

Unison Opening as Schema in Post-1945 Compositions*

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ABSTRACT: Sustained unisons on single pitches constitute a schema in post-1945 compositions—they recur across hundreds of pieces, establishing an initiating function in the absence of common-practice tonal function. Such unison openings thematize on the psychoacoustic cues by which we identify the presence of single or multiple notes. Standardized departures from unisons—particularly *wedges away* and *addition of notes*—invoke how auditory roughness/smoothness and (in)harmonicity cue a frequency to be heard either as part of a compound timbre or as a separate pitch in a consonant or dissonant pitch collection. While some compositions directly reference these acoustical foundations, unison openings persist more broadly, showing how psychoacoustic foundations underpin a wide range of repertoire.

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Organizer Guy: Okay, now look. This is how the piece is going to start. It's gonna begin. . . with just one. . . tone. . .

Critical Guy: Oh, that's original.

— Mark Applebaum, in *Pre-Composition* (2006), 1:35–1:50

[0.1] Many post-1945 compositions begin with a lengthy unison passage exclusively focusing on a single pitch.⁽¹⁾ I claim that such single-pitch unisons are common enough to function as a musical *schema*, with an initiating function that relies on their perceptual clarity and on the psychoacoustics by which listeners perceive sounds as having pitch. Such unisons are usually departed via just three exit strategies—wedges, addition of notes, and glissandi—which dramatize how the unison's one pitch leads to several distinct pitches. Through these exit strategies, unison openings direct listeners towards the boundaries of what we can hear as “one pitch.”

[0.2] In Part 1 of the article, I introduce the unison opening schema and its foundations in psychoacoustic smoothness/roughness and harmonicity/inharmonicity through James Tenney's chamber piece *Critical Band* (1988), an extreme example in which the schema and the standardized departures from it span the entire piece. I dwell on *Critical Band* to contemplate how the piece invokes roughness and harmonicity to explore their

relation to consonance/dissonance and auditory fusion. In Part 2 of the article, I build on this analysis to theorize what it means for such unisons to constitute a recognizable schema and instantiate an opening function across a wide range of post-1945 compositional styles.

[0.3] Following this investigation of *Critical Band*, I demonstrate the schema's broad relevance through a series of short analyses that show the schema's psychoacoustic bases, explanatory power, and wider generalizability. In Part 3, I consider pieces that open on unisons but do not necessarily reference psychoacoustics on the surface, showing how my reading of *Critical Band* can inform interpretations of dissimilar works. Through three longer vignettes in Part 4, I show how the schema's norms remain helpful for pieces whose "unisons" or "openings" are less clear-cut. Across the article, psychoacoustic principles provide a unifying thread shaping both compositional structures and potential listening experiences, demonstrating a shared musical vocabulary circulating among many composers from the last eight decades.

1. *Roughness and Harmonicity in James Tenney's Critical Band*

[1.1] Before proceeding with the investigation of *Critical Band*, some terminology should be clarified. By definition, a unison opening should be both a unison (it should begin with two or more instruments or voices articulating the same note) and an opening (it should move on to other, non-unison, material). This means that a unison opening is departed by moving from one sound to many, calling our attention as listeners to the psychoacoustics of pitch—that is, the aspects of a sound by which we identify the presence of one or multiple pitches. I find that unison openings often employ two such cues in particular, further defined below: roughness/smoothness and (in)harmonicity. Most often, composers showcase these cues via standardized exit strategies from the initial unison. **Example 1** introduces my shorthand notation: the *wedge* highlights roughness/smoothness and *addition of notes* highlights [in]harmonicity (the slow *glissando* away continues a wedge but will not be discussed until Section 2).

[1.2] In this first section, I introduce these exit strategies and their perceptual implications via James Tenney's *Critical Band*. Through a combination of close musical analysis and an introduction to select psychoacoustic principles, I make the following points, which will be foundational to the rest of this article:

1. Frequencies, pitches, and notes are distinct: *frequencies* exist in a physical sound wave, a listener identifies *pitch(es)* from these frequencies, and a *note* is a conceptual understanding of a pitch or an instruction to make a sound.
2. A sound is most often perceived as "one pitch" if it has a smooth amplitude envelope (*smoothness* rather than *roughness*) and its frequency spectrum resembles a harmonic series (harmonicity rather than inharmonicity). These foundations are also essential to consonance/dissonance perception: the more closely a collection of frequencies resembles the spectrum of "one pitch," the more it is conventionally consonant.
3. A collection of frequencies affords either *synthetic* hearings, in which a listener interprets frequencies as contributing to the timbre of one fundamental, or *analytic* hearings, in which those frequencies are heard as distinct pitches.
4. A composition can direct listeners' attention to these psychoacoustic phenomena and invite different modes of hearing.

[1.3] **Example 2** provides the full score for *Critical Band*, with my light annotations. *Critical Band* is an open-score piece with flexible instrumentation: within each section, Tenney indicates possible notes a performer might choose from, to be sustained for approximately "the length of one breath." Each note in the score consists of a note name, a deviation in cents from 12-tone equal temperament, and a frequency. Following Parncutt (2024, 79) and Parkhurst and Hammel (2018, 9–15), I term such markings on scores *notes*. The instruments produce sounds with *frequencies* at both the fundamentals indicated in the score and the harmonic overtones thereof. Frequency is a property of physical sound waves, interpreted as *pitch* only upon being perceived by a listener.⁽²⁾ The construction of *Critical Band* discourages listeners from hearing all of the score's notes and resulting frequencies as distinct pitches.

[1.4] *Critical Band* lasts 17 minutes: in the first 10, the ensemble slowly wedges outward from an A4 tuning note to an [01234] cluster around it; in the remaining 7 minutes, the ensemble moves further afield to complete a harmonic series on A2, of which A4 is eventually revealed to be its overtone.⁽³⁾ The composition relies entirely on two of the exit strategies shown in Example 1, with the original A4 remaining audible for the full duration. While the persistence of the opening pitch and exclusive use of the two exit strategies make the piece unusual, the exit strategies themselves are highly characteristic of the repertoire. The initial *wedge* away (shown with expanding orange arrows) destabilizes the opening pitch by creating rhythmic pulses such

as *beating* and *roughness*, which we might hear either as thickening the note or as adding dissonance to it; the final *addition of notes* (shown with orange brackets) restabilizes A4 as a *harmonic* partial of an A2 fundamental, which we might hear as a single note with a rich timbre or as a harmonic-series pitch collection. I will discuss these terms in turn.

[1.5] *Critical Band* is titled after the psychoacoustic phenomenon known as the critical band, the range around a given frequency within which other frequencies are indistinguishable in a listener's physiological inner ear.⁽⁴⁾ To that end, the first few minutes present and then destabilize a single pitch, within one critical band. As notated in the score, *Critical Band* begins with a perfectly smooth A4 at 440Hz, after which notes move 3.4Hz outwards both up and down. Here, listeners will likely perceive a pitch around A440, beating at a pulse of 3.4Hz or 6.8Hz—such differences are not only within A440's critical band, but well within our range of rhythmic perception.⁽⁵⁾ The only other pitches that might emerge would not be in the immediate vicinity of A440, but rather at least an octave higher in an instrument's frequency spectrum.

[1.6] Once frequencies within a critical band beat too rapidly to be heard as rhythmic, they create *auditory roughness*. This sensation has traditionally been interpreted as contributing to dissonance, following Helmholtz ([1885] 1954).⁽⁶⁾ Around the 4-minute mark of *Critical Band*, the beats get too fast to hear metrically: 433.1Hz beats against 446.9Hz at 13.8Hz, yielding a 72ms inter-onset-interval marginally shorter than the usual 100ms lower limit (London 2012, 35–37). The move to roughness is confirmed around the five-minute mark, where 453.8Hz enters and beats against 433.1Hz at 20.7Hz, solidly within the “fast amplitude fluctuation (c.20–30Hz)” of Harrison and Pearce's definition (2020, 218). I find that the beats are too fast to be heard as within a single pitch, yet the frequencies are too close to be heard as two distinct pitches.

[1.7] B♭4 begins a pivot between roughness and the perception of multiple pitches. At 467.5Hz, it is well over 30Hz from the lowest notes in the passage, and 27.5Hz (equal to A0, the lowest note on the piano) from A440. While I hear it as a distinct pitch—and it is by the standards of twelve-tone equal temperament—it remains in the critical bandwidth, not quite separable from A440 in the inner ear. As a result, I perceive Tenney's notes as a dissonant collection, but no longer as a thickened A4. Roughness continues to increase as the critical bandwidth around A4 accumulates more notated frequencies: **Example 3** shows the extent of roughness across the piece.⁽⁷⁾ Roughness is minimal (that is, the sound is *smooth* and remains consonant) when slow beating is first introduced, but it reaches a maximum 6 to 8 minutes in, when five frequencies saturate a whole tone.

[1.8] I suggest that over *Critical Band*'s ambiguous first few minutes, we can perceive either a “synthetic” or an “analytic” hearing (McAdams 1982, 280; see also Hasegawa 2019, 529–31).⁽⁸⁾ In a synthetic hearing, we seek to interpret all auditory cues as part of a single pitch percept. *Critical Band* opens with a sustained A4: the beating in its amplitude envelope and the shifts in upper partials as instruments enter and exit are perceived not as changes in pitch, but rather as changes in composite timbre.⁽⁹⁾ No other pitches emerge until after six minutes in, when the span of frequencies is simply too wide for the categories by which we understand a single pitch (Parncutt and Hair 2018, 490–91). By contrast, in an analytic hearing, A4 is unstable immediately: the introduction of 3.4Hz beating around A4 at the 2-minute mark might already suggest we hear harmonic overtones A5 or E6 emerge as pitch percepts due to their faster beating. Nearing the 5-minute mark, we might choose between many possible fundamentals even within the critical bandwidth. *Critical Band* affords both hearings because there are so few other auditory cues—in the absence of clear attacks or any pitches ending, the listener is given space to alternate between possible analytic and synthetic hearings.

[1.9] The second half of the piece continues expanding outwards in register, but the new notes are too far away to create beating—instead of a wedge, we now have *addition of notes*, highlighting how *harmonicity* (notes' proximity to those of a harmonic series) contributes to pitch perception. In *Critical Band*, all notes added from the eighth minute onward (when the ratio indications have a denominator of 8) contribute to a harmonic series over A1 (55Hz), whose common tones prepare the concluding sonority, a full harmonic series (up to the eighth partial) over A2 (110Hz).⁽¹⁰⁾ Example 3 shows that roughness is low throughout the passage, resulting mainly from a few high partials. Meanwhile, harmonicity in this passage is substantially higher than in the first half of the piece, reaching a full value of 1.0 at the concluding complete harmonic series.⁽¹¹⁾ *Critical Band*, then, dramatizes a shift from smoothness (or non-roughness) to harmonicity as primary psychoacoustic cues by which we recognize sounds as fusing together.

