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COLLEGE

Music of Animals

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The Music of Nature

This lecture opens *The Music of Nature* series, which explores the intersection of our musical experiences – seemingly private events of the imagination – and the vast external cosmos. We often assume these worlds are separate: music as a uniquely human invention, only made by and for us; and nature as everything outside us. Yet there is evidence that the boundary between these two worlds may well be porous. Music's tempo ranges align uncannily with the rhythms of our heartbeats and steps; we instinctively imagine "rising" and "falling" melodies moving through space; and evidence suggests that Neanderthals, and even other animals, share musical sensitivities.

Furthermore, composers have long drawn inspiration from the natural world, whether Beethoven's *Pastoral* lightning bolts or Copland's spacious skies. Others go further, directly translating natural and external forms into musical objects: Villa-Lobos's melodic contours of mountains and skylines, Tuvan throat singers' astonishing evocations of babbling brooks, or Messiaen's obsessive transcription of birdsong. Contemporary composers now borrow natural algorithms (of evolutionary growth, tree growth, gravity and ocean waves) for musical structures. These examples suggest that music not only reflects nature, but may emerge from it.

In this lecture we focus on a particularly fascinating intersection: between that of music and (non-human) animals. How have the movements, characters, forms, and songs of animals inspired musicians? And conversely, we ask whether animals recognise or enjoy our music – or even create a music of their own. As the 1st-Century BC poem by Lucretius alludes, perhaps we learned music from the animals, and perhaps music would do just fine without us.

Through all the woods they heard the charming noise

Of chirping birds, and tried to shape their voice

And imitate. Thus birds instructed man,

And taught us songs before art began.

The whispering winds through hollow reeds would glide,

And rustic hearts, by sweetness drawn, replied;

They blew through stalks, and from the breathing tone

Learned measured sounds that slowly grew their own.

Adapted from Lucretius, *De Rerum Natura* [1]

Listening for Language, Music and Animal Song

Before any useful answer to whether animals make music is attempted it is worth asking what we mean by human music. There is no civilisation or group on the planet without music; wherever we find people, we find music. Yet music varies so much between cultures that it escapes easy definition. The same is true of language. How do we distinguish these two forms of sonic communication? It proves harder than it first appears, as counterexamples quickly undermine simple definitions. The best start, perhaps, is to consider the most representative and generic descriptions of both spoken language and instrumental music, to see some common, if not universal, differences. Four themes are especially useful: **purpose**, **reference**, **organisation & structure**, and **effect**. ('PROSE' may be a useful way to remember).

Purpose

Spoken language tends toward the transmission of information. It tells, names, explains, or commands. Instrumental music, by contrast, is often valued for its power not to inform but to evoke. It calls forth moods, atmospheres, and emotions. The contrast is clear if we compare washing machine instructions with a symphony, yet both systems can blur these roles. Words can be used for evocative effect, and a melody can encode information, as in Morse code, bugle calls, or echolocatory music. As a general orientation, the axis from inform to evoke highlights a significant bias.

Reference

Words are denotative: they point to things in the world. The word *sunrise* always denotes the sunrise, regardless of who says it or in what tone. Musical elements, on the other hand, rarely denote external objects directly. There is no agreed musical sign for the sunrise, though music can certainly connote or evoke the experience. An F Lydian Dominant chord, for example, does not refer to anything outside itself. Yet both systems cross boundaries. Language can use nonsense words or neologisms with no clear referent and still be effective. Music can refer to other works, styles, or even external realities, as in Elgar's embedding of his friends' speech patterns in the *Enigma Variations*. Nonetheless, the distinction between denotation and connotation gives us another useful axis.

Organisation & Structure

Both language and music rely on discretisation, turning the continuum of sound into categories. Language divides sound into phonemes, categorical units that can be organised into hierarchical structures to build meaning.[2] These units define what is said, while prosody, rhythm, and timbral gesture provide a continuous layer that shapes how it is said and even colours its contextual meaning. We can ask "Where were you?" in many ways, with different degrees of anger or fear, while the literal meaning remains constant. Music, in general, works in the opposite direction. It divides sound into discrete categories of pitch (usually measured in relative intervals) and temporal units (spaces in time). Timbre helps to distinguish instrumentation and spatialisation, but often serves as the "how" rather than the "what." This distinction is reflected in common notation practices: pitch and rhythm are carefully notated, while timbre is added as an extra layer, if it is notated at all. In both domains, discrete units are organised hierarchically (words and sentences, measures and phrases) and enriched by continuous expressive layers. Again the counterexamples appear immediately in tonal languages like Mandarin and Yoruba, pitch can change the meaning of a sound; and there are musical forms where timbre and articulation is a primary force and discretised, but comparing discretisation and continuity in language and music is a very useful tool.

