It may be a property of how complex systems behave generally, a statistical attractor that everything from river flows to stock markets to symphonies falls into simply because they are complex and dynamic. In that reading, the convergence between music and earthquakes is trivially expected, not profound. I take the objection seriously. My response is that even if 1/f is a general property of complex dynamic systems, the fact that human nervous systems are specifically tuned to find the 1/f range pleasurable, that we experience deviations from it as either boring or chaotic, is not trivially expected. The statistical shape may be general. The human response to it is specific, and that specificity is what I think is worth explaining.

The cosmic microwave background adds another layer, though I want to handle it carefully. When cosmologists decomposed the CMB's power spectrum into frequencies and mapped them to audible range, harmonic ratios emerged: overtones stacking in predictable patterns above a fundamental tone. The large-scale distribution of matter retains signatures of those early acoustic oscillations, which cosmologists call baryon acoustic oscillations. But sonification is a mapping choice, not a discovery of literal music, and the harmonic structure in the result depends partly on physics and partly on the translation. What is real is the mathematical pattern. Whether that pattern connects to the patterns in music or merely resembles them is exactly the question I cannot close.

Music is organized vibration that produces organized response in a biological system. That much is not poetry. It is a description of what measurably happens when you play a note into a body. What I want to do with that fact is where the poetry starts.

* * *

The Earth itself resonates at 7.83 Hz, the Schumann resonance, which happens to sit in the theta brainwave range where human brains go during deep meditation and creative absorption. Whether that is meaningful or coincidental I cannot tell

you, and the EEG research investigating the connection is preliminary and inconclusive. I notice the clustering. I am not able to tell you what it proves. But the convergences I've walked through in this chapter are not going away, and the strongest case against them doesn't come from the physics. It comes from a study conducted in a jungle.

* * *

The hardest data point for my position comes from a 2016 study by Josh McDermott at MIT. His team traveled to the Bolivian Amazon and played consonant and dissonant intervals for the Tsimane, an indigenous group with minimal exposure to Western music. The Tsimane showed no preference. Consonance and dissonance sounded equally acceptable to them. The intervals that Western listeners experience as naturally pleasant landed as neutral. If consonance were hardwired, it should have shown up in the jungle too. It did not.

I have sat with this one for a long time. It is the kind of finding that either dismantles your thesis or sharpens it, and I was not sure which for a while.

Here is where I land. McDermott measured preference. He didn't measure response. The Tsimane didn't prefer consonance, but they still responded to rhythm. They still entrained to a beat. They still synchronized when music played. The part of the nervous system that locks onto organized sound and does something with it was fully operational. What varied was the part that decides which version of organized sound feels like home.

That distinction matters to me because it is the whole argument. I am not claiming that everyone should find the same music beautiful. I have spent this entire book arguing that they do not, and that the variation is part of the design. What I am claiming is that the capacity to respond to organized sound was not invented by any culture. The cultures decorated it differently.

Preference is the wallpaper. Response is the house. Preference appears culturally shaped. Responsiveness to organized sound is the deeper and more general phenomenon. I should note that McDermott's own subsequent work found that even the Tsimane show acoustic preferences along other dimensions: they prefer sounds with less roughness, which suggests the perceptual machinery for evaluating sound is present and active even where the Western consonance hierarchy is not. The system is running. The settings are local. If someone eventually demonstrates that rhythmic entrainment itself varies more than the current evidence suggests, the argument of this book will need to get smaller. I am watching for that finding. It has not arrived.

* * *

Samuel Mehr at Harvard found something that sharpens this further. Participants listened to recordings from sixty cultures they had no prior exposure to and were asked to identify what each piece of music was for. Lullaby. Dance music. Healing song. Love song. They got it right at rates far above chance. Not because they had studied ethnomusicology. Because the functions of music are encoded in its structure in ways that cross every cultural barrier. A lullaby sounds like a lullaby in Mongolian. A war song sounds like a war song in Gaelic. You don't need the language or the tradition. The music announces what it is.

The scale of Mehr's project is worth understanding. The Natural History of Song dataset spans recordings from 315 societies, coded by independent listeners with no prior ethnomusicological training. The listeners identified song function at rates significantly above chance across every category tested. A subsequent machine-learning analysis confirmed that acoustic features alone, without any cultural context, predicted song type with similar accuracy.