[1.10] The end of *Critical Band* is ambiguous, offering both a synthetic hearing as a timbrally rich A2 and an analytic hearing as a consonant pitch collection. Like smoothness, harmonicity constitutes both a

psychoacoustic cue for recognizing “one pitch”—sounds resembling the harmonic series fuse into one percept across cultures ([McPherson et al. 2020](#))—and a foundation for conventional judgments of consonance among pitch collections, following Stumpf’s ([1890] 1965) explanation of consonance as “tonal fusion.”⁽¹²⁾ The end of *Critical Band*, with performers given notes fitting one A2 harmonic series, entails a collection of frequencies that might all fuse into one pitch at A2 or, with performers rearticulating their notes, might encourage us to perceive partials 1 through 8 as distinct pitches.

Hearing Pitch(es) in *Critical Band*

[1.11] I believe that Tenney designed *Critical Band* to focus listeners’ attention on smoothness, harmonicity, and their potential interpretations as either fusion or consonance. The first clue is, of course, the title, which refers to a range of frequencies that fuse together in the inner ear. But much of the score, paratext aside, still points towards auditory fusion. As discussed above, the note collections lead from smoothness through roughness to harmonicity over the course of the piece. The long tones remove most cues by which we might hear instruments as distinct sources. Such a dramatization fits with Tenney’s musical background. His early training in computer music involved studies of psychoacoustics, which in turn shaped his compositional theories, which include a treatise on consonance and dissonance. In *Critical Band*, Tenney encourages listeners to fluctuate between analytic and synthetic hearings, or between consonant/dissonant collections or thick timbres.

[1.12] In *Auditory Scene Analysis*, Albert Bregman suggests that “the perception of dissonance can be suppressed when the tones that form the dissonance are perceived as belonging to different auditory streams” (1994, 508). That is, roughness and inharmonicity are more likely to be perceived as dissonance if they come from one apparent source, rather than being two pitches from separate lines. Bregman suggests that common-practice counterpoint rules are designed to minimize perceived dissonance—pitch combinations that might be dissonant are instead perceived as separate streams (503). *Critical Band* does the opposite: the performers play long tones that minimize such separations. As a result, Tenney pushes us to hear psychoacoustic phenomena that tonal norms obscure.

[1.13] Tenney distinguished between roughness and inharmonicity not just in *Critical Band* but also in his treatise of the same year, *A History of “Consonance” and “Dissonance.”* He presents five different historical concepts of consonance/dissonance; in his second concept, a dyad’s consonance is defined as how much it fuses into a tone via harmonicity (resemblance to the harmonic series); in his fifth, the same dyad’s consonance is defined as its smoothness ([Tenney 1988](#), 28–31, 87–90; [Wannamaker 2021a](#), 147–51; 2022).⁽¹³⁾ In distinguishing these concepts, Tenney inserted himself into a longstanding debate on the origins of consonance, originating from a nineteenth-century dispute between Carl Stumpf and Hermann von Helmholtz (Steege 2012, 216), and continuing into modern-day psychoacoustic research.⁽¹⁴⁾ I find that *Critical Band* constitutes a musical illustration of the same distinction. By presenting roughness and harmonicity in separate portions of the same piece and highlighting them by means of the exit strategies described above, *Critical Band* makes audible the enduring distinction between roughness and inharmonicity as theories of dissonance.

[1.14] By encouraging us to pivot between synthetic and analytic hearings, *Critical Band* blurs the borders between timbre and pitch. To hear timbres aligns with Tenney’s background in psychoacoustic research for Bell Labs: while developing early computer music software, he studied harmonic spectra as part of scientific research into timbre perception ([Tenney \[1965\] 2015](#); [Wannamaker 2021a](#), 62–63).⁽¹⁵⁾ But to hear pitches aligns with his return, after leaving Bell Labs and computer music, to writing fully notated compositions for instruments ([Wannamaker 2021a](#), 111). That we might hear both reflects the legacy of Tenney’s computer music training in his instrumental works—in the latter, he anchored his harmonic language in the harmonic series because of its potential for fusion; he described it as “a structure that our auditory systems have built into them: the capacity to reduce to a unity” ([Dennehy 2008](#), 87; see also [Wannamaker 2021a](#), 169–72; 2022). By encouraging listeners to pivot between analytic and synthetic hearings, *Critical Band* directs their attention to the psychoacoustics that are essential to pitch identification, and it showcases compositional techniques—unisons, wedges, and addition of notes—that I further explore in the many examples that follow.

2. Theorizing the Unison Opening

The Unison Opening as a Schema with Initiating Function

[2.1] Among pieces I have encountered so far, *Critical Band* is unique in its combination of formal simplicity, didactic presentation of material, and direct (indeed, titular) reference to psychoacoustic cues for fusion or consonance. These features make it an ideal example through which to demonstrate how a composition can thematize harmonicity/inharmonicity of a frequency collection, smoothness/roughness of beating, and ways we can hear such features as potentially contributing to consonance/dissonance. However, its central features are common to many other works from a range of post-1945 musical styles. The pathways by which Tenney departs his unison—wedging away from the opening note and then adding notes to complete a chord—appear in numerous other pieces. Because these aspects are common within post-1945 classical music, I believe *Critical Band*’s unison opening is a model example of a *schema* with an *initiating function*. Let’s unpack these terms in turn.

[2.2] As above, I define a unison as the same note being sounded simultaneously by at least two distinct sources and heard as the same pitch. Most often, these sources are different instruments or voices; in some cases, they might be multiple parts of the same instrument, include electronics, or so forth. I consider such unisons to be *openings* when they are the first sound of a piece (including as the sustaining component of a single percussive impulse), but not the entire piece.

[2.3] The unison opening is a *schema* because it is 1) a stock phrase (Gjerdingen 2007, 6); 2) bordering on a cliché (Byros 2012, 112, 117; Sutcliffe 2009, 468); 3) defined by a constellation of distinct features that often move together (Gjerdingen 1984, 44, 125; 1988, 64; Gjerdingen and Bourne 2015, [3]); and 4) practiced in a historically specific compositional style suggesting certain strategies for listening (Byros 2009, 287–89; Sherrill 2011, 230–32). We know it is a stock phrase because it is used so widely, as shown by the examples cataloged below. Its distinct features include it being a unison at the start of a piece, three common exit strategies, acoustic references, and open-string pitches. Unison openings are associated with particular compositional styles from the last few decades, and they suggest listening strategies with attention to psychoacoustics. While the term “schema” is often associated with outer-voice scale-degrees in Galant music (Temperley 2006, 278; Rabinovitch 2019; Sherrill 2011, 228–30), the unison opening’s ubiquity makes it a schema even without tonal grounding.

[2.4] The unison opening schema has an *initiating function* because it is a “standardized way” a passage can be “characterized as a beginning” (Caplin 2009, 54). As Anabel Maler observes, while form-function theory derives from an 18th-century tonal context, its definitions can be generalized as formal function did not end with tonality (2022, 47–48). I argue that the unison opening establishes formal function in the late 20th and 21st century. While formal analysis of post-tonal music often relies on Schoenbergian notions of motive (Boss 2014, 71–73; Burstein and Straus 2024, 438–40; Heneghan 2006, 241–54; Hier 2023, n8–9), my analysis establishes temporality even in music whose continuous surface allows few cues for segmentation. Much as amplitude envelopes can establish the beginning, middle, or end of an individual sound (Smalley 1997, 112; Blackburn, 6–7), the unison opening can articulate a sense of beginning within a larger unit subject to the generic context of the late 20th and early 21st centuries.

[2.5] The unison opening’s initiating function is strengthened by its schematic nature and the destabilizing of the opening note. Certain schemata take on conventionalized temporal positions (Rabinovitch 2022, 370–72)—in associating a recognizable constellation of features with a specific temporal position, the unison opening follows these precedents. And, in the absence of conventionalized tonal syntax, the appeal to basic psychoacoustics matches more general norms of how to initiate a piece. In Matthew Arndt’s terms, the clarity of a single pitch, a “[part] that include[s] a sense of beginning,” constitutes the piece’s establishment, while the exit strategies, destabilizing the pitch percept, suggest a confrontation with contrasting material (2018, 212–13) to push the piece forward.

Unison Openings and Harmonic-Series Endings

[2.6] For the unison opening to be a schema or have a specific formal function, it must be normative within a genre’s conventions, an assertion supportable only by a variety of examples. While my examples span a range of post-1945 compositional styles from composers with scant biographical ties, I find that the ubiquitous presence of unison openings among what has been considered “new music” demonstrates a shared compositional vocabulary that circulates as widely as any from earlier in music history.⁽¹⁶⁾ To that end, the

remainder of this article considers an assortment of pieces that begin on unisons, moving from surface invocations of psychoacoustics to the schema's furthest generalizations.

[2.7] I will begin with pieces that share *Critical Band*'s pathway from a unison opening to a harmonic-series ending, which suggests listening for psychoacoustic cues throughout. **Example 4** (duplicated in Appendix 1) lists all such pieces I have identified that use this framework. I will proceed from the most like Tenney's to the least, to show how my analysis of *Critical Band* generalizes.

[2.8] Julius Eastman's *Crazy [n-word]* (1979) uses an open-score format to slowly wedge outward before filling out a harmonic series.⁽¹⁷⁾ **Example 5** shows the opening of *Crazy [n-word]*: over 12 minutes, the piece expands outward in both directions from the opening B $\flat$ 4, and eventually a few notes fade away to the final sonority. **Example 6** reduces the passage to clarify the order in which notes enter, with small noteheads showing passing and neighbor tones and slurs indicating membership in the final sonority; analytical overlay in orange shows the dual contributions of the wedge and addition-of-notes exit strategies.

[2.9] I should issue some caveats: Eastman's notational flexibility means that this opening is, strictly speaking, not likely to be a unison in performance. The performance notes in the published score indicate that "absolute pitch values are *not* indicated" and that "any passage may be realized in any register." Accordingly, in recordings, the opening B $\flat$ resounds across registers. But additional performance notes ensure that roughness remains audible. Eastman writes that "the motivic or phrase-like component of the line is always preserved;" as a result, every individual stepwise motion can be heard, in register, as part of a wedge, encouraging attention to roughness.