Effect

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[1] This is an extension and minor edit of Rothenberg's poetic translation from *Why Do Birds Sing?*

[2] There are also parallels between language and music when it comes to the frequency distribution of common units (e.g., words or musical objects). Many languages and musical styles exhibit "Zipf-like" distributions, where the most frequent words or objects are used very often, while rarer ones appear only occasionally (Manaris et al. 2005; Zanette 2006; Perotti et al. 2019). Similar statistical patterns have also been observed in animal communication systems, including the calls of chickadees (Ficken et al. 1994; Freeberg & Lucas 2012; Lucas & Freeberg 2007).

The primary effect of language is pragmatic. We come away from an interaction with new information about the world, the speaker, or ourselves. Music, on the other hand, tends to have an aesthetic effect: it gives us an experience of beauty or intensity beyond conventional information. The Chinese word 音樂 (yīnyuè) literally sound-pleasure frames this beautifully. Again, counterexamples are easy to find. We may dislike a piece of music – or have no aesthetic engagement whatsoever – and yet recognise it as music. We may learn pragmatic information from listening, and we may infer the state of a musician through their playing even without lyrics. Conversely, listening to a speaker can be an aesthetic experience regardless of whether we follow the meaning. Yet the bias remains: language leans toward pragmatic force, music toward aesthetic experience

