Embodied Vibrations: Noise, Mood, & Subtractive Synthesis in High Intensity Acoustic Experiences

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Abstract: *In this paper, we argue that the acoustic phenomenon of Sympathetic Resonance and Subtractive Synthesis can be deployed to clarify the somaesthetics of mood and attention. Leaning on recent work on the notion of "atmosphere" and several classic conversations about the sharedness of moods from thinkers like Hubert Dreyfus and Sarah Ahmed, as well as on a reading of music theory and an analysis of experimental music performances, we argue that Subtractive Synthesis provides a model for understanding how lived presence and attention emerges as co-constituent with the noisiness of life. Put more bluntly, Subtractive Synthesis allows for the possibility of a "Sympathetic Resonance," where a given person, properly calibrated through the unfolding of their embodied life "vibrate" alongside or in the midst of the possibilities of a given moment. This understanding of embodied attention clarifies the necessity of pluralism in lived engagements and suggests that political attempts to homogenize experience are not only doomed to fail but based on a fundamental misunderstanding of the sharedness of our attentional realities.*

Keywords: *Sympathetic Resonance, Attunement, Atmosphere, Experimental Music*

Noise, Atmosphere, and Intensity

Life is often loud. In the modern world, perhaps more than ever before, we are constantly beset by a range of messy, noisy, confusing, and often destabilizing auditory experiences that put pressure on our capacity to cope with our shared environment. This noisiness is so pressing that Susan Buck-Morss has (alongside Walter Benjamin) suggested that the condition of modernity is one of shock (Buck-Morss 1992, 16). Our bodies rumble as trucks vibrate the air around us and the ground under our feet, our phones and devices constantly ring with updates and alerts, our washers beep, our televisions blare, and far too many of us are confronted with the violent explosions and earth-shattering collapse caused by munitions and weaponry. According to Buck-Morss, Cressida Heyes, and others, one common response to this shock is a kind of self-anesthetization, or a volitional dulling of our senses to minimize or drown out the chaotic noisiness that threatens to overwhelm us (Heyes 2020, 2).

In general, noise is treated as something that confronts, challenges, disrupts, and even damages us and our capacity to engage with our world and each other.[1] This characterization

1 According to Vasilicos et al, "noise is often referred to in at least five main registers: (a) as clamour, commotion, or din; (b) as disagreeable or

is often apt—trauma of all sorts emerges from the chaotic and noisy disruption of life. Noise can cause deep discomfort.[2] And yet, there are many among us who seek out the noisy and chaotic, perhaps most often through music. Heavy metal, punk rock, hardcore, and even less culturally provocative forms of music play into an aesthetics of the loud and the messy, and people continue to flock in droves to crowded sweaty basements where highly distorted and chaotic auditory experiences rattle their bones and destabilize their sense of time and space.

These experiences of what James Dow refers to as "heavy timbres" (Dow 2026) might fit well into Heyes' account of the anaesthetics of experience—of deliberate numbing to cope with the chaotic uncertainty of modern life (Heyes 2020, 3). But they might also tap into something less modern and perhaps "deeper" about human experience. Though this possibility won't be fully explored here, in what follows we will suggest that noise, acoustic and otherwise, might be one of conditions for the possibility of human attention and presence. In short, noise of nearly all kinds might be understood as the chaotic field of possibilities out of which our attention and presence are able to be formed.[3] In that way, noise may be the inexhaustible well of our possibilities, and, consequently, something we should be careful with when trying to minimize.

In a 2007 lecture on Heidegger's *Being & Time*, Hubert Dreyfus claims that the "ontology of moods" is experienced as "shared atmospheres [within] which people...resonate" (Hubert Dreyfus 2007). Dreyfus here seems to imply that the affective "atmosphere" of our shared embodiment can be understood in terms of a kind of auditory phenomenon–a sympathetic vibration or "resonance" within the background "noise" of an event or situation. He goes on to say that there can be "breakdowns" in this resonance, where people "aren't resonating with anything. They are just [encountering] some debris in their minds" (Hubert Dreyfus 2007)

Dreyfus (and, through him, Heidegger) are here engaging with a core question in somaesthetics—in what way are we able to gain access to a shared sense of an environment or experience? Or, more directly, how is it that human persons are able to tap into and exist in the midst of a shared environmental reality or situation—what we might call an "atmosphere" or the shared mood of an event or space?