[2.10] Like *Critical Band*, *Crazy [n-word]* moves from roughness to harmonicity. After the opening passage, much of the piece relies on similar registral expansions, with transposed equivalents returning notated at A5, B4 again, and B5, and then sections starting on F and A, notated only as pitch-class names without staff notation. But the piece concludes, as shown in **Example 7**, with a statement of the harmonic series no less didactic than Tenney's. The fundamental is stated for a full minute and a half as a single note, and harmonic partials are added on top of it, notated (and most often performed) at pitch.⁽¹⁸⁾

[2.11] Gérard Grisey's *Périodes* (1974) concludes with one of the most discussed passages in late twentieth-century music, the orchestration of a trombone's acoustic spectrum.⁽¹⁹⁾ This sound famously affords both timbre and pitch hearings—it is modeled on the sound of a single trombone sound with an E2 fundamental frequency, but harmonic partials emerge moments later as clear pitches, orchestrated separately.⁽²⁰⁾ Much as with the harmonic series at the end of *Critical Band*, we as listeners have a sound that we can hear either way—Grisey describes it as "without being a timbre. . . no longer quite a chord" (Grisey [1982] 2008, 51; qtd. and trans. in Drott 2013, 28). I do not intend to overstate similarities between French Spectralism and Tenney's brand of American Experimentalism—Tenney was interested in mathematically ideal rather than physical spectra (Dennehy 2008, 86; Wannamaker 2008, 123). Despite these differences, *Périodes* shares an emphasis on harmonic overtones' ambiguity between timbre and pitch.

[2.12] Less discussed than this harmonic-series ending is *Périodes*'s unison opening and wedge.⁽²¹⁾ **Example 8** shows the opening: the unison consists of D4 on 3 strings of the same viola; a slow glissando downward on the G string begins a wedge and introduces beating, which accelerates into roughness. Added notes confront us with conflicting harmonic contexts for that D4: the open-string tuning is a fundamental over which the violin's A5 is a third partial added, but the G-string's flat D4 is a 7th partial for the double bass's E1. The slight difference in intonation, made audible by beating, keeps the two possibilities separate. Although the harmonic-series ending eventually confirms D to be an overtone of low E, the beating is crucial to initiating the conflict.

[2.13] Catherine Lamb's *Prisma Interius IX* (2018) adapts Tenney's just-intonation techniques into a more through-composed format that still showcases beating (Lamb 2017).⁽²²⁾ The piece exclusively contains overtones of a 5Hz fundamental, so that all note combinations will beat at that frequency or some multiple thereof. **Example 9** shows the opening—above each note in the score, Lamb provides what partial it is of 5Hz (E $\flat$ in her notation)⁽²³⁾ and below each note is its frequency. The wedge is spread across instruments: the piece opens with an alternation between the 81st and 80th partials in the violin, both notated at G4 (405 or 400 Hz); the second note beats audibly against the sustained 81st partial in the cello.⁽²⁴⁾ [the piece opens with a unison, strictly speaking. The clash is the second event] The addition of a 320Hz E $\flat$ 4 in the viola part

encourages us to assess these conflicting notes as potential harmonics of an 80Hz E $\flat$ 2 fundamental. The wedge then continues, pushing outward to F4 (360Hz) and A $\flat$ 4 (420Hz), the latter of which is close enough to G4 to generate prominent beating at 15–20Hz, thereby constituting roughness.

[2.14] When describing the *Prisma Interius* series, Lamb asks, “how is one tone a pivot between activating a total harmonic space as well as expanding a contour in time?” (liner notes to [Lamb 2019](#), 16). The opening G4 provides an answer to the question while raising another: its two possible interpretations leave open whether the harmonic space relies on Pythagorean or just-intonation ratios. As Lamb’s pitches expands outward, this ambiguity sets up such a contrast. The end of the piece, shown in **Example 10**, illustrates that “harmonic space:” all partial numbers on the last page are multiples of 8, so that the whole ending passage composes out a harmonic series over a 40Hz E $\flat$ 1 fundamental (the 8th partial of the composition’s 5Hz conceptual fundamental and beat frequency). From the opening page, partials 80 and 64, the competing notes added to the initial partial 81, remain; partial 81 itself does not.

[2.15] Toshio Hosokawa’s *Fragmente II* (1989) sits at the margins of this formal archetype: instead of a unison, it starts with a single note that other instruments later join, and instead of a harmonic series, it ends with a widely spaced major triad. **Example 11** shows the opening and exit strategies: although the F $\sharp$ 4 briefly has a few added notes as more instruments complete the unison, the cluster at the end of the system constitutes a wedge and its roughness. Unlike most other pieces discussed above, F $\sharp$ 4 never dissipates—some instrument is always playing it, so that it remains audible across the piece. A few characteristic harmonies recur amidst the same techniques—**Example 12** shows two octatonic subsets, voiced to emphasize close-register minor thirds traced in blue and green, bearing a subset relationship that helps bookend the piece. **Example 13** shows how this chord occurs alongside a wedge gesture to prepare the piece’s ending. These internal references set up the actual final sonority, a major triad in harmonic-series spacing above the always-sustained F $\sharp$ 4. The prior octatonicism sets such an open, harmonic sonority into stark relief.

3. *Additional Continuations of Unison Openings*

[3.1] Most single-pitch unison openings do not invoke both smoothness/roughness and (in)harmonicity quite so directly. Yet, unison openings persist in a broad range of music from the last few decades, and as they share the same schematic norms, similar analytical strategies remain useful. This section demonstrates how these principles of unison openings generalize as we move beyond the previous examples’ defining characteristics. None of the pieces here end on a harmonic series or other such symbols, but the same psychoacoustic foundations remain essential as the pieces depart their unisons.

[3.2] I begin with compositions whose materials explicitly reference beating, roughness, or inharmonicity as they depart their unison openings, suggesting that their listeners consider how sounds split apart. The remaining compositions in this section do not mention such phenomena explicitly on the score, but still share many surface features. I next discuss compositions whose unison openings begin on open strings or natural harmonics on bowed string instruments—the acoustic purity of the open string is common in pieces that *do* reference acoustics, and provides a purer tone against which to hear beating. Finally, I examine pieces that begin with a unison but have no open strings or references to (psycho)acoustics, showing the schema’s broader ubiquity.

Other Explicit Acoustic References

[3.3] **Example 14** (duplicated in Appendix 2) lists compositions that directly invoke acoustic phenomena. By and large, the layout of the table is the same as that of Example 4, with an added column documenting the acoustic reference. In most cases, the acoustic phenomenon is familiar from previous analyses, being either beating/roughness or (in)harmonicity (that is, inharmonicity/harmonicity). The reference to acoustics is most often an explicit mention or notation—whether in the score, performance notes, or program notes—of beating or harmonic-series intervals.

[3.4] Some composers’ techniques are familiar from analyses above—Lamb and Tenney continue to notate frequencies and/or ratios as in *Prisma Interius IX* and *Critical Band*, as do Niels Lyhne Løkkegaard, Alvin Lucier, and Sam Pluta. Not all notational invocations of beating, however, are quite so precise: Giacinto Scelsi

and Per Nørgård indicate beating speeds less precisely, showing how microtonal frequencies can create beating in a more intuitive fashion.

[3.5] Scelsi's music might be taken as a logical extreme of unison openings: he wrote a set of pieces titled *Quattro pezzi su una nota sola* (*Four Pieces on a Single Note*) (1959), all of which begin with a lengthy unison or octave passage.⁽²⁵⁾ Many of his later pieces proceed in similar ways—beginning on a unison and often juxtaposing it against adjacent notes. However, beating emerged incidentally in these early works, and although Scelsi probably was aware of the phenomenon, the scores do not document beating explicitly. As Thomas DeLio (2017) suggests, Scelsi's music reached more precise technical sophistication a few decades later, such as in his 1973 pair of solo violin works *L'âme ailée* and *L'âme ouverte*.

[3.6] In *L'âme ouverte*, Scelsi creates beating by slowly destabilizing an opening pitch until it drifts away by a semitone. As shown in **Example 15**, Scelsi provides exact notation for how fast near-unison dyads should beat: instead of precise intonation, he notates the desired psychoacoustic results. **Example 16** presents how this technique appears at the opening. While Scelsi starts with one D5, he soon thickens it with a D♭5 that, although far enough to be heard as a distinct pitch, is so quiet (“quasi inaudible”) that I find D5 to remain audible as the most prominent pitch. The violin's two notes become comparably loud only in the second system, at which point beating slows to just 2 or 3 bpm. In the third system, the notated frequencies slowly drift up, with attendant beating within a critical bandwidth, so that the single perceived pitch drifts up as well. Beating ends in measure 9, at which point only D♭5 remains audible—the pitch has shifted up through a glissando, thus lacking the symmetry of a wedge.⁽²⁶⁾

[3.7] Per Nørgård's String Quartet No. 5, “Inscapè” (1988), notates beating both graphically and verbally in score and sketches. The first two movements reside entirely within a B3–D4 minor third, seeking a path downwards from an opening unison on D4. Moving primarily by microtones, the first two movements are even more severe than *Critical Band* in their dramatic thematization of beating. Nørgård termed beating “interference,” a term I use interchangeably with beating below, and considered it a central technique in works of this period (Jensen 1986, 118–21; Nørgård 1969). He had likewise used the harmonic series a year earlier in *Voyage into the Golden Screen* (Jakubowski 2019, 186–90), further illustrating his interest in acoustics. The unison opening and its exit strategies, then, provide a compositional tool by which Nørgård could achieve his desired acoustical results.

[3.8] In the first movement, beating from a unison D4 expands to fill out a semitone. The gesture fuses characteristics of the wedge and the glissando—like in a wedge, D4 continues sounding throughout, but like in a glissando, the expansion is only in one direction (downward). **Example 17** shows the opening; all four instruments play D4 in unison across strings tuned in a scordatura, shown in **Example 18**, in which D4 is simultaneously an open string, natural harmonic, and stopped note.⁽²⁷⁾

[3.9] **Example 19** shows the end of this process—at the first pause in the piece, all instruments sustain a quarter-tone dyad between D♯4 and C³/₄♯4. As a result, the sustained dyad produces rapid beating (on the border of roughness), which Nørgård refers to in the score both by naming interference and showing its rapidity with the notation defined in **Example 20**. This opening phrase, then, constitutes a unison opening and the beginning of an exit. The slow drift away to C³/₄♯4 sets out the wedge and expansion in register essential to the piece: the remainder of the movement expands down to B3, completing the minor-third register within which the entire first two movements operate—only the third movement expands further.