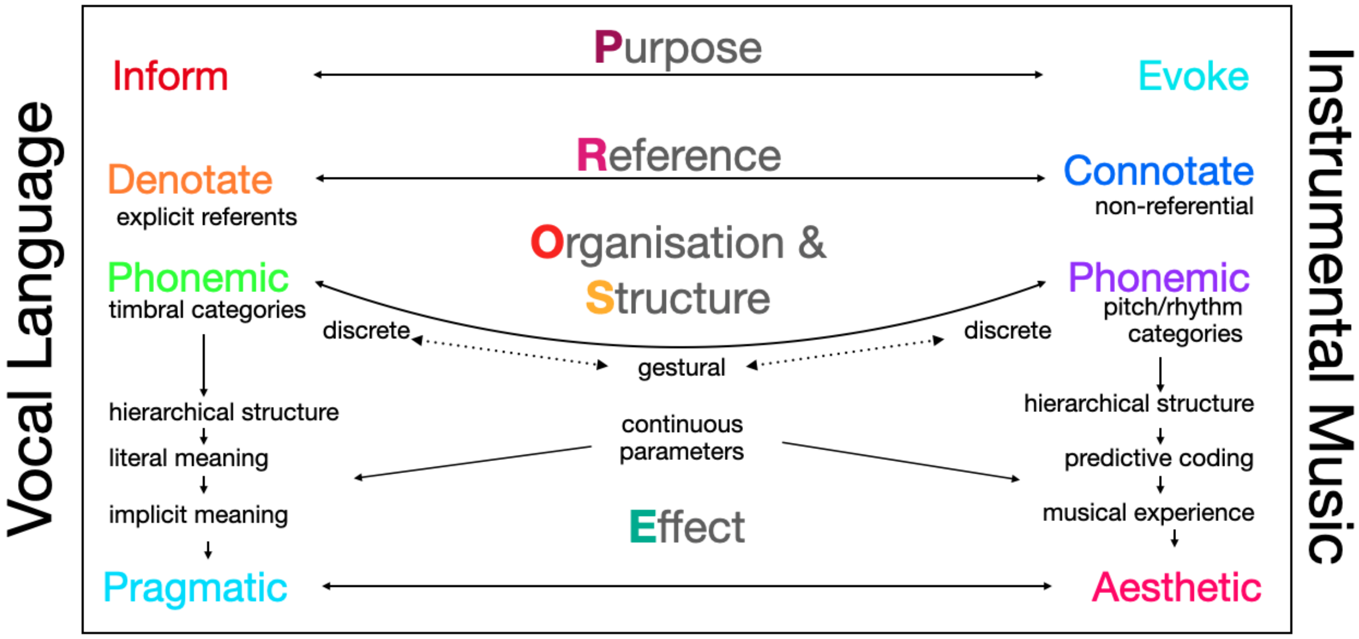

Figure 1: The PROSE model illustrating a continuum of sonic communication along several axes, with (conventional) spoken language on the left and (conventional) instrumental music on the right. None of the categories are necessary or sufficient, and counter-examples are readily available, revealing the complexity of easy definitions. Animal song adds further tangled complexity. (for example by using pitch rhythm categories *pragmatically* to *inform* and *denotate*, or by eliciting an aesthetic experience in the listener).

These axes (illustrated in Figure 1) help us make sense and delineate music and language, but they are fraught with counter-examples and boundary cases. There is for example a broadly known two-note 'musical symbol' for 'shark' thanks to John Williams; manipulation of 'musical' pitch and rhythm in language can change significantly the intended meaning from the literal; we can often perceive emotional gesture in languages we don't speak; and poetry, free verse, rhetorical speech, and the use of lyrics further complicate any easy differentiation of language–music. In fact some evolutionary theorists (see Mithen, and Brown) suggest that music and language co-evolved, their shared ancestor being a hybrid form of communication.

With this broad view we can however now ask more lucid questions regarding non-human animal music: What is the purpose of birdsong? Is it only for survival advantage – warning, attracting, identifying – or is there an aesthetic component of play to enjoy the beauty of song. Can this be 'explained away' by sexual selection, bonding or self-soothing, and could the same be asked of human music? We might ask whether birdsong says anything (more than 'look out!' and 'look at me') – does it refer to specific places, objects or feeling? What are the 'units' of bird song and does its structure follow that of human music? So let's organise and approach this forest of questions along four intersecting paths of curiosity:, **Animals in Music** How are animals represented in music and do animals make what we recognise as musical sounds? **Music in Animals** do animals appreciate (human) music? **The Musical Language of Animals** what is the language (or indeed music) of animals themselves? And **The Music of Life** – what music might all living beings share?

Animals in/as Music

In his diary for 8 August 1666 (shortly before the Great Fire of London), Samuel Pepys records a conversation with Robert Hooke (the then Gresham Professor of Music), who demonstrated that the pitch of a fly's hum could be used to calculate the rate of its wingbeats. By matching the buzz to a known musical note, Hooke estimated how many strokes per second the insect made with its wings. He may have drawn inspiration from his own experiments with toothed wheels, which produced pitched sounds by the regular striking of teeth against a body. This principle – vibration frequency as pitch – later underpinned the Savart wheel, but also fed into the design of early electronic instruments such as Thaddeus Cahill's *Telharmonium* (1906) and Léon Theremin's *Rhythmicon* (1931).

Music – despite its abstract state – forms an effective virtual environment within which musical objects 'move' and imitate animals. Saint-Saëns's *Carnival of the Animals* (1886) maps musical ideas onto the form, personality and movement of different creatures: ponderous double basses for the elephant, and the 'fluid' piano glissandi of the aquarium. Velocity, heaviness and 'texture' are made music. These can become rather specific. A bee, for instance, moves small distances but rapidly changes direction. Not only its sound but its position in space is immediately apparent in Rimsky-Korsakov's *Flight of the Bumblebee* (1899–1900). While the buzzing movement may seem chiefly onomatopoeic, when we plot the melody in a circular orbit (where distance from origin is pitch and melodic trajectory is direction), the similarity in movement become quite apparent (see Figure 2).