Conversations about somaesthetics and atmospheres have become increasingly common in recent years. In addition to several conferences in 2024 and 2025,[4] there have been a number of important articles[5] published on both a general somaesthetic understanding of "atmosphere" and applications of the concept to discussions of technology and spirituality. Building on Gernot Böhme (2017, 2021) and Albert and Chen (Albert and Chen 2023), Tschaepe and Hunter describe atmospheres as "what brings together human situations and qualities of environments…" (forthcoming, 1). Further, atmospheres "may be considered as the space of experience within a particular context or situation that necessarily contains a certain mood or tone….They are *mood-defining spaces* or *spatially extended moods*" (forthcoming, 2). For Albert and Chen, an atmosphere is "the haptic sensation of being in the world at a specific place and time, the actuality of existence" (Albert and Chen 2023, 78). More colloquially, atmospheres are the vibe or the energy of a space and/or event that can be picked up by individual human participants. Types of spaces and events commonly generate certain kinds of atmospheres—

vexatious sounds; (c) as manifestations that disturb, obscure, and make uncertain; (d) as stimuli or data that are irrelevant or devoid of meaning; (e) as sheer sound or sound that is unidentified" (Vassilicos et al. 2025, 4). In what follows, our sense of noise is intended to touch on all four.

2 See (M. D. Tschaepe 2024), especially Chapter 2 for a careful discussion of the many valences of discomfort.

3 This view is related to Alva Noë's observation in Strange Tools, that perception is a kind of achievement that takes place in part through our capacity to non-thematically block out or restrict our vision by winnowing down the field of our attention (Noë 2016, xii).

4 Including the 2024 "Somaesthetics of Atmosphere conference hosted by the Center for Mind, Body, and Culture, and the follow-on conference "Atmospheres of the Spiritual: Somaesthetic Explorations" the following year.

5 Including (Anderson 2009), (Mark D. Tschaepe and Hunter forthcoming), (Fiala 2023)

spas are relaxing, sports games are exhilarating, fireside chats are cozy, and so on, and everything from architecture, to cleanliness, to the excitement, or lack thereof, of participants can contribute to an atmosphere (Mark D. Tschaepe and Hunter forthcoming, 2).

Building on Heidegger's infamous discussion of "mood" or "attunement" [*Stimmung*] in *Being and Time*, Dreyfus seems to suggest that we can gain access to the sharedness of an atomosphere in terms of an acoustic metaphor (Heidegger 1962, chap. 5). In short, the experience of the "mood" or "atmosphere" of a space or situation can be understood in terms of a) how a given person "resonates" with the atmosphere of a space, and b) how the space and atmosphere themselves are attended to in virtue of a kind of "subtraction" or removal of extraneous potential objects of attention for the sake of the focal phenomenon. In other words, we are able to find ourselves in an at least partly sensible coherence with the world around us through resonant encounters with different "threads" hiding within the noise of being. Likewise, we are able to gain access to these threads in virtue of how we are already "tuned" to be able to experience them. For instance, gaining access to the atmosphere of a given concert might depend a) on whether I had experienced and enjoyed similar acoustic experiences previously, b) if I am well rested and not experiencing any physical limitations, c) if I am appropriately disposed to the style of the social environment, and so on.

The sharedness of moods is a commonly noted phenomenon. A holiday party can be cheery or dull, time with friends can be melancholic or joyful, a classroom experience can be enriching or tense, and so on. However, some of the most potent and least articulable examples of shared moods involve live music performances, many of which are characterized by senses of connection and resonance among concert-goers on the one hand, and extreme bodily and auditory intensity on the other. In this paper, we explore the acoustic metaphor and suggest that careful attention to the somaesthetics of noise can give us insight into the sharedness of moods while also helping to answer questions about why some people seek out intense auditory experiences. For the work at hand, we are particularly interested in experimental heavy music, or music that involves intense and often overwhelming auditory experiences characterized by seemingly chaotic sonic features, high volume, body vibrations, and what is colloquially referred to as "noise."

These kinds of experiences reveal how the process of "resonating" with that noisy intensity expresses a particular kind of enactive/co-constitutive engagement between a person and their world, and, ultimately, why attention to noise and noisiness have the potential to disrupt the normative politics of homogeneity expressed by contemporary political powers. Through examining high intensity auditory experiences ("noise shows," doom, metal, etc.), we argue that the auditory phenomenon of Sympathetic Resonance and Subtractive Synthesis can be deployed to reveal core aspects of lived experience. In particular, we argue that Subtractive Synthesis provides a model for understanding how lived presence and attention in a particular environment or situation emerges as co-constituent with the noisiness of life. Put more bluntly, a process of Subtractive Synthesis (understood as the process by which certain sub-frequencies are stripped away from a noisy composite source to reveal a resonant signal) allows for the possibility of a "Sympathetic Resonance," where a given person, properly calibrated through the unfolding of their embodied life is able to "vibrate" alongside or in the mist of the possibilities of the moment they are currently encountering. This understanding of embodied attention clarifies the necessity of pluralistic dynamism in lived engagements with a given moment and suggests that attempts to homogenize experience are not only doomed to fail but based on a fundamental misunderstanding of the sharedness of our attentional realities.