[3.10] Just as Scelsi and Nørgård use wedges to achieve roughness and beating, later French spectral composers add notes to emphasize (in)harmonicity.⁽²⁸⁾ Tristan Murail's work provides a didactic case study. **Example 21** reproduces his summary of *Mémoire/Erosion* (1976), showing how he “organiz[es] pitches by successive generators” (Murail [1980] 2005a, 128). That is, each note generates overtones that slip out of tune and create new tones through ring modulation, slowly accumulating into one of his favored “complex sounds.” Murail writes that “the spectrum is increasingly distorted” and suggests this example “might provide an entry into the domain of inharmonic spectra” (129). We can thus listen to this passage in terms of its deviation from harmonicity.

[3.11] Kaija Saariaho's *Lichtbogen* (1986) also uses a unison opening to introduce a sound's deviations from harmonicity. The piece's pitch content is built on computer-aided spectral analysis of both “pure” and “very

noisy” cello sounds (Saariaho 1987, 129–30; see also Kankaanpää 2011, 166–72; Cobb 2024, 248–53). Accordingly, the opening moves away from its “basic chord” (Cobb 2024, 263), a *sul tasto* unison on F#4, to introduce the sound’s impurities. As shown in **Example 22**, *sul ponticello* introduces upper partials, and *pizzicato* entails attack transients, both of which add further frequencies to the sound and imply addition of notes; a slight quarter-tone wedge is also present. One might hear the work’s first minutes as either adding new pitches or thickening the timbre of a constant pitch (following Eric Drott [2017, 277], I hear some of both). **Example 23** shows that shortly after, addition of notes is confirmed as Saariaho, for the first time in the piece, assigns notes other than F#4—derived from the cello spectrum (Kankaanpää 2011, 170–71)—to the transient-laden glockenspiel, piano, and harp. That is, the non-string instruments confirm the presence of pitches implied first by changes in playing technique. For both Murail and Saariaho, then, addition of notes to a unison showcases how inharmonic spectra deviate from the referential harmonic series and its attendant auditory fusion.

Open-String Unison Openings

[3.12] Many of the examples discussed so far began with unisons on open strings or their natural harmonics. As shown in **Example 4**, Tenney’s *Critical Band* began on the quintessential tuning note A4, Grisey’s *Périodes* on open-string D4, and Lamb’s *Prisma Interius IX* on a G4 open in the piece’s unique scordatura. In these examples, open-string tuning aids performers in achieving a precise frequency with few overtones; for Tenney and Grisey, these features help beating become audible as performers slowly drift away to another string. Open strings also begin many of the acoustics-focused compositions listed in **Example 14** and **Appendix 2**.⁽²⁹⁾ In all of these cases, the open string or natural harmonic makes the deviation from that opening note, and the psychoacoustic phenomena that result, that much more audible.

[3.13] Following this trend, **Example 24** (duplicated in **Appendix 3**) lists compositions with string instruments that begin on open strings or natural harmonics, without *explicitly* referencing acoustics. Note that Grisey, Saariaho, Scelsi, Soper, and Tenney recur here after appearances in previous tables. I find it likely that in these cases, rather than overtly highlighting acoustics, the schema instead is simply part of a vocabulary each composer deploys across their compositions. For instance, **Example 25** presents the opening of Scelsi’s 1965 *Xnoybis* for solo violin. Although the D#5 pizzicato is the only string open in the piece’s scordatura tuning, E5 is recognizable as a standard open-string pitch. By combining these notes and intensifying their beating through vibrato and a slow glissando, as in *L’Aime Ouverte*, the passage juxtaposes two conceptions of the open string: its conventional pitch and its acoustical quality. Beating—unstable and wavering due to the vibrato on E5—immediately results. If not centered on an open string, this passage—particularly the pizzicato D#5—would be unperformable.

[3.14] Luciano Berio’s 1976 *Sequenza VIII* for solo violin likewise combines open and stopped notes to produce beating and roughness, while not naming them in the score. **Example 26** shows that, across the first six notes, the same pitch (A4) is to be played on the G, A, and D strings (in that order), setting up subsequent triple-stops and a wedge away. Within those triple stops, beating becomes audible—perhaps not composed in, but as an unavoidable practicality of performance. Beating transitions to and from roughness as the triple-stops move between A4 unisons and a semitone wedge around them. As in Scelsi’s *L’Aime Ouverte*, the beating and wedge help the passage slowly push upward, in this case by a whole step to B4, where the same processes can resume and push further.

[3.15] Sofia Gubaidulina’s *Second String Quartet* (1987) deploys similar techniques to depart a natural harmonic rather than an open string. **Example 27** presents the opening of the piece. The instruments sit on G4, with some *sul pont* highlighting overtones as in Saariaho’s *Lichtbogen*. The octave harmonic, much like an open string, guarantees pure intonation, but when the note is stopped and played with vibrato, the intonations clash and we hear beating, making the vibrato act as the beginning of a wedge. In **Example 28**, vibrato develops into separate notes, moving outward further. **Example 29** shows the end of the piece’s unison passage: the wedge gets larger, but the unison remains underneath; the wedge fails at achieving an exit. Instead of leaving by wedge or addition of notes, the wedge develops into a glissando much like in Scelsi’s and Berio’s works.

[3.16] So far, these examples have departed open strings (or natural harmonics) by sliding away and creating a wedge that emphasizes beating. But an addition of notes can also lead away from open strings. **Example 30** shows the opening of Bent Sørensen’s *It is pain flowing down slowly on a white wall*: the A4 unison is shared by

all string instruments at first, including a double bass natural harmonic, and is sustained by the offstage solo violinist as the rest of the strings recontextualize it within a series of chords.

Remaining Unambiguous Acoustic Unison Openings

[3.17] Not all unison openings reference acoustics or open-string pitches. **Example 31** (duplicated in Appendix 4) lists all remaining examples of unison openings that are both unambiguously unisons and entirely acoustic.⁽³⁰⁾ Virtually all of these examples demonstrate the same three exit strategies, suggesting a broader applicability for both the schema and my suggested attention to roughness/smoothness, (in)harmonicity, and psychoacoustics.

[3.18] Many composers use unison openings both in pieces with acoustic and/or open-string references and in those without, as shown by the orange highlighting in Example 31. For example, consider Toshio Hosokawa's *Blossoming* (2008) for string quartet. Much like *Fragmente II*, discussed above, the piece begins by lingering on a unison, here B $\flat$ 3, for quite some time. **Example 32** shows that he uses the same two exit strategies— instruments push out by tone or semitone in either direction, constituting a wedge, after which another note harmonically recontextualizes the first pitch. Although the piece does not reference acoustics directly, it nonetheless exits its unison by the same means as *Fragmente II*.

[3.19] Among composers who have not yet been mentioned, György Ligeti has a crucial position—not only does his name appear seven times in Example 31, he is the most previously analyzed composer discussed in this article. Several of his unison openings have been analyzed by Benjamin Levy as being “chromatic wedges,” one of Ligeti's preferred “contrapuntal structures” in his 1960s works (2017, 213–18). I would add that Ligeti is not unique in this regard, and that his use of unison openings follows generic norms of his time. While Ligeti's unison openings seldom reference acoustics or open strings like the examples above, he shares the standardized exit strategies of the wedge and addition of notes. Because of this common vocabulary, I suggest that the same attention to psychoacoustics remains a useful analytical strategy, particularly given Ligeti's own studies in auditory fusion as applied to electronic sound synthesis.

[3.20] Of all the unison-opening pieces I am aware of, Ligeti's *Lontano* (1967) has by far the most extant analyses. The unison opening itself has been described as a “stable tonal area” (Morgan 1977, 49) or as a “focal point of clarity” (Bauer 2004, 125). Most often, analyses begin with describing the compositional process—the work contains several canons in Ligeti's characteristic micropolyphony—and consider how such canons shape the resulting textures.⁽³¹⁾ In addition to these findings, I note that the unison opening provides another connection between composition and perception: the canon's *dux* is constructed so that the unison opening schema and a wedge departure emerge as the audible outcome.

[3.21] In stronger terms, the subject of Ligeti's canon is designed to result in a unison opening and wedge departure, situating his micropolyphonic techniques within broader stylistic trends. Furthermore, Ligeti's studies in electronic music at the West German Radio meant he was familiar with the psychoacoustic principles underlying auditory fusion, linking his use of the schema to the perceptual concerns discussed above. Indeed, his sound mass music (of which *Lontano* is often considered an example) was an acoustic adaptation of additive synthesis, which relies on psychoacoustic research just as much as music by Tenney or Grisey.⁽³²⁾ Even though Ligeti provides no surface references to psychoacoustics, his compositional methods still reflect the influence of such studies on his broader musical environment.

[3.22] *Lontano*'s *dux* first repeats a note, creating a unison when realized as a canon at the unison, and then moves away from it by step, causing a wedge. **Example 33** reproduces the *dux*, in turn borrowed from *Lux Aeterna*, as identified by Levy (2017, 200–202). **Example 34** reproduces Amy Bauer's range graph of the opening, showing that this *dux* results in a wedge.⁽³³⁾ Note the arrows I have overlaid on these examples, which show that as the subject expands in register, the resulting canon saturates an increasingly wide pitch range. The canon's initial motion by tone and semitone will create auditory roughness once realized for multiple instruments. The canon is, by Ligeti's own design, inaudible and rather intended to create a larger-scale effect (Bauer 2004, 121–22; Bernard 1987, 209; Reiprich 1978), or, as in Ligeti's words, “polyphony is written, but harmony is heard” (Iverson 2009a, 167).

[3.23] At measure 14, pitches arrive in a new register. They do not result from the initial canon and its wedge; rather, they constitute a further exit by addition of notes. As Jonathan Bernard notes, the passage doubles the

in-progress canon at the octave (1987, 228), which Amy Bauer considers a “second canonic unit” (2004, 125). But from the perspective of the unison opening schema, what matters is that this doubling establishes a new register perceived as separate. As the canon is inaudible, I hear the passage as adding notes beyond those of the wedge. The *dux* and canon create the wedge; Ligeti’s further doublings create addition of notes.

[3.24] Wilfrido Terrazas’s “Tótem II (Miro hacia el cielo),” from *The Torres Cycle* (2019), also uses a canon to instantiate a unison opening and its exits. Instead of fully composing out a realization, “Tótem II” presents the canonic subject as a score for performance, shown in **Example 35**, along with instructions. Composed for any number of piccolos, “Tótem II” presents an “irregular canon” in which the first note, B6, is repeated four times to establish a unison much like in *Lontano*. The canon first implies a wedge with beating and roughness: the motion down a quarter tone is answered up a whole tone. But when the subject jumps to E6, the move is too large to be heard as a continuation of the same line. Instead, the E6 is a new added note, also departed by small intervals to maximize beating and roughness. As in *Lontano*, the canonic subject and its treatment generate the eventual shape of the unison opening and departure therefrom.