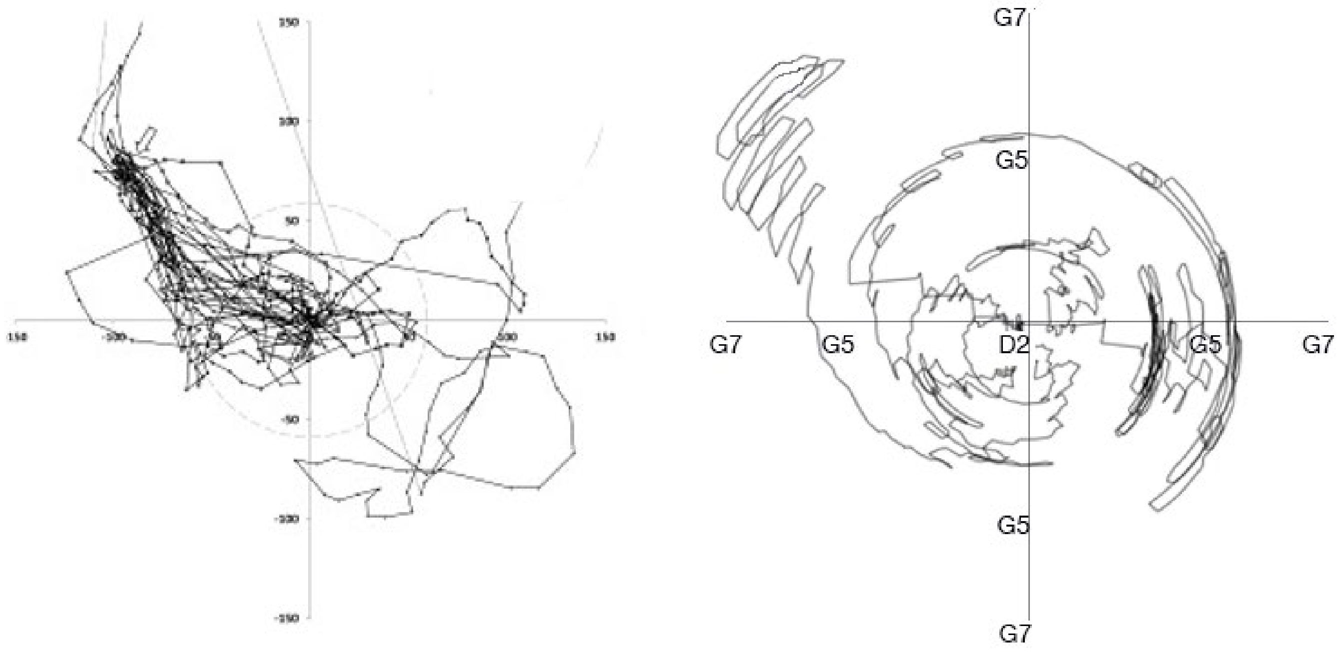

Figure 2: On th the left, the homing flight of bumblebee (from Wolf et al. (2014), next to a rendering of the *Flight of the Bumblebee* melody in circular orbit where pitch is radius (distance from origin) and circular direction is determined by melodic trajectory (Mermikides 2025). There is similarity in the frantic 'scribbles' blanched by occasional darting 'searches'.

Alongside movement, composers have often tried to mimic the sounds that animals themselves make. Traditional Chinese qin pedagogy uses poetic vignettes of animals to elicit appropriate expressive playing in the student. Aboriginal Australian didgeridoo playing likewise incorporates animal sounds, with players using vocalisations and overtones to evoke dingoes, kookaburras, and frogs. The disarmingly accurate 'elephant call' technique – using distortion, harmonics in clusters, volume swell and tremolo bar –is a famed party trick of electric guitarists Country guitar is infused with 'Chicken-picking' a set of muting and popping articulations imitation the *ba-ka* cries of chickens. More subtly, Stevie Ray Vaughan attributes his powerful Texas shuffle swing rhythm to that of a 'horse walking'. Inspired by this I have explored a wider catalogue of horse gaits as sources for rhythmic feels (including the extraordinary four-beat *tölt* of Icelandic horses).

Birds, however, occupy a special place in the history of music. Unsurprising as they appear to share the pitch/interval discretisation of human music. Ottorino Respighi's *Pines of Rome* (1924) goes as far as including a recording of a nightingale, the earliest example of integrating taped sound into an orchestral piece. Olivier Messiaen devoted much of his career to transcribing and celebrating birdsong, most famously in his *Catalogue d'oiseaux* (1956–58), which painstakingly renders the calls of species from across France into virtuosic piano works. For Messiaen, birds were not simply sources of inspiration but co-composers. In this presentation I extend this tradition by going beyond simple quotation. Using slowed-down recordings of songbirds such as the Eurasian wren and the song thrush, as notation to a flautist. At normal speed these songs are impossibly fast and high for human performers to replicate, but stretching them reveals intricate melodic contours and rhythmic designs. Speeding up these detailed performances of accomplished musicians form remarkably convincing imitations. With a little EQ we've even managed to fool a bird call app into believing a piccolo was a song thrush.