Ceremonial drumming across diverse traditional cultures clusters around a similar tempo range, roughly 120 to 180 beats per minute. Siberian shamans, West African ritual, Brazilian candomblé. Different continents, different centuries, and a strikingly similar tempo. It sits in the range at which the human nervous system begins to shift states. One plausible reading is that many traditions converged on tempo ranges that reliably entrain human attention and physiology.

Patterned vibration and resonance predate life. If music is an expression of that older physical order, then what we do when we play is not invention. It is participation. It is us, saying back to the physical world: we hear you. We are here. Whether that is what is happening, or whether it is what I want to be happening, is a question I haven't been able to settle.

We don't master music. We grow alongside it.

* * *

Yo-Yo Ma said it on The Late Show with Stephen Colbert in January 2026. The man could have said almost anything and he chose this.

Music is energy. Period.

He has spent the last several years playing music in forests, caves, and coastlines for a project called Our Common Nature. A man who has performed in every major concert hall on the planet looked out at the natural world and said: that's what I'm missing. Nobody in the room pushed back. Sound is energy in the physics sense: mechanical energy, molecules transferring kinetic force through a medium. When that energy enters a body and produces dopamine and tunes heartbeats and occasionally produces goosebumps and tears, it is doing what energy does. It is converting. Mechanical energy to neural energy to chemical energy to whatever happens at the end when a song breaks you open in a parking lot. I am aware that I just crossed a line. The first half of that chain is measurable physics. The last part is experience, and experience is not the same category as

joules and watts. I am not pretending the line isn’t there. I am saying the line is where the interesting question lives.

You know a song. You have known it for twenty or thirty years. Every time you listened, the sound arrived as energy, was converted by your nervous system, produced chemical and neural changes, and became part of your body’s state. The neural pathways that encode musical memory are physical structures. The listening changed the architecture. The song is in you in a way that is more literal than most people realize. It altered the shape of the receiver.

Which means the music you have heard is not something you experienced and filed. It is part of what you are. Not because you remembered it. Because it became part of the instrument.

I did not write this book because I have the answer. I wrote it because I found a trail and I could not walk away from it.

Is music a byproduct of the patterns that organize physical reality, or is it made of the same energy? I haven’t been able to answer that from inside the system I am describing. But the patterns keep converging, and the question has not released me, and I have stopped being able to look away.

## Chapter 27: Across the Universe

On February 4, 2008, NASA pointed a 70-meter radio dish in Madrid at Polaris and pressed send.

The whole thing was somebody's idea of a beautiful coincidence. The occasion was a cluster of anniversaries: forty years since the Beatles first recorded the song, forty-five years since the founding of the Deep Space Network, fifty years since NASA itself was born. A Beatles historian named Martin Lewis hatched the idea, pitched it to NASA, and somehow got everyone to say yes. Paul McCartney, Yoko Ono, Apple Records. All of them signed off on sending a four-minute song into the void at the speed of light, aimed at a star 431 light-years away.

John Lennon wrote it one night in 1967 when he couldn’t sleep. His wife Cynthia was talking downstairs. He was lying in bed. The words arrived while he was horizontal in the dark. He went down and wrote them. He later said it was one of the most beautiful things he’d written. He was also famously dissatisfied with every recorded version of it. He thought the production let the song down.

Lennon died in 1980. He never heard what NASA did with his song twenty-eight years later. He never knew that the words he wrote in the dark one night, that he spent years feeling were imperfectly captured, were eventually encoded into a radio signal and aimed at a star.

That detail gets me every time. The songs we make, the ones that feel like they came from somewhere bigger than us, don't stop when we do. They keep traveling.

The signal will reach Polaris in approximately the year 2439. It degrades along the way. The format is parochial. There’s no reason to assume that any receiving intelligence would share enough of our perceptual architecture to interpret organized pressure waves as something more than noise. All of that is fair. And none of it is the point.

The point is what we chose to send.

We have been capable of radio transmission for over a century. We could have sent anything. We have sent things: mathematical sequences to demonstrate intelligence, diagrams of human biology, coordinates of our location, maps of our solar system. The standard SETI logic is that mathematics is the universal language, that a sequence of prime numbers is something any sufficiently advanced intelligence would recognize as intentional, as a signal rather than noise. The logic is sound. If you want to announce that you are intelligent, you send something that only intelligence would produce.