The following argument proceeds in four stages. In Part 1 ("A Somaesthetics of Embodied

Noise"), we provide an overview of a somaesthetics of mood and atmosphere inspired by Hubert Dreyfus and Sarah Ahmed and then provide our first foray into an account of intense auditory experiences. In Part 2 ("Acoustic Technics"), we provide a brief overview of the science and history of Sympathetic Resonance and Subtractive Synthesis, with an eye to how these two concepts can inform our understanding of moods and atmospheres. In Part 3 ("Resonance & Resistance") we apply the concepts developed in Part 2 to clarify the account offered in Part 1, and ultimately suggest that this way of approaching the somaesthetics of atmosphere encourages us to prioritize dynamism, plurality, and emphasis on experiences of noise as a way of counterbalancing forces that aim to enforce normative and homogenizing understandings of how to best share our reality.

Part 1: A Somaesthetics of Embodied Noise

Dreyfus, Ahmed, & Resonance

Hubert Dreyfus' 2007 lectures on *Being and Time* are a tour-de-force in philosophical interpretation. While mostly remaining close to the inciting text, Dreyfus also embarks on several attempts at expanding and enriching Heidegger's approach to phenomenology, often inspired by questions and comments from his students. Of particular note is one such exchange with a student while discussing Section 1, Chapter 5, of *Being and Time* titled "Being-In as Such." This chapter is dedicated to characterizing how Dasein[6] encounters itself as always already attuned to the world it inhabits in a variable yet particular way. In other words, our being is largely characterized by a disposition or mood that unfolds variably throughout the moments of our life, but also provides our sense of the tone, energy and "vibe" of a given experience. According to Dan Dahlstrom,

> Moods are different ways in which we are oriented to this or that, ways that disclose our situation holistically (albeit not completely). They affect how the world and entities within the world appear to us, e.g. as inviting or irritating, enthralling or threatening. Moods are pre-reflective, and they are matters neither of our choice nor our making. Instead they come over us as part of our thrownness into the world. (Dahlstrom 2013, 113)

All of this is to say that moods, though variable and dynamic, are what grounds our orientation in the world, and help characterize and shape the field of our possible engagements. According to Sara Ahmed, "a mood is thus rather like an atmosphere: it is not that we catch a feeling from another person but that we are caught up in feelings that are not [fully] our own" (Ahmed 2014, 15). For Ahmed, importantly, we can often miss out on connecting with a particular mood. To become attuned to another person or a group involves an often deliberate process that can be derailed or disengaged for any number of reasons. In other words, perhaps contra Heidegger, we are not simply receptive to moods but instead take an active role in opening ourselves to the possibility of certain moods while also characterizing our willingness to engage with certain kinds of sociality.

Perhaps prefiguring Ahmed, Dreyfus too describes moods as "shared atmospheres [with] which people...resonate" (Hubert Dreyfus 2007). The term resonate is of particular importance, and highlights Ahmed's concerns about how and in what way we are able (or not able) to enter into moods. For Dreyfus, these are "breakdowns" in resonance, where people "aren't resonating with anything. They are just [encountering] some debris in their minds" (Hubert Dreyfus 2007). Earlier in the same lecture, he suggests that when people are out of sync with a given mood,

> it's like saying a string in the piano is attuned to middle C but it's not resonating to middle

6 Heidegger's word for a human person, often translated as both "Being-Here" and "Being-There."

> C. No, in Heidegger's language…when you're attuned to it, that just *means* that that aspect of the situation is what matters to you...it isn't that everybody has to be in the *same* mood, it's that when you're in any mood, it's the atmosphere…so that *everything* is disgruntling to the disgruntled person, even though in fact *everything* isn't disgruntling really, because everything can be promising [for example] to the happy upbeat person. If it's a mood, [the person in the mood] senses it as the whole situation…that's what they attune to, that's what they resonate to. Everything else in the situation they are blind to. (Hubert Dreyfus 2007)

In other words, resonance is not a matter of mere opinion, nor can we by fiat force ourselves to resonate with a given situation. When we enter into a mood, we participate in an only semi-volitional resonance with the possibilities made available by the coming together of our existing conditions and the affordances of the space of the mood (the venue, the group of people, the friends, etc.). Even so, moods aren't merely private. While everyone in a given group experiences a mood from their particular perspective, bringing their own sedimented and embodied history to bear on the present experience, people who are genuinely disconnected from the mood of a space are, in a sense, out of touch with what is on offer.

This tension raises a potent set of questions. Under what circumstances are we able to resonate with a given mood or atmosphere, and in what ways do our various personal idiosyncrasies light up different aspects of our shared reality? In other words, what accounts for both our success and failures in aligning with one another through our moods? Likewise, how are we to account for the differences in ways we respond to the mood on offer?

Noise & Heaviness

Before proceeding to unpack the above questions, it will be helpful to examine a particular kind of mood. Many of us are familiar with the various ways that live music can generate specific kinds of moods. The particular tone and quality of the music, the presence and energy of a crowd, the choices in lighting, venue, and stage direction all come to bear on developing a specific mood in the space. Frequently these moods are characterized by a kind of "easy access" dynamic flow that has the effect of smoothing over rough edges and inviting people into a mostly coherent and fluid set of experiences. Most popular forms of music fit this description. While the music and mood may not be to everyone's taste, the environment and music play into existing musical conventions that are accessible to a wide audience.