Music in Animals

If animals have long served as inspiration for human music, a more provocative question is whether animals themselves exhibit a sensitivity to musical parameters such as pitch, rhythm, and timbre. To ask this is to probe the evolutionary roots of musicality: how deep in our shared ancestry might the capacity for music lie? One archaeological artefact that sparks this discussion is the purported "Neanderthal flute," a bone fragment discovered in Slovenia in 1995 with holes aligned in a way that suggests a fingered wind instrument. If correct, we might then wonder about the "most recent common ancestor of music" – the point in our lineage where sensitivity to organised sound began to flourish as a cognitive and social tool. Chimpanzees, our closest living relatives, have been observed to distinguish between consonant and dissonant intervals, suggesting that at least some preferences for harmonic structure are not uniquely human. Yet when it comes to rhythm and beat induction, primates seem less adept. Despite an ability to produce rhythmic drumming, they do not appear to lock into external beats the way humans readily do. This makes the case of Snowball, a sulphur-crested cockatoo, all the more striking. In 2007 videos of Snowball dancing (with remarkable character and groove) went viral, and subsequent scientific studies confirmed that the bird adapted its movements to the beat of the music. Beat synchronisation – the ability to entrain movement to a pulse – had long been assumed to be uniquely human, since it was not demonstrated in non-human primates. Snowball's example, along with later evidence of seals and other vocal-learning species responding rhythmically to music, suggests that beat perception may have evolved multiple times in different lineages, linked to the neural machinery required for vocal mimicry.

In terms of timbre, domestic cats – it seems – have learned to manipulate their purrs so as to target a frequency band associated with an infant's cry (see McComb et. al. 2009) in order to gain our attention (and their bidding). This is similar to how composers and performers (such as belt voice, distorted guitars and high violin lines) induce such arresting *frisson* in the listener, a mixture of chilling alertness and cathartic relief when resolved.

The 'rhythmic grid' – a rather robust criteria music holds over spoken language – is also observed in animals. The Eurasian *scops* owl produces a call whose periodicity is so remarkably regular that my wife and I have used its hoot to support our nighttime guitar practice in long hot summers. It turns out that this accuracy (within the range of professional musicians, outperforming the general public) is tight within individual owls, but differs *between* them, the hypothesis being that it may be a form of identification (in effect broadcasting "(not) my tempo")

The Musical Language of Animals

We should of course take ourselves out of the conversation and move beyond our own imitation of animals, or their response to our music. What do we know of animals' own sonic communication and its link to music. This burgeoning field of *zoomusicology* has revealed that many species show structural organisation that parallels the parameters we call musical: pitch, rhythm, timbre, phrasing, and even variation over time.

Frogs offer a case of arranging and mixing. In dense choruses, male frogs avoid masking one another by shifting frequency bands. This "acoustic niche partitioning" or "leapfrogging" creates layered textures where individuals remain distinct to potential mates (Schneider & Sinsch 2007). The strategy echoes the registral separation used in human polyphony. Birds show grammatical organisation too. Nightingales and thrushes build repertoires from recurring motifs and improvisatory recombinations, while zebra finches learn song socially, in stages that resemble infant speech acquisition (Catchpole & Slater 2008). The song of the Hermit Thrush relates to the harmonic series (a fundamental reference point in human music). Songbirds also display categorical perception: they divide continuous acoustic changes into discrete steps, much like humans hearing pitches and rhythms as units (Nelson & Marler 1989). Other animals reveal similar structural richness. Crickets synchronise their chirps with nearby individuals, producing entrained group rhythms (Greenfield & Roizen 1993). Elephants communicate with infrasonic rumbles that can travel for kilometres, often organised into repeated, phrase-like contours (Poole et al. 1988). Gibbons, meanwhile, perform duets in which male and female parts interlock with striking precision, creating antiphonal exchanges that resemble call-and-response (Geissmann 2002).