4. Beyond Unisons and Openings

[4.1] So far, every example has been both a unison and an opening, without problematizing those definitions. Each example has been a unison because one pitch emerges from two distinct sources. Each example has been an opening to a piece that begins with the single pitch but then deploys an exit strategy to move on to contrasting material. But many compositions employ the same acoustic references and exit strategies even when the opening is not quite a unison or not quite an opening.

[4.2] Consider, for example, Joan La Barbara’s Voice Piece: *One-Note Internal Resonance Investigation* (1974). By the definitions set out above, this piece is neither a unison nor an opening—it is only one pitch from one performer, and the single pitch lasts the piece’s full 15 minutes. Yet, *Voice Piece* shares many of the schema’s defining characteristics. While the piece maintains one source throughout, it develops the initial pitch by changes in timbre that can be heard as adding new pitches. **Example 36** shows the first 50 seconds from the 15-minute track: La Barbara only sometimes sings with overtones above 1000Hz (approximately C#6, or the 5th partial of her consistent A3 fundamental), or with growling subharmonics. Accordingly, the opening suggests a process by which overtones and multiphonics are added, and the piece focuses our attention on those changes in timbre—indeed, in recent remarks about the piece, the composer/performer states that the piece “was really [her] way of putting out there how many different sounds you can get starting with just one pitch and getting into different resonance areas as you saw on the score” (qtd. in Gutkin 2022, 22).

[4.3] Despite her calling the piece “one note,” I find some additional pitches to be potentially audible—in the sixth articulation of her A3, at 0:20, the high harmonics are so much richer that I find C#6 a plausible, albeit unstable, pitch. Such moments are characteristic of the piece’s usage of vowels, overtone singing, and multiphonics throughout (La Barbara 2002, 38; Bell 2016, 147–50; Ripley 2016, 45–51). But although such pitches seem to emerge out of the varying timbre, they never destabilize the A3 fundamental. The one-note passage, despite seeming like an opening, becomes frozen in time; the schema’s normative function fails.

[4.4] In the remainder of this article, I present three analytical vignettes that push at the definitional limits of my proposed schema and exit strategies. My first example, Pamela Z’s *Quatre Couches* (2015), shows how electronic compositions blur the boundaries between unisons and single notes. The second example, Ambrose Akinmusire’s “Americana / the garden waits for you to match her wilderness” from *Origami Harvest* (2018), demonstrates how unison passages can point to one another in shifting contexts over the course of a piece. My final example, Eric Wubbels’s *the children of fire come looking for fire* (2012), returns to psychoacoustics, showing how varied use of unison passages can intertwine acoustic references with one another across a larger form.

Pamela Z’s *Quatre Couches* and other Electronic Unisons

[4.5] Many electronic compositions imply that multiple sources are present. Such pieces might combine electronic and acoustic sources, so that sounds come from two distinct places. They might also invoke an element of live performance where one can visually associate sources with performers. In the absence of such cues, layered and overlapping amplitude envelopes might help listeners hear the sounds as being multiple.

Even when one sample is looped, so that notes share both fundamental and overtone pitches, “different parts of the spectrum [might] change in the same way at the same time” (Bregman 1994, 249), suggesting underlying grouping. If an electronic passage contains only one plausible pitch percept, such questions take on increased importance.

[4.6] The opening of Pamela Z’s *Quatre Couches* is recognizable as a unison on account of its mix of live and electronic sounds, the alignment of the performer’s actions to sounds’ onsets, and audible sonic overlap between grains of the same pitch. Some specifics of the piece vary between Z’s performances; I analyze her studio recording (combined with *Flare Stains*) on her album *A Secret Code*. **Example 37** provides an annotated spectrogram of the opening. In such a fixed format, all the sounds come from the same set of speakers. Listening to it, the first note, in all its repetitions, is recognizable entirely as Z’s voice. Despite this, I still hear it as a unison. And, as my annotations show, this unison’s subsequent behavior confirms its place in the schema: the first few seconds *wedge* away from the first note by step in either direction, and then another sonic texture is *added* atop the resultant cluster.

[4.7] The opening note is recognizable as a unison, rather than just a single note, because it is audibly looped and thus distinct from the sound of an unprocessed voice. Z writes in the album’s accompanying liner notes:

Quatre Couches is a sonic trifle, tiramisu, or mille-feuille—juxtaposing four contrasting vocal layers and toying them—mixing them and moving them around on the plate until they all melt away. The first (numeric) layer originated when I was counting during a concert soundcheck and, pleased with the resulting looped sound, decided to incorporate it into a new piece I was experimenting with. When I perform this piece live I manipulate that layer, along with three others, using a gesture-controlled MIDI instrument. (liner notes to Z 2020, 5)

The looping of her voice, then, establishes a contrast between her voice as actually sounding (likely amplified through the same speakers as the processed electronics) and the numerous instances of it when played back from the electronics, creating unisons both between her live voice and between the many recurrences of it that emerge from her software.

[4.8] In performance, Z’s physical gestures might help distinguish the different layers. To that end, **Example 38** presents a short excerpt from her June 24, 2020 streamed performance for the University of Chicago’s Gray Sound Sessions.⁽³⁴⁾ This video begins with her initial pitch, counted in English: note that she looks to the right, with her hands away from the front MIDI controller, as the loop continues to echo. Five seconds into the clip, Z prepares to reenter a step up, counting in French. As she inhales, not quite yet making the sounds a pitch above, the loop at the original pitch continues, firmly detaching the audio from her visual presence. Her hand, being positioned closer to the MIDI controller, helps cue that second layer.

[4.9] Although live performance helps to highlight the contrast between live and processed sound, I still hear the opening as a unison even when the piece is just an audio recording. In both situations, listeners can hear the sounds as overlapped because words’ initial articulations arrive as other words are sustaining. This multiplicity makes such overlaps unison dyads rather than solo monads. But even amid a plethora of sonic events, her voice’s overtones remain fused—unlike the many articulations of the first pitches, those high frequencies *do* start and stop together with their fundamentals.

[4.10] Z’s opening gambit is not uncommon within electronic music: **Example 39** (duplicated in Appendix 5) lists compositions that start on electronic unisons. This is not surprising: we saw above that the unison opening relies on psychoacoustics of pitch and timbre, which were studied through listener responses to electronically synthesized sounds. Likewise, we saw that composers, including Tenney, Grisey, Saariaho, and Ligeti, approach their acoustic unison openings with the help of their studies in electronic music. As timbre recognition is so intertwined with source recognition, unisons can be quite difficult to follow in electronic music—and while many compositions in Example 39 rely on distinct acoustics and electronic sources, many contain their unisons within a single prerecorded track.

[4.11] Electronic musicians, then, manipulate psychoacoustic cues not just for how many pitches one hears, but for how many sources that pitch might come from. A brief comparison is instructive—relative to Z’s *Quatre Couches*, Phil Niblock and Joseph Kamaru trace a path towards an uncanny valley between unison and one-note, in which a sound has the characteristics both of one instrument and of many. **Example 40** shows how Phill Niblock’s fixed-media piece *Harm* progresses from suggesting one cello note to many notes. The

piece consists entirely of prerecorded cello samples, often pitch-shifted but without additional sound synthesis (Demers 2010, 96). Despite being presented only as a fixed-media recording, I hear the piece as reflecting the many samples it is made from: during the opening unison, onset transients (marked with in blue arrows) rearticulate the pitch even as its partials sustain, creating the impression of multiple sources. As high frequencies accumulate, the piece suggests hearing the one fundamental pitch as emerging from many cellos.

[4.12] Finally, **Example 41** shows how sound artist KMRU (Joseph Kamaru)’s *Imperceptible Perceptible* sits on the edge between unison and one-note. While the spectrogram shows a clear single pitch at A $\flat$ 4, with inharmonic noise and an A $\flat$ 3 drone hovering, the waveform shows repeated amplitude envelopes, each starting before the previous one fades to silence. The resulting sound thus blends the constant sustain of one fused source with the perpetual attacks and shifting envelopes of an ensemble. Such ambiguity persists until a G $\flat$ 4 initiates a wedge at 0:37, at which point multiple pitches confirm multiple sources. Across all three examples, then, electronic pieces create the impression of multiple sources through careful layering of new articulations’ transients, envelopes, and unstable overtones, so that we hear these pitches as unisons no less than in instrumental music.

Ambrose Akinmusire’s “Americana”: Opening Single Notes and Non-Opening Unisons

[4.13] Ambrose Akinmusire’s “Americana / the garden waits for you to match her wilderness” (henceforth “Americana”), from his 2018 album *Origami Harvest*, demonstrates how unisons can take on different roles throughout the same piece. Over the course of “Americana,” unisons (and one-note passages that are immediately repeated as unisons, not unlike in Z’s *Quatre Couches*) begin the piece, return to opening material, and introduce contrasting material—even when not at the opening of the piece, they initiate formal regions. To demonstrate how unisons on the same pitch can invoke different material, **Example 42** provides fifty seconds from the middle of the track, from 6:04 to 6:54. Both 6:04 and at 6:40 both introduce unisons on D $\sharp$ =E $\flat$ 4, but while the first one points backward, referencing a wedge and B-major collection from the piece’s opening, the second leads forward, with the addition of notes suggesting a new E $\flat$ -major context for the remainder of the piece. The 3-second pause at 6:37 (33 seconds into the example), in which Kool A.D. speaks without instrumental backing (the only such pause in the track), highlights the break between these two contexts for the same pitch.

[4.14] **Example 43** provides an outline of “Americana,” showing which instruments and voices make sound over the course of the track, and where a few particularly pivotal pitches—unisons on D $\sharp$ =E $\flat$ 4, C $\sharp$ =D $\flat$ 4, and occasionally D $\sharp$ =E $\flat$ 5—are favored, with exit strategies labeled as appropriate. Unison passages and their motivic quasi-departures cover much of the piece, but not all—the interlude from 1 to 4 minutes in, in which Akinmusire plays a solo on a sampler keyboard (Williams 2021, 116), stands especially apart. But throughout, unison passages initiate new sections that later become identifiable by changes in instrumentation. The reentrance of a D $\sharp$ =E $\flat$ 4 unison in strings at 3:39 cues the jazz sampler’s and drums’ 4:14 exit. In turn, the strings’ drift downward to C $\sharp$ =D $\flat$ 4 around 4:24 anticipates Kool A.D.’s spoken overlay at 4:48. Nearer the end of the track, at 8:20, D $\sharp$ =E $\flat$ 5 an octave up prepares the trumpet’s entrance, after which both the voice and the drums exit.