Experimental music (here including genres like noise, industrial, ambient, drone, free improv, and so on) takes on a profoundly different strategy. As the title suggests, experimental music tends to eschew traditional musical conventions and "experiment" with the possibilities of sound, sometimes regardless of whether those possibilities would produce traditionally "pleasant" experiences. Though not universal, many of these experiments are distinctly "noisy" in the sense that they present chaotic and often seemingly disorganized auditory experiences that defy easy classification into melody, rhythm, or any of the other conventional markers of traditional music. Of particular note (among many) are artists like Sissy Spacek (2025), Lawrence English (2022), and SUNN O))) (2026), all of whom regularly experiment with different ways of constructing and organizing sounds that produce audible environments characterized by dissonance, intensity, discomfort, and a lack of traditional musical organizational structure. To a listener more accustomed to popular music, these artists are all distinctly noisy and often unsettling.

Similarly, the live performances by artists like these tend to lean into pushing the limits of intelligibility in both auditory and embodied ways. Venues are variable, but are often small,

dark, and cramped while various instruments, synthesizers, and other sound production technologies are routinely amplified well beyond the range of comfortable hearing. SUNN O))) is particularly famous for producing soundscapes that are so intense that they induce involuntary bodily vibrations and resonances among concert goers. The mood of these spaces varies widely as well, ranging incredibly active and energetic to meditative and almost trance like. Lawrence English, for instance, often uses sampled recordings of natural environments (e.g., a blizzard in Antarctica[7]) layered repetitively over the top of one-another to induce a wave-like sense of repetition and abstraction.

Key to all of these performances is how the artists involved deliberately confront their audiences with sounds that are deliberately disruptive, alienating, disorienting, and confusing, often bordering on Julia Kristava's sense of the abject (Kristeva 2010). Indeed, to use Samantha Pentony's language, in environments like these, meaning seems to "collapse," and the mood is one of dissolution into a passive reception of the possibilities of audible experience (Pensstony 1996). In performances where heaviness is prioritized, there is often a sense of melting or dissolving into the noise as one's body is compelled to vibrate at whatever low frequencies are generated by amplifiers.

What makes performances like these appealing to audiences and what might they tell us about atmospheres, moods, and how we gain access to them? The answers to the first question are as variable as audience members themselves, but in what follows we will suggest that these kinds of noisy and chaotic experiences are attractive in part because they open an atmosphere of experimental vulnerability where audience members are both invited into a dynamic play of sonic and embodied possibilities while at the same time overcome by their receptivity to resonances laden into their sedimented and embodied being. In other words, experimental music makes demands on a listener based on their existing physical, psychological, and historical personhood while also inviting dynamism and variability in how those demands unfold internally. The mood is there for us to pick up (in fact, in some performances, it almost forces itself on us), but its noisiness provides a space where the interaction between our cognitive and perceptual systems and the sound on offer is open to new possibilities of pattern formation and engagement.

Part 2: Acoustic Techniques

To clarify the above account, it will be helpful to provide an overview of several concepts that are central to the study of acoustics. Though Subtractive Synthesis and Sympathetic Resonance are the two concepts most germane to this inquiry, in what follows we will also highlight the harmonic series, overtones, and Fourier transforms. This overview should allow for a more careful engagement with Dreyfus' acoustic metaphor.

Subtractive Synthesis

Subtractive Synthesis is a technique of forming complex timbres. Starting from a noise generator (or other complex sound) and using a series of filters, frequency bands are removed from the initial sound, resulting in a new timbre. The metaphor of sculpting is helpful in making sense of the phenomenon. A sculptor may begin with a basic material (a block of wood or stone) and then slowly carry away the "excess" till they reach the desired shape. This process is in contrast to *creatio ex nihilo* or creation from *tabula rasa*. Instead, in a sense, the desired object is "lying dormant" within the "noise" of the original object, be it stone, wood, or literal noise, and the artist must perform a series of operations to strip back the noise from the original tonality,

7 (English 2022)

revealing the desired "signal."

The human voice produces the specific and differentiated sounds necessary for human speech through a similar process. Roughly put, we push our breath out of our lungs and through our throat, which, through a series of muscle contractions, induces oscillations and wave patterns in the medium of the breath, which are again reshaped by mouth position. The result is a sound which has been winnowed into a shape that can be appreciated by the perceptual and cognitive systems of a listener as intelligible speech. The noisiness of our breath, filtered through our particular body, mouth, and nose, creates the timbre of our particular speaking voice (Einbond 2013, 57–58).