Whales provide one of the most compelling examples of musical communication in the natural world. The acoustic environment of the ocean plays a crucial role. Whale songs are adapted to the SOFAR channel, a deep sound channel where low-frequency sound waves can travel with minimal attenuation. By using this natural waveguide, whales are able to transmit their calls across thousands of kilometres, effectively turning the ocean into a resonant instrument (NOAA, 2023). In one of those rare cross-disciplinary flashes, underwater acoustician Michel André invited Senegalese drum master Arona N’Diaye Rose to listen to sperm-whale click trains; within minutes Rose parsed the rhythms and even inferred how many whales were present—a conclusion the research team later verified after months of analysis (André & Kamminga 2000; ISEA2010 Proceedings). Recent research has shown that humpback whale songs exhibit statistical structures similar to those found in human language. Arnon et al. (2025) demonstrated that repeated sound elements are organized into higher order units, with hierarchies of phrases and themes that unfold over long periods of song. Their analysis revealed that humpback songs do not simply repeat motifs, but instead follow rules of element frequency and transition that resemble the grammars underlying human speech. The way these songs evolve over time also points to cultural transmission. Garland et al. (2022) documented “song revolutions,” in which one version of a song rapidly sweeps through a population and replaces earlier versions. These changes can move directionally across populations, spreading across ocean basins and showing that whales transmit song patterns on a large scale.

What makes these systems “musical” is partly their internal organisation and partly their expressive effect. The downward swoops, vibrato, and abrupt leaps that animals employ are the same acoustic cues humans use for emotion in speech and song (Morton 1977). Thus, when listeners describe whale song as haunting or a gibbon duet as plaintive, they are responding to real structural features that overlap with our own expressive repertoire.

The Music of Life

Artists such as David Rothenberg and Scanner (Robin Rimbaud) have taken the idea of an interspecies shared language into field practice, playing clarinet in dialogue with whales, improvising alongside cicadas, and duetting with nightingales. Their work demonstrates that animal and human musicians share tendencies toward repetition, variation, and call-and-response, with moments of genuine synchrony (Rothenberg, 2019). This idea of trans-species musical sharing also appears in the work of Tomás Saraceno in *Arachnid Orchestra / Interspecies Jam Sessions*, where spider webs are treated as instruments. Research teams have used piezoelectric sensors to capture web vibrations, translating string tension and fiber architecture into audible frequencies so that humans and spiders may effectively perform together (Saraceno, 2015). At MIT, Markus Buehler’s group scanned spider webs in three dimensions and sonified them through virtual instruments, assigning fiber lengths, tensions, and connectivities to parameters of pitch and timbre. The result is a haunting music that reveals the structural harmonies of webs themselves (Buehler et al., 2021).