But we also sent a song. Not as proof of intelligence. Not as a coordinate or a diagram or a declaration. A song about lying in the dark and feeling the universe flow through you and not knowing what to do with that feeling except try to put it into words that don't quite fit. A song that was written in forty-five minutes in a bedroom in Weybridge and that its author spent the rest of his life feeling he hadn't gotten quite right. That song is now roughly 18 light-years from Earth and moving.

I think about what that choice says about us. Not the strategic choice, not the publicity calculation, not even the anniversary logic. The instinct. When the moment came and someone said what should we send, a man named Martin Lewis said a Beatles song, and everyone in the room understood immediately what he meant. Not because a Beatles song would communicate intelligence. Because it would communicate something that a proof of intelligence cannot: that whatever is making the signal feels things. That there is something it is like to be us. That the organized frequency patterns we produce are not just demonstrations of cognitive capacity. They are expressions of inner life.

A mathematical proof says we can think. A song says we can hurt and wonder and lie awake and feel the universe moving through us and try to name it. The song is the more honest signal.

Why does it feel right?

Not whether it was strategically optimal. Not whether the aliens will understand it. Whether it was the right thing to do. When you ask most people who know about it, the answer is almost always yes. Of course we sent music. What else would you send?

That instinct does not prove that music is closer to the structure of reality than math or language or image. What it proves is something about us. When humans want to say who they are, when the moment is ritual or grief or courtship or a transmission aimed at a star, they reach for music. They have been doing this at funerals and weddings and national anthems and lullabies for as long as there is any record of humans doing anything. The Polaris transmission is one more data point in a pattern that is already overwhelming: music is what humans choose when they need to say something that matters and words are not enough. That does not make it cosmic. It makes it ours, more deeply than almost anything else we do.

Lennon never knew any of this happened.

The score goes on past us. In 2439, something near Polaris will receive four minutes of what John Lennon heard lying in the dark in Weybridge in 1967. Whether anything is listening, we were right to send it.

# What I Couldn’t Answer

Every culture that has ever buried its dead has used music to do it. Not most of them. Language existed. Silence existed. Ritual gesture existed. They all reached for organized sound, independently, without coordinating, across every geography and century we have a record of. The neuroscience can explain part of it, oxytocin, heartbeat synchronization, the communal distribution of pain. What it hasn’t explained is why it was always music specifically, and not any of the other tools that were available. Something about organized sound does a thing at the threshold of death that nothing else does, and I haven’t seen that question asked directly in the literature, which bothers me more than not having the answer.

Every working songwriter I’ve read or spoken to describes the experience of composition in the language of receiving rather than building. McCartney found Yesterday waiting at the piano. Richards woke up with Satisfaction on a tape he didn’t remember using. Dylan described it as taking dictation. Parton wrote two iconic songs in a single afternoon and joked about it like it was weather. Mayer called a new song a guest arriving from another world. These are not naive people performing humility for a camera. They are professionals describing what the process actually feels like from the inside, and they are all describing the same thing without coordinating. That consistency is not scientific data. It is phenomenology: a shared account of inner experience, reported independently, across decades, in nearly identical language. At what point does that pattern become something the rest of us have to take seriously?

Alzheimer’s takes language. It takes faces. It takes the names of your children and the memory of breakfast and the ability to find the bathroom in a house you’ve lived in for forty years. It does not take the songs. Not first, and sometimes not at all. The brain built more redundancy around musical processing than around almost anything else, and nobody asked it to. It arrived at that priority on its own, across millions of years, and it holds that priority under the most sustained neurological assault we know of. What does the brain know about its own requirements that we haven’t caught up to?

The evidence in this book points in a consistent direction. Music is not entertainment that happens to affect the body. It is a biological stimulus that the nervous system was built to receive, with dedicated neural architecture, dedicated memory systems, and a measurable capacity to regulate emotion, synchronize groups, encode identity, and hold the dead. The response is not learned. The preference is. Every culture decorates the capacity differently. No culture that we have found lacks the capacity itself. That much I believe this book has earned. The questions above are where the trail continues past what I can prove, and I would rather leave them honest than dress them up as answers.

A seven-year-old in the back of a station wagon gets goosebumps from a song he has never heard before, in a genre nobody explained to him, and knows without a single word for it that something important just happened. His body responded

before his mind had any framework for what it was responding to. The recognition was already installed. The receiver was already built. I've spent most of my life wondering who built it.

## Acknowledgments

This book took over a year to write when I finally committed to it. It took considerably longer to live the experience and find the right words for it. The people who made it possible deserve more than a page at the back, but this is what I have.