[4.15] Within this instrumental context, **Example 44** presents my transcription of 5:53 to 6:14, where the unison on D $\sharp$ =E $\flat$ 4 marks a return to opening material. At this point, C $\sharp$ =D $\flat$ 4 has been repeated as a unison for about a minute, but at “sand ho out to Yonkers,” the original opening pitch returns, wedging through a B-major diatonic collection as continued into Example 42. For comparison, **Example 45** shows the opening of the entire track—as in Example 44, D $\sharp$ 4 wedges into a semitone dyad with E4.⁽³⁵⁾ When the wedge expands the opposition direction on the same scale, it introduces the same C $\sharp$ and B that we hear 6 minutes in.

[4.16] After the 3-second pause at 6:37, E $\flat$ =D $\sharp$ 4 takes on a different character: it rejects the B-major wedge in favor of E $\flat$ -major addition of notes. **Example 46** shows the first 20 seconds after the pause. While the first added note, B $\flat$ 4 establishing a perfect fifth, could still be diatonic as A $\sharp$ 4 in B major (as in 0:43 of Example 45), the cello’s subsequent G $\natural$ and C $\natural$ confirm the shift from B to E $\flat$ collections. Eventually, chordal and stepwise motions are combined at 9:24, shown in **Example 47**—E $\flat$ 5 is realized through a full E $\flat$ major scale, confirming the apparent modulation and preparing the track’s closing minute.

[4.17] Before the 6:37–40 pause, exit strategies are evaded, achieving genuine exists only afterwards. As shown in my exit-strategy annotations in Example 43, passages such as the actual opening (Example 45) get stuck on their unisons. In “Americana,” the conventional wedge thus becomes part of a continuous musical fabric, transcending its generic role in the schema to recur across the piece. Addition of notes is part of a larger breakthrough after the pause at 6:40, confirmed by the octave–5 register (Example 47) and the singular appearance of the composer on his usual instrument of trumpet, shown in **Example 48**.

[4.18] Unison passages and their departures in “Americana” transcend their opening function for long-range connections across the piece. The piece does begin with a unison (a single note on piano, immediately repeated as a unison with strings)—but as it goes on, the same material takes on further layers. At 6:04, the return to D $\sharp$ =E $\flat$ 4 invokes the piece’s opening, but less than a minute later, at 6:40, the same pitch is recontextualized with a new tonal context (E $\flat$ major instead of B major as a diatonic collection) and a new exit strategy (addition of notes rather than a wedge). Instead of creating roughness in its vicinity, conventionally tonal fifths are added to move forwards. This breakthrough extends beyond the confines of the track—**Example 49** shows a short excerpt from the album’s final track, “the lingering velocity of the dead’s ambitions,” in which an E $\flat$ 4 unison and a brief departure, surrounded by percussive attacks, briefly emerges as the final melodic fragment in the entire album.

Conclusion: Eric Wubbels’s *the children of fire come looking for fire*

[4.19] Eric Wubbels’s *the children of fire come looking for fire* provides an ideal concluding analysis as it brings together every aspect of unisons that I have discussed so far. A momentary unison at the opening echoes more and more as the piece goes on, culminating in a large *backwards* wedge whose eventual unison initiates a brief coda. As the piece goes on, its unisons and their exits gradually point towards acoustics, with notated beating speeds, multiple open strings, and at times attempting to sound fragments of a harmonic series. In *the children of fire come looking for fire*, then, the unison’s acoustical, schematic, and formal aspects all depend on one another.

[4.20] The leadup to the piece’s coda, illustrated in **Example 50a**, demonstrates how these elements can all emerge together.⁽³⁶⁾ In a grand rhetorical gesture, the violin wedges by glissando a bit over an octave inward to a beatless unison. In the first system, the violin’s pitches are notated; in the second, only beating speeds are notated, in Wubbels’ own idiosyncratic notation (resembling those of Scelsi and Nørgård) as shown in **Example 51**. This is an *inwards* wedge that brings the piece to its apparent ending; as opposite of the outward-opening wedge normative in our schema, it fits a concluding role. Nonetheless, beating, the wedge, and concluding function are all linked here, with help from the D being an open string. The unison at the end of the wedge does not, however, completely end the piece. Instead, it segues into a short “after-the-end” coda that adapts a passage by Brahms into just intonation, fitting it into the harmonic series. The coda uses the unison, then, to lead from a smooth lack of beats to near-fusion, echoing the acoustic possibilities discussed above.

[4.21] The unisons throughout *the children of fire* take on distinct relations to function, acoustics, and open strings over the course of the piece. These unisons, by resemblance to each other, set up a network of interrelated features much like those I have shown in the schema more broadly. The piece, over two large sections, slowly builds up a network of associations between unisons; the ending establishes the final connections as traced by the boxes and arrows in Example 50.

[4.22] While clear pitch is fragmentary at the opening of *the children of fire*, a lengthy unison (3 minutes later) suggests that we retrospectively hear the opening as a unison proper. Example 50b shows that the brief opening B $\flat$ 6 (i) recurs on the fourth page (ii), repeated while “glitching” as a unison between violin and piano. Its later return, initiating a section after a long pause, realizes the opening’s latent potential as a unison. It inhabits, then, two distinct opening functions—a local one for this section beginning, departed as more and more notes are added to the repeated fragments, and a global one where the initial cluster of B $\flat$ 6s and noise constitutes a single large beginning.

[4.23] The same combination of events—a pause and then a unison—initiates the first half’s coda. On page 13, shown in Example 50c, E5 in the violin enters, doubled between the open E string and a stopped A string; the stopped note slowly drifts flat.⁽³⁷⁾ This dyad introduces beating whose frequency is precisely notated in the

score, with exact rhythmic indications, taking the earlier notations by Nørgård and Scelsi to their logical extreme. This introduction of beating constitutes a wedge, joined later by addition of notes in the piano. This extended passage on E has a few distinct formal and schematic roles. Temporally, it initiates a large section in the middle of the whole piece, which concludes the first half of the piece. But as a recognizable open string invoking beating so directly, it also connects the passage, and by extension the earlier B $\flat$ unison, to the schema's usual norms.

[4.24] The opening of *the children of fire*'s second half helps to bring these unisons together. A rare passage (along with the coda) not to feature rapid-fire attacks, the system at the bottom of page 14 provides the context necessary to integrate the E5, D5, and B $\flat$ 6 unisons into a single vision. **Example 52** reproduces the passage with colors corresponding to the same pitches in Example 50, linking it to the unisons discussed above and to the final coda. In opening with E5, p. 14 continues the E5 unison that ended the first half. Moving down the violin's open strings leads from E5 to D4, the goal of the piece's pre-coda wedge on p. 24. Finally, this passage also recontextualizes the opening B $\flat$ 6. My interpretation here is admittedly speculative, but I find it helpful to hear the just-intonation B $\flat$ 4s in the violin, both in this passage and at the piece's very end, as integrating the opening B $\flat$ 6s into the open-string material, linking B $\flat$ to D through a shared just-intonation context.

[4.25] By way of conclusion, this final example has brought together much of what the unison opening schema offers. A momentary unison at the beginning of the piece, too brief to notice at first, is vastly expanded when it initiates a new section later. Across the piece, unisons begin sections, highlight the psychoacoustics of beating, roughness, and harmonicity, and bring the piece to its close. Eric Wubbels's own program notes point out that the wedge, a conventionalized exit strategy, is crucial to the piece (he writes that the wedge is "converted to a neume that functions on every structural level"). While the wedge becomes clearest at the end, unisons allude to it throughout. As my analysis shows, the piece's unisons become increasingly inseparable from their exit strategies: they gradually lead into wedges with notated beating and addition of notes within notated harmonic series. Likewise, the unisons become bound up with one another, referencing each other's pitches, pitch-classes, and motivic material at moments bookending and within the piece.

[4.26] Of course, *the children of fire* is not the most representative example—for one, it does not exactly begin on a sustained unison. But it still demonstrates how many of the schema's usual features can operate in conjunction with one another, bringing together many of the unison opening's typical behaviors. Like the many pieces that do place unisons at their start, *the children of fire* repurposes beating and harmonicity as new aesthetic ends. While they *can* be interpreted as contributing to traditional common-practice consonance, as Wubbels showcases in the Brahms quotation, their interpretations at the borders of pitch and timbre provide new contexts.

[4.27] Wubbels's composition could not have relied on unisons so extensively if they were not such a recognizable schematic trope in his musical surroundings. Like in Tenney's *Critical Band*, a unison from an open string generates beating at a notated tempo, within a piece that concludes by referencing the harmonic series and its consonance-fusion borders. Unisons recur on two different open-string pitches and a natural harmonic, echoing their common association with sonic purity, and yet the piece begins with a stopped note, showing the unisons' potential independence from such constraints. Unisons here transcend their opening role—the initial pitch at the opening spirals outward, showcasing the vast potentials of smoothness, roughness, inharmonicity, and harmonicity as they emerge from a single pitch. Wubbels's composition traces much of this article's course: while unisons are an effective way to highlight the psychoacoustics of pitch, they take on conventionalized structural roles within post-1945 compositional styles. The connections I have drawn demonstrate how unison passages, particularly at openings, place the psychoacoustic foundations of pitch perception within a shared musical vocabulary in decades of recent compositions.