As a technique for producing music, Subtractive Synthesis was first developed in the 1950s during the early days of electronic music.[8] Its inverse, Additive Synthesis, was developed in preceding decades as a method of creating new timbres by combining multiple simple oscillators and recording the resulting combination or overdubbing them (Huff 2020, 85). Given the tape-based technology of the time and the bulk and expense of oscillators, it was exceedingly difficult to build sufficiently complex timbres. A composer would have to record the sine wave from an oscillator onto a piece of tape and then combine multiple sine waves together onto a four-track tape recorder. If more than four was desired, a composer would then have to repeat the process on a new piece of tape and then record over the top of the previous four-track recording. A composer would then have to repeat the process on a new piece of tape and then record that new piece on top of your previous four-track recording (Huff 2020, 91–98). Additive Synthesis was also a logical extension of Western classical music. Most early electronic musicians were trained in traditional orchestration where the desired timbre was built via a combination of particular orchestral forces.

This historical precedent for Subtractive Synthesis is reflected in John Cage's attribution to Debussy the claim "I take all the tones there are, leave out the ones I don't want, and use all the others" (Cage 2010, 118). However, the origin of Subtractive Synthesis can be traced most clearly to the so called "cold war" between German studios and their preference for "pure sound" and the French radio use of more collage-based tape techniques now known as *musique concrète* (Toop 1979, 380; Huff 2020, 21, 76, 81). German composers such as Karlheinz Stockhausen and Herbert Eimert and their *elektronische musik* emphasized "pure synthesis" techniques that employed noise generators and simple filters to build complex timbres without needing to resort to manipulating instrumental recordings or collaging pre-existing sounds. At the same time, French *musique concrète* composers such as Pierre Schaeffer and Pierre Henry were already deploying the same technique, but mostly using pre-existing sound sources filtered into new sounds. Subtractive Synthesis was famously utilized in Stockhausen's 1954 piece *Studie II* and was used again in his 1956 piece *Gesang der Jünglinge*, remembered as one of the first Western electronic music "masterpieces" (Huff 2020, 85; Toop 1979, 391; Morgan 1991, 466).

Harmonic Series / Overtones

To clarify Subtractive Synthesis and Sympathetic Resonance, it is helpful to first understand the harmonic series, overtones, and partials. All sounds (other than the simple sine wave) contain a complex mixture of many sounds at various frequencies.

Within every sounding tone, at varying intensities and forming timbre, lies "a whole series of higher musical tones which we call the harmonic upper partial tones" (Helmholtz and Ellis 1895, 22). The simple ratios described by the Pythagoreans when experimenting with

8 One famous example comes from the early electronic music experiments in the WDR studio in Köln, (Huff 2020, 85).

monochords and the proportionate properties of strings and their divisions can be used to build up this "harmonic series." As a basic illustration, if we divide a length of string in half and then pluck the shortened string with the same force, we will cause that string to vibrate twice as fast as the full string, giving a ratio of 1:2. This causes the sound to become one octave higher than the original string. If we divide our initial string into three equal parts, we develop the ratio of 1:3, creating a tone an octave plus a fifth higher than the original tone. As Cazden writes,

> The harmonic series…is further interpreted to provide an elegant, automatic and inescapable natural guide to…a gradation among consonant values of intervals, with those lowest in the series, and hence of simpler ratio, being superior, and with those requiring higher numbers placed in decreasing rank order of natural perfection… (Cazden 1980, 130)

According to Adrian Rice,

> Each harmonic oscillator will have a lowest possible frequency, f, which determines the note created when oscillations occur along the whole length l of the string or air column. This fundamental frequency f almost always has accompanying faster sound waves called overtones which, ideally, have frequencies $f, 2f, 3f, 4f, 5f$, etc. Consequently, the wavelengths of these harmonic overtones will be $l, ½\,l, ⅓\,l, ¼\,l, ⅕\,l$, and so on. It is from this sequence of "harmonic" wavelengths that the harmonic series gets its name. (Rice 2011, 269)

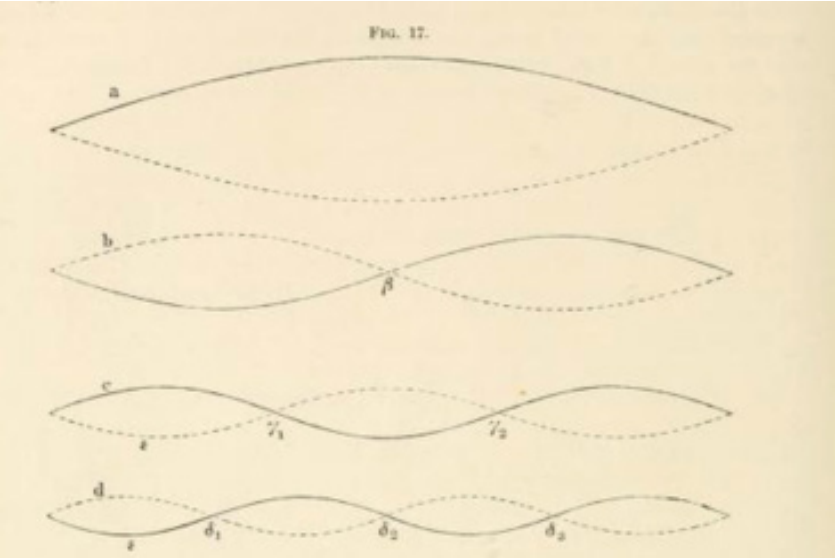

Figure 1: Helmholtz's Diagram of the Harmonic Series (Helmholtz & Ellis, 1895, p. 46)

These "harmonics" or "partials" can be found by lightly touching your finger against a string instrument's strings at proportional intervals.