Jessica, my amazing wife, who lived with this project for as long as I did and never once told me to stop talking about it, even when she should have. I watched her cross the finish line at the Detroit Marathon and it inspired me to cross this one. My children, Hudson, Anderson, and Lucette, who gave me reasons to care about this that I did not have when I started. I hope they will read this one day and understand the world around them and all the possibilities to unlock through music.

My parents, who always let the music play, especially my mother, whose hands at her piano showed me where mine needed to go. My brothers, who are always with me in spirit, for demonstrating to me early in life that the same song in the same setting doesn't always do the same work.

Steve, a fellow author, transcendent friend, and the older brother I never had, who read an early draft and thanked me for putting this work into the world. His listening, encouragement, and belief in me helped make this possible.

Gail, an extraordinary talent who made me an author, and Robert, for making sure I didn't lose myself in doing so. I've never met either of them in person, but I'm a better writer because of them and I'll always be grateful.

My friends, who I've bored to death talking about this stuff for years and whose souls were moved by the same music in the same chapter of life. There's nothing like memorable joy to revisit when a song decides to say hello.

And lastly, to the boy in the dedication. I hope he knows he was right to be afraid, and right to keep going anyway.

# Notes on Sources

This book makes claims rooted in published research. What follows is not a complete bibliography but a guide to the primary sources behind specific claims, organized by chapter. Where findings are described as preliminary, contested, or drawn from small studies, that qualification is present in the text as well.

### Foreword and Chapter 1: What We Carry

On frisson and neural connectivity: Sachs, M.E. et al. (2016). Brain connectivity reflects human aesthetic responses to music. Social Cognitive and Affective Neuroscience, 11(6), 884-891. This is the influential but small imaging study referenced in the text. Its findings are described as preliminary rather than definitive.

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### Chapter 2: The Compulsion

On flow states in musical performance: Csikszentmihalyi, M. (1990). Flow: The Psychology of Optimal Experience. Harper & Row.

On choir members' synchronized heart rates: Vickhoff, B. et al. (2013). Music structure determines heart rate variability of singers. Frontiers in Psychology, 4, 334.

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On music memory and Alzheimer's: Janata, P. (2009). The neural architecture of music-evoked autobiographical memories. Cerebral Cortex, 19(11), 2579-2594. The text qualifies the mPFC preservation finding as suggestive rather than universal.

On Music and Memory personalized playlists: The program founded by Dan Cohen is documented at musicandmemory.org. The film referenced is Alive Inside (2014), directed by Michael Rossato-Bennett.

On melodic intonation therapy: Zumbansen, A., Peretz, I., & Hébert, S. (2014). Melodic Intonation Therapy: Back to basics for future research. Frontiers in Neurology, 5, 7. The Giffords example is drawn from public reporting; the mechanism described in the text is simplified and the actual debate among researchers is more complex.

## Chapter 8: The Architecture of Awe

On the psychology of awe: Keltner, D. & Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. Cognition and Emotion, 17(2), 297-314.

On the acoustic properties of the Temple of Kukulkán at Chichén Itzá: Lubman, D. (1998). Archaeological acoustic study of chirped echo from the Mayan pyramid at Chichén Itzá. Journal of the Acoustical Society of America, 104(3), 1763. Lubman documented the clap-echo quetzal bird call phenomenon and confirmed the match to the resplendent quetzal's chirp. On the diffraction grating mechanism of the staircase: Declercq, N.F. et al. (2004). Acoustic diffraction effects at the Hellenistic amphitheatre of Epidaurus: seat rows responsible for the marvellous acoustics. Journal of the Acoustical Society of America, 115(5), 2456. Declercq's broader work on periodic architectural structures informs the analysis of the staircase's step-by-step diffraction pattern. The raindrop echo produced by footsteps on the stairs has been documented in multiple acoustic surveys of the site. Whether the Maya designed these effects intentionally or discovered and refined them remains debated among archaeoacousticians.

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On statistical universals in music: Savage, P.E. et al. (2015). Statistical universals reveal the structures and functions of human music. Proceedings of the National Academy of Sciences, 112(29), 8987-8992.

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On Bobby McFerrin and the pentatonic scale: World Science Festival panel, Notes & Neurons, New York, 2009.

## Chapter 13: Everything Vibrates

On Ronan the sea lion and beat entrainment: Cook, P. et al. (2013). Spontaneous rhythmic entrainment in a California sea lion (Zalophus californianus). Journal of Comparative Psychology, 127(1), 1-16.