Appendix

Appendix 1 (duplicating Example 4): list of pieces beginning on a unison and ending on a harmonic series

Surname	First name	Title	Year	Pitch	Exit	Discussed in
Eastman	Julius	<i>Crazy [n-word]</i>	1979	B $\flat$ 5	W	Gottschalk 2016, 47; Hanson-Dvoracek 2015; Hisama 2014, 276–79

Grisey	Gerard	<i>Periodes</i>	1974	D4	AG	Baillet 2000, 11–14, 113; Drott 2013, 25; Féron 2010; Féron 2021, Jakubowski 2019, 68–69, 201–3
Hosokawa	Toshio	<i>Fragmente II</i>	1989	F#4	AG	
Lamb	Catherine	<i>diviso spiralis</i>	2019	Bb5	W	
Lamb	Catherine	<i>Prisma Interius IX</i>	2018	G4	WA	
Tenney	James	<i>Critical Band</i>	1988	A4	WA	Fakhratabaie and Jennings 2021; Wannamaker 2021a, 225–231

Appendix 2 (duplicating Example 14): list of compositions explicitly referencing acoustic phenomena without ending in a full harmonic series (orange indicates composers previously mentioned)

Surname	First name	Title	Year	Pitch	Exit	Acoustic Reference	Discussed in
Grisey	Gérard	<i>Solo pour deux</i>	1982	D3	W	spectral fusion	Brown 2023, 161
Harvey	Jonathan	<i>Bhakti</i> , Mvt. 1	1982	G4	AW	notated harmonic series sweep	Harvey 1999, 77–78; Metzger 2009, 58
Lamb	Catherine	<i>Prisma Interius IV</i>	2017	C4	WA	same as in <i>Prisma Interius IX</i>	
Lamb	Catherine	<i>Prisma Interius V</i>	2017	Eb4	AW	same as in <i>Prisma Interius IX</i>	
Lamb	Catherine	<i>Prisma Interius VIII</i>	2018	G4	W	same as in <i>Prisma Interius IX</i>	
Lanzilotti	Leilehua	<i>On Stochastic Wave Behavior</i>	2021	E3	AW	waves generally	
Løkkegaard	Niels Lyhne	<i>Music for 30 Chromatic Tuners</i>	2015	A4	W	beating, exact frequencies notated	
Lucier	Alvin	<i>Canon</i>	1996	B3	G	beating	
Lucier	Alvin	<i>Check</i>	2011	G6	G	beating	
Lucier	Alvin	<i>Corner Church and High</i>	2019	D4	W	beating	
Lucier	Alvin	<i>Fan</i>	2003	D4	G	beating, exact ratios notated	
Lucier	Alvin	<i>Fideliotrio</i>	1987	A3	W	beating	Lucier and Tenney 1988, 12; Lucier 1998, 8
Lucier	Alvin	<i>Indian Summer</i>	1993	C (any)	W	beating	
Lucier	Alvin	<i>Intervals</i>	1983	A3	WG	beating	Lucier 1995, 290
Lucier	Alvin	<i>Step Slide and Sustain</i>	2014	D4	WG	beating, exact frequencies notated	
Murail	Tristan	<i>Mémoire/ Erosion</i>	1976	C4	A	ring modulation spectra	Murail [1980] 2005a, 125–33
Murail	Tristan	<i>Treize Couleurs du Soleil Couchant</i>	1978	E6	A	ring modulation spectra	
Nørgård	Per	String Quartet No. 5 “Inscape”	1988	D4	WG	beating and interference notated in score	
Pluta	Sam	<i>Broken Symmetries</i>	2012	D4	WA	beating, exact frequency ratios notated	
Saariaho	Kaija	<i>Lichtbogen</i>	1986	F#4	WA	spectral analysis of a sound	Cobb 2024, 248–53; Drott 2017, 271–80; Kankaanpää 2011, 166–72; Saariaho 1987, 129–31
Scelsi	Giacinto	<i>L'âme ouverte</i> and <i>L'âme ailée</i>	1973	D5	W	beating and interference notated in score	DeLio 2017
Schafer	R. Murray	<i>String Quartet No. 3</i> , Mvt. 1	1981	A3	W		Elliott 1997, 145–47
Soper	Kate	“Across the Turbid Waves/In a Silent Valley” from <i>Here be Sirens Suite</i>	2013	C5	W	singing and hitting into resonant piano, tuning fork often included in staging. More speculatively, perhaps the “waves” and “sirens” of the title.	
Tan	Anthony	<i>On the Sensation of Tone II</i>	2016	D4	A	Title invokes Helmholtz	
Tenney	James	<i>Diapason</i>	1996	Bb6	AW	whole piece is harmonic series collection	Wannamaker 2021b, 333–37
Tenney	James	<i>Saxony</i>	1978	Eb2	A	whole piece is harmonic series collection	Wannamaker 2021b, 169–72
Tenney	James	<i>Septet</i>	1981	A2	A	whole piece is harmonic series collection	Wannamaker 2021b, 193–99
Tenney	James	“Trias Harmonica” from <i>Glissade</i>	1982	D3	W	whole piece is harmonic series collection	Wannamaker 2021b, 207–12

Appendix 3 (duplicating Example 24): compositions starting on a unison playable as an open string or natural harmonic (orange indicates composers previously mentioned)

Surname	First name	Title	Year	Pitch	Exit	Discussed in
Abrahamsen	Hans	<i>Ten Preludes/Ten Sinfonias, Mvt. 2</i>	1973	G3	A	
Andre	Mark	<i>Riss 1</i>	2017	D4	A	
Berio	Luciano	<i>Corale</i>	1981	A4	WG	Roberts 2007 , 127–30
Berio	Luciano	<i>Sequenza VIII for solo violin</i>	1976	A4	WG	
Birtwistle	Harrison	<i>Nomos</i>	1971	G4	G	
Birtwistle	Harrison	<i>Silbury Air</i>	1977/2003	E4	A	
Brook	Taylor	<i>Amalgam</i>	2015	D4	G	
Carter	Elliott	Sonata for Flute, Oboe, Cello, and Harpsichord, Mvt. 2	1952	G4	A	DeLio [2007] 2021 , 106
Cerrone	Christopher	<i>New Addresses, “To Breath”</i>	2020	C4	A	
Cheung	Anthony	<i>Bagatelles, Mvt. 2</i>	2014	G4	A	
Cox	Jessie	<i>Alien Stories</i>	2020	G4	WA	
Gravgaard Madsen	Allan	<i>SUITE, “Overture”</i>	2016	D6	W	
Grisey	G�rard	<i>D�rives</i>	1974	A4	WA	Brown 2023 , 96
Gubaidulina	Sofia	<i>Seiltanzer</i>	1993	A4	W	Birch 2017 , 31–69
Gubaidulina	Sofia	<i>Sieben Worte, Mvt. 1</i>	1982	A3	WA	
Gubaidulina	Sofia	String Quartet No 2	1987	G4	WG	Lochhead 2016 , 123–46
Haas	Georg Friedrich	<i>in nomine</i>	1999	D4	A	
Horst	Marta	<i>The Universe Remembers Gravitational Waves</i>	2021	G4	W	
Ludwig	David	<i>Pale Blue Dot</i>	2014	A5	W	
Kurt�g	Gy�rgy	<i>Kafka-Fragmente, Part 1, No 16 “No Going Back”</i>	1992	D4	AG	
Kyriakides	Yannis	<i>Paramyth</i>	2010	D4	G	
Montgomery	Jessie	<i>Break Away, Mvt. 4 “Quick Pass”</i>	2013	D4	G	
Montgomery	Jessie	<i>Source Code</i>	2013	A4	G	
Nemtsov	Sarah	<i>SKOTOM</i>	2019	A4	G	
Neuwirth	Olga	<i>In the realms of the unreal</i>	2009	A4	G	
Saariaho	Kaija	<i>Nymphea Reflection, Mvt. 1</i>	2015	A4	G	
Satoh	Somei	<i>Kyokoku</i>	1991	F�4	W	
Saunders	Rebecca	<i>To and Fro</i>	2013	D4	W	
Saunders	Rebecca	<i>Vermillion</i>	2003	A3	WG	
Scelsi	Giacinto	<i>Voyages, Mvt. 2</i>	1985	D4	A	
Scelsi	Giacinto	<i>Xnobybis</i>	1965	E5	WG	Dickson 2012 , 223–26
Schafer	R. Murray	String Quartet. No. 2 “Waves”	1976	D4	WA	
Soper	Kate	<i>Cipher</i>	2012	D5	A	
Soper	Kate	<i>The Ultimate Poem is Abstract</i>	2016	D4	W	
S�rensen	Bent	<i>It Is Pain Flowing Down Slowly on a White Wall</i>	2010	A4	A	
S�rensen	Bent	<i>Sirengesang</i>	1994	D4	W	
S�rensen	Bent	String Quartet 1 No. “Alman”, Mvts 1 and 2	1986	D4	WA	
Sorey	Tyshawn	<i>Sentimental Shards</i>	2014	F�6	A	
Spahlinger	Mathias	<i>Gegen unendlich, Mvt. 1</i>	1997	D5	AG	Menke 2001
Szmytka	Jagoda	<i>f* for music</i>	2012	A5	G	
Tenney	James	<i>Harmonium 5</i>	1978	E5	A	
Tenney	James	Seeds, Mvts 1 and 2	1956	E5	A	Wannamaker 2021a , 25–30
Tenney	James	<i>Song ‘n’ Dance for Harry Partch, Mvt. 2</i>	1999	G5	A	Wannamaker 2021b , 346–49
Tulve	Helena	<i>L’ombre derri�re toi</i>	2011	D4	AG	Bauer 2021
Wijeratne	Dinuk	Tabla Concerto, Mvt. 1	2011	D4	WA	
Woolley	Nate	<i>Experiment Three Modney Roberts Take Two</i>	2023	D4	AW	
Zimmermann	Bernd Alois	<i>Stille und Umkehr</i>	1970	D4	A	Decroupet 2022 , 184

Appendix 4 (duplicating Example 31): list of other compositions starting on an acoustic unison, none of which contain open strings or acoustic references (orange indicates composers previously mentioned)

Surname	First name	Title	Year	Pitch	Exit	Discussed in
Abrahamsen	Hans	String Quartet No. 2, Mvt. 1	1987	A�3	WG	
Abrahamsen	Hans	Ten Pieces for Orchestra, Mvt. 10	2020	B3	WA	
Abrahamsen	Hans	<i>The Snow Queen</i>	2018	E�4	A	
Albright	William	Alto Saxophone Sonata	1984	A4	A	