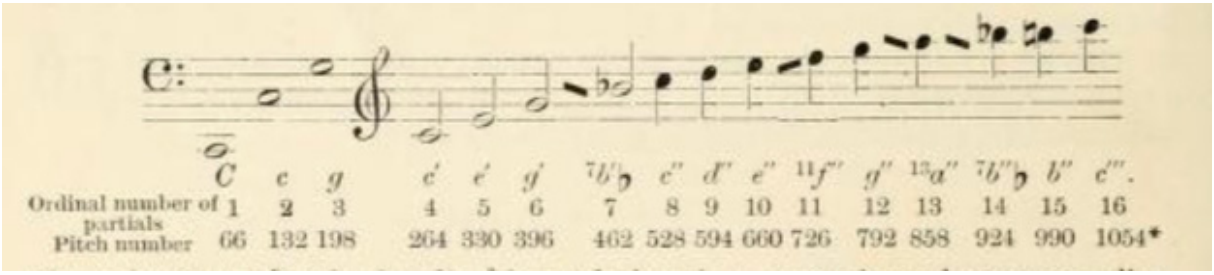

Figure 2: The harmonic series based on the fundamental of C2, including partial numbers and "pitch number" (or frequency in Hertz) (Helmholtz & Ellis, 1895, p. 22)

Fourier Transforms

Those sounds can then be broken down into their constituent parts via Fourier transforms.[9] Henrich Helmholtz is credited for first applying the concept of Fourier transforms to sound waves, arguing that "any given regular periodic form of vibration can always be produced by the addition of simple vibrations, having pitch numbers which are once, twice, thrice, four times, &c., as great as the pitch numbers of the given motion," and further, that

> any vibrational motion of the air in the entrance to the ear, corresponding to a musical tone, may be always, and for each case only in one single way, exhibited as the sum of a number of simple vibrational motions, corresponding to the partials of this musical tone. (Helmholtz and Ellis 1895, 34)

Interestingly, Helmholtz goes on to stress how these "simple vibrations" may or may not be readily perceptible themselves,

> ...any form of vibration, no matter what shape it may take, can be expressed as the sum of simple vibrations, its analysis into such a sum is quite independent of the power of the eye to perceive, by looking at its representative curve, whether it contains simple vibrations or not, and if it does, what they are. (Helmholtz and Ellis 1895, 34)[10]

Rayleigh describes Fourier's achievement as, "...it has been proved by Fourier, that the most general single-valued periodic function can be resolved into a series of circular functions, having periods which are submultiples of that of the given function" (Rayleigh and Lindsay 2011, 17)

This application of Fourier transforms makes possible the construction and filtering of sounds. If we know that a complex sound has a wide range of frequencies involved in its propagation, then we can choose to remove a selection of frequencies and still leave enough remaining such that the sound isn't entirely attenuated.

Sympathetic Resonance

In short, Sympathetic Resonance can be understood as the way in which an object or material might be induced into parallel vibrations by an appropriate wave. Two analogues might help to clarify Sympathetic Resonance for the non-acoustician. First the common phrases "we're on the same frequency" and "that resonates with me" generally indicate more than simply mutual

9 Fourier transforms are named for Jean-Baptiste Fourier, the 18th century mathematician and physicist who, through the study of heat waves, discovered that complex waveforms can be broken down or decomposed into simple sine waves. As a corollary, simple sine waves can then be composed into more and more complex forms. For more on Fourier and Fourier transforms, see (Stein and Shakarchi 2003).

10 Today, the Fourier transform can be calculated on computers by a version of it called FFT or fast-Fourier-transform. See (Huff 2020, 77) and (Toop 1979, 383).

understanding. Instead, they gesture towards a deep, implicit, even embodied connection. Generally, this type of personal resonance is akin to how a tuning string vibrates in "sympathy" with a nearby sound source of the appropriate frequency.

A second example is perhaps more instructive. Consider a hand-dial radio. In order to listen in to a given radio station, the listener must manually adjust a dial that corresponds to an internal component that allows the receiver to pick up specific frequencies. When the radio dial lands on a frequency that matches the transmission of a near enough radio signal, the two come into resonance with each other, and the internal mechanism of the radio transforms that resonance into audible sound. The way of opening a channel between a receiver and a transmitter is through a mechanical and electric adjustment so as to allow the receiver to "inhabit" the same frequency as the transmitter.