On birdsong and musical reward systems: Bolhuis, J.J. & Moorman, S. (2015). Birdsong memory and the brain: in search of the template. Neuroscience & Biobehavioral Reviews, 50, 41-55.

## Chapter 14: The Neuroscience of Being Moved

On the neuroscience of musical expectation and reward: Zatorre, R.J. & Salimpoor, V.N. (2013). From perception to pleasure: Music and its neural substrates. PNAS, 110 (Suppl 2), 10430-10437.

On “Just Like Heaven” by The Cure: Robert Smith has described it as “the best pop song The Cure ever wrote” in multiple interviews. Boris Williams’s drum fill inspiring the sequential instrument introduction is documented in Songfacts and various Cure retrospectives. The song is in A major; the descending riff is played on a single string in step-wise motion. The recording uses electric guitars despite the appearance of acoustics in some performance footage.

On M83’s “Reunion”: Anthony Gonzalez is from Antibes, France. Morgan Kibby sang the interlude on the track. The album is Hurry Up, We’re Dreaming (2011).

### Chapter 15: Synesthesia and the Crossed Wires

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On music in psilocybin-assisted therapy: Grob, C.S. et al. (2011). Pilot study of psilocybin treatment for anxiety in patients with advanced-stage cancer. Archives of General Psychiatry, 68(1), 71-78. The Johns Hopkins playlist referenced is described in multiple published protocol documents from the research group.

### Chapter 17: Frequency as Medicine

On rhythmic auditory stimulation and Parkinson's disease: Thaut, M.H. et al. (1996). Rhythmic auditory stimulation in gait training for Parkinson's disease patients. Movement Disorders, 11(2), 193-200.

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On the use of music as torture at U.S. detention facilities: Cusick, S.G. & Joseph, B.W. (2011). Across an Invisible Line: A Conversation about Music and Torture. Grey Room, 42, 6-21. The FBI memo regarding interrogation timelines is documented in ACLU FOIA disclosures. Binyam Mohamed's account is from Reprieve and multiple press sources. Secretary of Defense Donald Rumsfeld authorized the use of auditory stimuli in interrogations in April 2003; Lieutenant General Ricardo Sanchez followed in September 2003.

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On focused ultrasound opening the blood-brain barrier in Alzheimer's patients: Chang, J.W. et al. (2025). Focused ultrasound blood-brain barrier opening with microbubbles in Alzheimer's disease. Journal of Neurosurgery (published online ahead of print, January 2025). Six patients, no drugs administered, amyloid reduction in four of six, neuropsychiatric improvement in five of six. On combining focused ultrasound with aducanumab: Rezai, A.R. et al. (2024). Blood-brain barrier opening with focused ultrasound and aducanumab in Alzheimer's disease. New England Journal of Medicine, 390(1), 55-62. Amyloid clearance was greater in ultrasound-treated brain regions than in regions receiving the antibody alone.

On focused ultrasound for movement disorders: FDA approval timeline drawn from Focused Ultrasound Foundation records: essential tremor (2016), tremor-dominant Parkinson's (2018), expanded motor symptoms (2021), bilateral treatment (July 2025). The 25,000+ patients treated worldwide figure is from Foundation reports. The Arkansas woman treated at OHSU in August 2025 is referenced from published patient accounts.

On low-intensity focused ultrasound for neuromodulation: The Nature Biotechnology reference is to a February 2025 feature on emerging ultrasound-based brain therapies. NewYork-Presbyterian trial preparations for addiction, depression, and PTSD are referenced from institutional press materials. The text explicitly separates this trial-stage evidence from proven clinical applications.

## Chapter 18: Nature Freestyles

On absolute pitch and infant auditory learning: Saffran, J.R. & Griepentrog, G.J. (2001). Absolute pitch in infant auditory learning: Evidence for developmental reorganization. Developmental Psychology, 37(1), 74-85.

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### Chapter 19: Who Sings

On prevalence of amusia: Peretz, I. & Vuvan, D.T. (2017). Prevalence of congenital amusia. European Journal of Human Genetics, 25(5), 625-630. The approximately 4% figure is from this and related studies.

On ADHD and music preference: Kour, H. & Basu, S. (2023). Music-based interventions for ADHD: A systematic review. Complementary Therapies in Clinical Practice, 52, 101770. The text notes the literature is limited and not all studies agree on the mechanism.