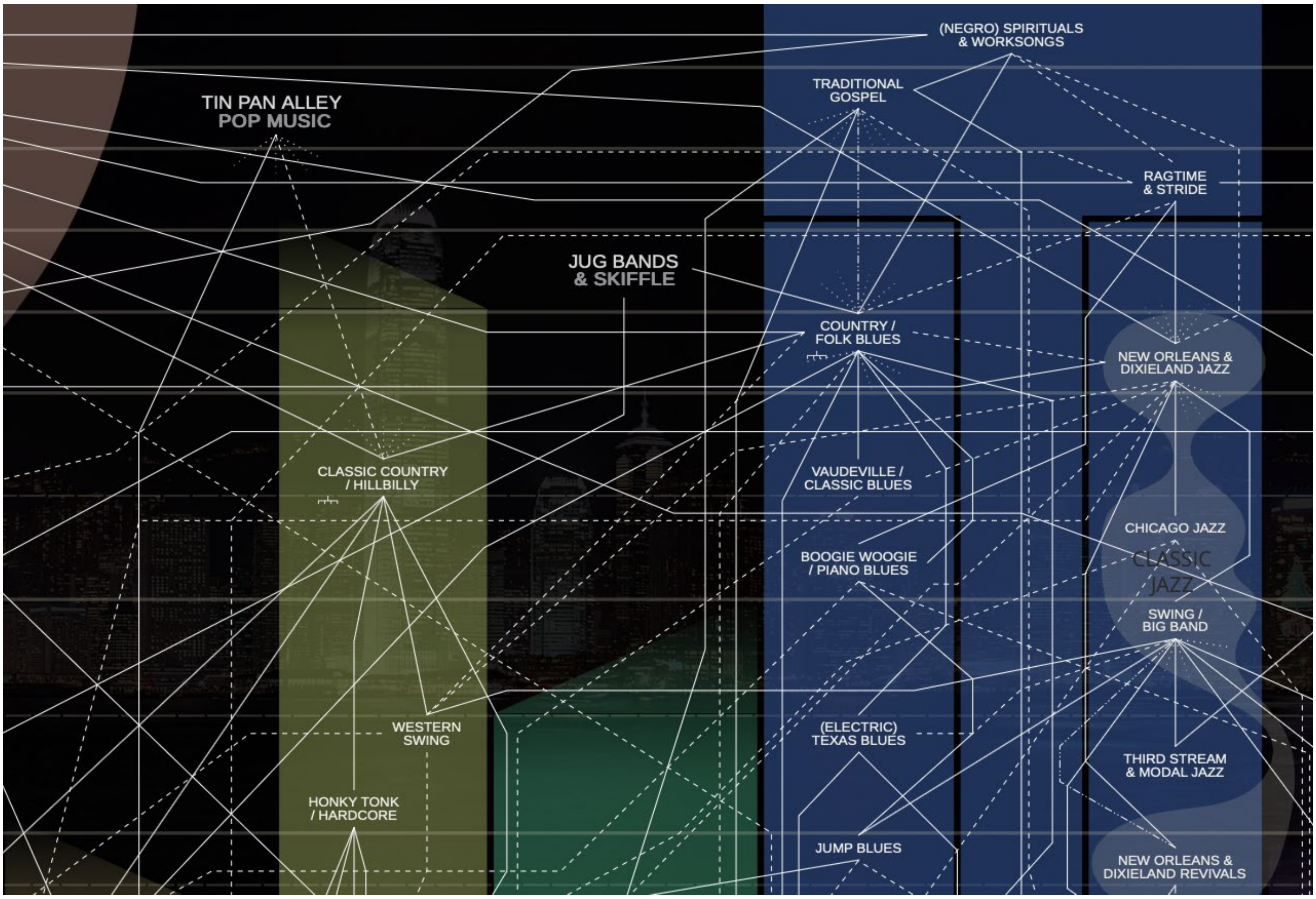

Figure 3: A small excerpt of the ambitious attempt of a 'musogenealogy', echoing the evolution of species (source: musicmap.info)

The burgeoning field of sonification, allowing for example, the hidden algorithms of bird murmurations to be connected to musical parameters (see Deighton 2025) suggests life itself converges in musical patterns that can be heard if we listen in deep. My own work during the COVID-19 pandemic explored the same principle at the microscopic level. I mapped viral mutations of SARS-CoV-2 onto pitch and rhythm to produce an evolving choral piece, allowing the mutations of a pathogen to be heard as a mutated motif. In this sense, biological processes themselves became compositional processes. In essence we can borrow from the algorithms that the animal kingdom has found – such as the elegantly simple swarming rules producing the beautiful murmurations of starlings – in order to create our own music.

DNA is perhaps the most elemental score, encoding instruction and substance simultaneously. Like DNA, a core of musical listening requires no external referents. Musical objects form structures in time, pitch and timbre which provide a structure for musical material and meaning to emerge.[3] It contains within it, the logic of its own unfolding.

From such a perspective one might think of the evolution of life as a grand and self-composing musical work, from the motif of mitochondrial Eve, the motivic variations at every branch, to the origin of self-aware human lineages, perhaps the first to truly listen. As Lucretius imagined, just as birds may have taught humans to sing before art began, all living creatures are fellow players in this biological orchestra.

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[3] See Ockelford's *Zygonic conjecture* suggesting music emerges from 'imitative bonds' in the listener's mind. An accessible introduction can be found in *Comparing Notes: How we make sense of music* (2017),

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And all the unknown (but unharmed) animals for lending us their music for this event.

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An entire programme of foundational musical material may be found in my inaugural lecture series, the inversely named *The Nature of Music*:

https://www.gresham.ac.uk/watch-now/series/nature-music