In general, Sympathetic Resonance is a property of material objects to vibrate "in tune" with or at the same frequency as an encountered wave. Sound, which describes waves that are detectable by the human auditory systems, is the result of some kind of concussive action that causes the air around the impact to move in a wave pattern. Human hearing in general is made possible by the capacity of the tympanic membrane and other ear structures to vibrate in frequency with (to resonate with) ambient airwaves.

As the term implies, resonance (ultimately derived from the Latin *re+sonare*, or literally "sound again") contains an element of repetition and continuation. What is repeated are the highs and lows (more formally, crests and troughs) of the sonic wave form as it crashes into a material that can mirror its vibrational frequency, and, by extension, how the sound "keeps sounding" through the new material. According to Helmholtz, Sympathetic Resonance occurs when bodies "*continue* to perform…vibrations." It is worth quoting Helmholtz at length:

> Such an effect occurs in the phenomenon of Sympathetic Resonance. This phenomenon is always found in those bodies which when once set in motion by any impulse, continue to perform a long series of vibrations before they come to rest….provided the periodic time of the gentle blows is precisely the same as the periodic time of the body's own vibrations, very large and powerful oscillations may result. But if the periodic time of the regular blows is different from the periodic time of the oscillations, the resulting motion will be weak or quite insensible…. When, for example, the strings of two violins are in exact unison, and one string is bowed, the other will begin to vibrate. (Helmholtz and Ellis 1895, 22)

Resonance is the act of sound interacting with either a surface (in the case of the resonance of a space, echo, reverb, etc.) or another vibrating body continually until it ceases vibrating either the body itself or the air, whichever fades first.

To understand how one instance of vibration could put another, physically disconnected body into vibration, we must first understand another derivation of *sonare*: consonance, or per its etymology, "sounding-with" or "sounding-together" (Cazden 1980, 126).[11] In short, the multiple frequencies that become options for Sympathetic Resonance only exist in virtue of how they are consonantly related to each other. The aspect of objects that decides whether they resonate alongside one another is tied to the relationship between consonance and dissonance.

Debates have raged through music theory and musicology for decades regarding whether consonance and dissonance are culturally learned or mathematically and biologically inherent.[12]

11 See also (Parncutt and Hair 2011)

12 See (Cazden 1980). While it is our considered position that these two views are compatible and perhaps even mutually constitutive of each other, for the purposes of this paper, we are adopting the psychoacoustic "tuning system" terminology put forward by Cazden and clarified by (Cohen 2022) (wherein harmony is derived from the Greek term harmonia, which indicates a "fitting together").

Regardless, consonance occurs when two or more sounds can be heard together in such a way that they seem to blend or cohere with each other. For instance, a C played in two separate octaves appear matched with one another even though the sound waves are themselves quite different. For Carl Stumpf, consonance occurs as a sort of "fusion" that occurs when two or more tones "fuse" together into a "sum but not a whole" (Stumpf 1883, 127)[13]

The opposite of consonance, dissonance, occurs when two or more sounds seem to "clash."[14] Patrizio Barbieri provides much of the scientific background regarding *consonance* and *resonance* in his 2001 paper ""Galileo's" coincidence theory of consonances":

> A musical note is characterized by its frequency, i.e. the number of vibrations per second produced by the body emitting it. According to the above theory, the greater the number of "coincident" (i.e. in-phase) vibrations of the notes making up an interval, the greater its consonance. In the unison, for example, all the vibrations of the two sounds are coincident; in the octave, expressed by the frequency ratio 2:1, coincidence occurs every other vibration of the upper note; etc. In conclusion, the degree of consonance was thus defined (1) by the greater or lesser blend of the sounds, and (2) by the number of in-phase vibrations that went to strike the eardrum (assuming that the out-of-phase vibrations, instead, brought disturbance). (Barbieri 2001, 201)

Quoting the second century Adrastus, Barbieri continues:

> [Two] sounds are mutually consonant when—on a string instrument—in playing one, the other simultaneously proceeds to sound, by a certain property of sympathy. Hence, for the same reason, if both are played at the same time, from their blend a sweet and pleasant sound will reach the ear.[15]

Here Adrastus refers to *sympatiam* or sympathy when explaining consonance. When a sound is consonant and has "a certain…sympathy," "the playing of one" string causes "the other…to sound." Consonance can similarly be demonstrated with a piano and a viola. If I play the open G string on my viola while the hammers are not blocking the piano strings from vibrating, the piano begins sounding as well. On closer observation, the same exact string as was played on the viola (G3) is also vibrating inside the piano. Importantly, some other strings will also begin to vibrate, though with varied intensities. Barring other factors, the vibrating strings on the piano will have a close ratio with the pitch that initiated the consonance.

These frequencies can be predicted with knowledge of the harmonic series. For example, I can predict that G4 will be the second-most intense vibration after playing G3, and then D4, etc. [16]This vibration of strings, or other physical objects for that matter, in response to the resonating of another sonic source, without direct physical contact, is called "Sympathetic Resonance."