On the Hyde Park Bohemian Rhapsody singalong: Green Day concert, Hyde Park, London, July 1, 2017. Approximately 65,000 attendees sang the full six minutes of the song before the band took the stage. Green Day regularly plays Queen recordings before their sets. Bohemian Rhapsody was released in 1975; Freddie Mercury died November 24, 1991. Multiple press and video sources confirm the event.

### Chapter 20: The High Lonesome

On Dolly Parton composing “Jolene” and “I Will Always Love You” on the same day: Parton has recounted this in multiple interviews including her 2020 interview with Jad Abumrad on the Dolly Parton’s America podcast (WNYC Studios). On Sturgill Simpson: career details and album reception drawn from public interviews and published reviews. On Chris Stapleton: the “Tennessee Whiskey” CMA performance and its impact are documented in multiple industry accounts from 2015.

### Chapter 21: Talent as Torment

On Brian Wilson’s mental health and creative process: Wilson, B. (2016). I Am Brian Wilson: A Memoir. Da Capo Press. The speculative framing of Wilson’s auditory experience is the author’s interpretation, labeled as such in the text.

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### Chapter 22: A Bolt from the Blue

On Tony Cicoria and sudden musical obsession after lightning strike: Sacks, O. (2007). Musicophilia: Tales of Music and the Brain. Alfred A. Knopf. Chapter 1. Additional details from published interviews with Cicoria. The Ravel case, the musical hallucination patients, and the Williams syndrome observations are also drawn from Musicophilia.

### Chapter 23: The Architecture of a Hit

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On musical expectation and the prediction machinery: Margulis, E.H. (2014). On Repeat: How Music Plays the Mind. Oxford University Press.

## Chapter 24: The Door

On grief and shared neural pathways with physical pain: Eisenberger, N.I. (2012). The pain of social disconnection: examining the shared neural underpinnings of physical and social pain. Nature Reviews Neuroscience, 13(6), 421-434.

On oxytocin release and group singing: Keeler, J.R. et al. (2015). The neurochemistry and social flow of singing: bonding and oxytocin. Frontiers in Human Neuroscience, 9, 518. On heartbeat synchronization in group music-making: Vickhoff, B. et al. (2013), also cited in Chapter 2.

On funeral and mourning traditions involving music: Cross-cultural examples referenced are drawn from ethnographic sources. The chapter’s treatment is observational rather than systematic.

## Chapter 25: Walk-Up Music

On Dave Van Horn and walk-up music at Arkansas: Van Horn’s comments on walk-up music selections are drawn from press conferences and published interviews. The Arkansas Razorbacks walk-up playlist is published seasonally by the athletics department.

## Chapter 26: Fractal Music

On 1/f noise and fractal structure in music: Voss, R.F. & Clarke, J. (1975). 1/f noise in music and speech. Nature, 258(5533), 317-318. Also: Levitin, D.J., Chordia, P. & Menon, V. (2012). Musical rhythm spectra from Bach to Joplin obey a 1/f power law. PNAS, 109(10), 3716-3720.

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On humpback whale song and cultural transmission: Noad, M.J. et al. (2000). Cultural revolution in whale songs. Nature, 408(6812), 537. On gibbon duets: Geissmann, T. (2002). Duet-splitting and the evolution of gibbon songs. Biological Reviews, 77(1), 57-76.

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On the Natural History of Song dataset: The expanded description of Mehr's project draws on Mehr, S.A. et al. (2019), cited above, and the companion dataset of 315 societies. The machine-learning analysis that predicted song function from acoustic features alone is reported in the same publication. Sample sizes, listener independence, and effect sizes are described in the supplementary materials.

### Chapter 27: Across the Universe

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including Beatles historian archives. Paul McCartney's and Yoko Ono's statements are from the NASA press materials.

On the Teen Age Message and Cosmic Call transmissions: Zaitsev, A.L. (2006). Messaging to Extra-Terrestrial Intelligence. arXiv preprint physics/0610031. Zaitsev's critique of the NASA transmission format is drawn from published commentary.

On Kepler and planetary melodies: Kepler, J. (1619). Harmonices Mundi (The Harmony of the World). Kepler determined that elliptical orbits produce varying speeds and distances, making it impossible to assign a single note to a single planet, and concluded that planets sing melodies rather than hold fixed tones. His melodic intervals were calculated mathematically from orbital mechanics.

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