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13 Quoted in (Guernsey 1928, 177)

14 As Andrew Baker writes in his translation of Porphyry's Commentary on Ptolemny's Harmonics, the term 'Consonance' comes into English from Greek by way of a somewhat rough Latin translation. He writes that the Latin term 'consonare' is supposed to "to represent synēchēsis 'combined sound' (ēchos), 'sounding together.'" He continues, "typical uses of the cognate verb synēchein appear [elsewhere in the text], where they refer to the resonances set up in some material by another sound, or to the 'sympathetic' response of one string to another when the latter is Struck" (Porphyrius (234-305) and Barker 2015, 213).

15 Consonant ad se mutuo soni, quorum altero pulsato (in instrumento fidibus instructo) reliquus, per quondam proprietatem et sympatiam, simul sonat. Atque, ob eandem causam, utrisque simul pulsatis, lævis grataque ex mistione vox exauditur.

16 Setting aside the equal-temperament of the modern piano.

Part 3: Resonance & Resistance

Returning to where we started our inquiry, we say again, perhaps a bit more clearly, that life is often loud, and frequently noisy. We are perpetually bombarded with a vast array of stimuli from nearly every direction, each with a multiplicity of possible meanings. In the language of Parts 1 and 2, the frequencies available for our engagement are essentially limitless and far beyond our capacity to meaningfully cognize. Instead, over the course of our lives, we develop a variety of capacities and rubrics to winnow away (to subtract out) those frequencies that are less relevant for the moment at hand. In other words, our system of attention is constructed out of our embedded habits of subtracting away (of carving out) various possible meanings to leave behind (or reveal) a central set of frequencies that allow us to engage with whatever moment is at hand. This process is partially volitional, but largely non-thematic—my particular way of filtering out incidental frequencies is usually not a cognitive accomplishment, but one rooted in habits and dispositions developed over the course of my life. When I see a rock wall as something available for me to climb, it is because I have had training and past experiences that allow me to see it in that particular way. For someone afraid of heights or untrained in belaying, harnesses, carabiners, and so on, the rock wall is merely a colorful obstacle. This process of subtracting away incidental aspects of perceptual and embodied experience is strongly analogous to the account of Subtractive Synthesis outlined above.

Likewise, in order to pick up and make sense of a particular aspect of my environment (e.g., a mood or atmosphere), that aspect must have something within me with which to generate a resonance. The point is not that there is some kind of sounding note out there that triggers a Sympathetic Resonance in me. Rather, my sense of myself as an embodied system of possibilities is activated in my engagement with what is on offer in my environment. My sense of the world as filled with objects, activities, agents, moods, and so on becomes alive out of how my system of engagement and understanding is made possible in this particular space.

Importantly, our resonances are variable internally as well. As with the example of octaves resonating above, I may embody patterns that may resonate more or less distantly with whatever tone is being played. To continue the metaphor, when a G3 is played, my neighbor might resonate at a G3, but I might only have available a consonance at a D4.

In terms of moods and atmosphere, and returning again to experimental music, part of what is so engaging about loud, noisy, chaotic, and audibly intense environments is that they both activate and disrupt our pre-filtered (pre-subtracted) synthesis while simultaneously providing a dynamic landscape (or, rather, soundscape) where new patterns of meaning can be formed out of the possibilities elicited in our resonance. More directly, experimental performances both activate aspects of our embedded capacities to resonate with a mood, while at the same time leaving profoundly open how that mood plays out internally. We still exist in a shared atmosphere with our fellow performance goers, but at the same time, we are made acutely aware of how our engagement with the piece of work at hand is profoundly particular and individual.

This last point opens up the possibility of a radically noisy politics. Where much of contemporary political conversation is organized around how to encourage or, in more problematic cases, compel a kind of unity where the noisy and chaotic elements of experience are homogenized into a predictable and consistent set of community expectations, the above account of atmospheres points out that our political and personal possibilities emerge directly out of the noise, and that our engagement with that noise is inevitably both radically particular and open to communal connections. We share in moods, but we can only share in them out of our particular way of subtracting and resonating with the people and place around us.

It is no secret that many contemporary political leaders and movements have a distinct aversion to difference and the reality that our perspectives are varied, dynamic, and rooted in our particular histories, embodiments, and ways of life. While it is not the purpose of this paper to provide a thoroughgoing critique of these movements, many seem to rest on the idea that a better world is one where experiences are uniform, predictable, and consistent from person to person. The aversion to difference is, in a sense, an aversion to noise, to the idea both that the world often breaks into our experience and compels us to engage with it in unpredictable, confusing, and even unsettling ways, and to the reality that, even in existing together in community, the very possibility of sharedness emerges out of the messy, noisy wildness of our lived histories. Trying to eliminate or deaden that noise borders on fascism in the way that it undercuts the origin and substance of the creative dynamism. While in no way completed, the view of moods and atmospheres offered here provides the beginning of an alternative way of understanding how difference structures and makes possible both meaningful community and human life more generally.

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