Alit	Dewa	<i>Ngejuk Memedi</i>	2016	scale tone 7 (precise height varies by ensemble)	A	Tenzer 2018
Akinmusire	Ambrose	“The Beauty Of Dissolving Portraits” from <i>The Imagined Savior Is Far Easier To Paint</i>	2014	E♭5	A	
Berio	Luciano	<i>Chemins IV</i>	1975	B4	W	Oliveira, Taffarello, and Garcia 2019 , 12–20; Roberts 2007 , 125–27
Berio	Luciano	<i>O King</i>	1968	F4	A	
Berio	Luciano	<i>Requies</i>	1985	C♯5	W	
Bertrand	Christophe	<i>Aus</i>	2003	F4	A	
Birkenkotter	Jorg	<i>In Nomine</i>	1999	D4	A	
Birtwistle	Harrison	<i>Duets for Storab: VI. Crunluath</i>	1983	D4	A	
Birtwistle	Harrison	<i>Hoquetus Petrus</i>	1995	E5	A	
Birtwistle	Harrison	<i>Meridian</i>	1971	E4	A	
Birtwistle	Harrison	String quartet: The Tree of Strings	2008	E5	WA	
Causton	Richard	<i>Phoenix</i>	2006	C5	WA	
Chacon	Raven	<i>Old Song</i>	2022	C5	W	Yazzie and Chacon 2022
Cheah	Victoria	<i>Walk for a shell</i>	2023	A4	WG	
Cheung	Anthony	<i>A line can go anywhere</i> , Mvt. 1	2019	E♭4	A	
Cheung	Anthony	<i>Double Allegories</i>	2019	A♭3	W	
Cheung	Pius	<i>Unsynced</i>	2020	B3	WA	
Chin	Un Suk	Cello Concerto	2013	G♯4	WG	Lee 2020
Chin	Un Suk	<i>Graffiti</i> , Mvt. 1 “Palimpsest”	2013	F♯5	G	
Cline	Nicholas	<i>I had a white room</i>	2018	A3	G	
Davachi	Sarah	<i>Long Gradus</i> , Part III	2021	G4, F4, or F3	A	
Dean	Brett	<i>And once I played Ophelia</i>	2013/ 2018	A4	WG	
Dean	Brett	<i>Eclipse</i> , Mvt. 1	2003	A3	A	
Eastman	Julius	<i>Gay Guerrilla</i>	1979	A5 notated	A	
English	Lawrence	<i>A Binding</i>	2021	C♯2	A	
Ferneyhough	Brian	<i>Mnemosyne</i>	1986	C4	G	
Gravgaard Madsen	Allan	SUITE, “Gigue”	2016	D6	WA	
Green	Brittany	<i>Maps</i>	2017	C4	A	
Gubaidulina	Sofia	<i>Garden of Joys and Sorrows</i>	1980	A4	W	
Gubaidulina	Sofia	<i>Sieben Worte</i> , Mvt. 5	1982	F2	WG	
Haddad	Saad	String Quartet No. 2	2021	G6	W	
Hennies	Sarah	<i>Clock Dies</i>	2021	C5	AW	
Herndon	Julie	<i>I Can Take</i>	2018	C4	W	
Holliger	Heinz	<i>Ma'mounia</i>	2002	A3	G	
Honstein	Robert	<i>Endless Landscape</i> , Mvt. 3 “Darkly hypnotic, insistent”	2022	C5	AW	
Hosokawa	Toshio	<i>A Song from far away: in nomine</i>	1999	D4	A	
Hosokawa	Toshio	<i>Arc Song</i>	2012	E♭4	G	
Hosokawa	Toshio	<i>Blossoming (String Quartet)</i>	2008	B♭3	W	
Hosokawa	Toshio	<i>Threnody</i>	2012	G3	G	
Kidambi and Liberatore	Amirtha and Matteo	<i>Neutral Love</i> , “Bells”	2020	D3	WA	
Kurtág	György	<i>Kafka-Fragmente</i> , Part 1, No 4 “Restless”	1992	G5	W	
Kurtág	György	<i>Kafka-Fragmente</i> , Part 3, No. 12 “Scene on a Tram”	1992	E4	A	
Kurtág	György	<i>Kafka-Fragmente</i> , Part 4, No 1 “Too late”	1992	F♯4	W	
Kyriakides	Yannis	<i>the arrest</i>	2010	E4	W	
Lancaster	Yaz	<i>intangible landscapes</i>	2020	C4	A	
Lang	Klaus	<i>parthenon</i>	2018	C5	W	
Laurello	Michael	<i>Churches Made Out of Shipwrecks</i>	2018	C4	A	

Ligeti	György	Cello Concerto	1966	E4	W	DeLio 2017 ; Levy 2017 , 205–9; 2022 , 145–46
Ligeti	György	Chamber Concerto, Mvt. 3	1974	E4	G	
Ligeti	György	<i>Lontano</i>	1967	A♭4	W	Bauer 2004 , 121–30; Bernard 1987 , 228–33; Levy 2017 , 200–5; Morgan 1977 , 49–50, Reiprich 1978
Ligeti	György	<i>Lux Aeterna</i>	1968	F4	A	Levy 2017 , 192–200
Ligeti	György	String Quartet 2, Mvt. 2	1968	G♯4	WA	
Ligeti	György	Ten Pieces for Wind Quintet, Mvt. 5	1969	D4	W	
Ligeti	György	Ten Pieces for Wind Quintet, Mvt. 9	1969	E♭6	W	Clendinning and Marvin 2021 , 867; Levy 2017 , 213–15
Lockwood	Annea	<i>Bayou-Borne</i>	2016	B3	GA	
Lokkegaard	Niels Lyhne	<i>Music for 19 Clarinets</i>	2016	A5	WG	
Lokkegaard	Niels Lyhne	<i>Towards a major third</i>	2016	A5	W	
Maysaud	Nebal	<i>Decolonized Arabesques</i> , Mvt. 2	2018	D4	W	
Morris	Robert	<i>Landscape Greeting</i>	2020	B♭4	A	
Morris	Robert	<i>Multiplicities and then some</i>	2019	E3	A	
Netzer	Osnat	<i>They bury their dead with great ululations</i>	2018	B4	WG	
Neuwirth	Olga	<i>In Nacht und Eis</i>	2007	E♭2	WA	
Oliveros	Pauline	<i>Horse Sings from Cloud</i>	1975	any	A	
Poppe	Enno	<i>Stoff</i>	2015	E♭4	A	
Rands	Bernard	<i>Canti dell'Eclisse</i>	1992	C♯4	AW	
Rosing-Schow	Niels	<i>FlashNight</i>	2016	E4	W	
Rowden and Birdsey	Zach and Henry	<i>From the Crypt</i> , Side B	2024	F♯5	A	
Saariaho	Kaija	<i>Leino Songs</i> , Mvt. 2 “Sydan”	2007	E5	A	
Saariaho	Kaija	<i>Neiges</i>	1998	E♭2	A	
Saariaho	Kaija	<i>Nymphaea Reflection</i> , Mvt. 6	2015	D3	G	
Saunders	Rebecca	<i>A Visible Trace</i>	2006	B3	AG	
Scelsi	Giacinto	<i>Elegia per Ty</i> , Mvt. 1	1988	G♭3	G	
Scelsi	Giacinto	<i>Elegia per Ty</i> , Mvt. 2	1988	B♭3	G	
Scelsi	Giacinto	<i>Quattro pezzi su una nota sola</i> , Mvt. 3	1959	A♭4	WGA	Elezovic 2007 , 57–66; Reish 2006 , 185; DeLio [2007] 2021 , 105–43
Scelsi	Giacinto	<i>Quattro pezzi su una nota sola</i> , Mvt. 4	1959	A3	AW	Elezovic 2007 , 66–84; Reish 2006 , 186–87
Scelsi	Giacinto	<i>Sauh IV</i>	1973	A4	W	
Scelsi	Giacinto	<i>Voyages</i> , Mvt. 1	1985	B♭3	WG	
Schafer	R. Murray	<i>Gamelan</i>	1980	C4	W	
Schafer	R. Murray	<i>Requiems for the Party Girl</i>	1966	C4	WA	
Schafer	R. Murray	<i>Scorpius</i>	1990	C4	W	
Schafer	R. Murray	String Quartet No. 3, Mvt. 3	1981	C4	G	
Sharpe	Christopher	<i>Joy Cometh in the Morning</i>	2018	G♭3	A	
Singleton	Alvin	<i>Be Natural</i>	1974	B3	A	
Smooke	Vid	<i>All are Welcome Here</i>	2017	C5	A	
Soper	Kate	<i>Here be Sirens, "Prologue"</i>	2013	E4	W	
Strand	Ryan Townsend	<i>PAX - NOX</i>	2017	F3	A	
Stockhausen	Karlheinz	<i>Inori</i>	1973	G4	A	Harvey 1999 , 81–82
Stockhausen	Karlheinz	<i>Stimmung</i>	1968	B♭2	A	
Tanaka	Gen	<i>Sobering</i>	2018	F4	A	
Tenney	James	<i>Three New Seeds</i> , Mvt. 7	1992	F4	W	Wannamaker 2021b , 288
Terrazas	Wilfrido	<i>The Torres Cycle</i> , “Tótem II, Miro hacia el cielo”	2019	B5	WA	
Thomas	Augusta Read	<i>Dance Mobile</i>	2022	E4	A	
Thomas	Augusta Read	<i>Of Being is a Bird</i>	2015	G4	W	
Travers	Aaron	<i>The Nameless Path</i>	2022	E♭5	WA	
Tsao	Ming	<i>(Un)cover</i>	2010	D4	G	
Tulve	Helena	<i>Öð (Night)</i>	1997	C4	AW	
Webber	Anna	<i>Swell</i>	2023	C4	A	

Woods	Ayanna	<i>Shift</i>	2020	G3	A	
Xenakis	Iannis	<i>Waarg</i>	1988	E4	AW	
Xenakis	Iannis	<i>Pléiades</i> , “Metaux”	1978	perc.	W	Ceuster 2021
Xu	Shuya	<i>In nomine</i>	1999	D4	WA	

Appendix 5 (duplicating Example 39): list of unisons involving electronics (orange indicates composers previously mentioned)

Surname	First name	Title	Year	Pitch	Exit	Discussed in
Beil	Michael	<i>Die Zwei</i>	2004	F3	A	Chung 2019 , [6.2.1]–[6.2.9]
Benge		<i>1970 ARP 2500</i>	2008	F4	AW	
Benge		<i>1971 ARP 2600</i>	2008	G4	WA	
Benge		<i>1983 Fairlight CMI</i>	2008	G2	A	
Berio	Luciano	<i>Altra Voce</i>	1999	F4	W	Roberts 2007 , 126
Berio	Luciano	<i>Sequenza VII for solo oboe</i>	1969	B4	W	Alessandrini 2007 ; Oliveira, Taffarello, and Garcia 2019 , 6–11; Roberts 2003 ; Snyder 2000 , 248
Bertucci	Lea	<i>Sustain and Dissolve</i>	2018	F#5		
Bertucci	Lea	<i>Warp and Weft</i>	2019	C5		
Bertucci	Lea	<i>Wind Piece</i>	2019	F#5		
Bonvalet	Thomas	<i>440Hz, Téléphone... And Métronome, Guitare, Scotch De Peintre, Membranes...</i>	2021	A4	W	
Branciforte and Bleckmann	Joseph and Theor	<i>10.11.5</i>	2023	D4	AW	
Cerrone	Christopher	<i>A Natural History of Vacant Lots</i>	2017	B5	A	
Clift	Paul	<i>Astatine</i>	2019	C2	A	
Cruel Diagonals		<i>Reconciliation</i>	2023	D4	A	
Davachi	Sarah	<i>Alms Vert</i>	2013	D3	A	
Davachi	Sarah	<i>Olsun</i>	2015	B3	A	
Davidovsky	Mario	<i>Synchronisms No. 6</i>	1970	G5	A	
de Asis	Clara	<i>Repetition of the Same Dream</i>	2020	A5	A	
Diels	Natacha	<i>automatic writing mumbles of the late hour</i>	2020	E6	A	
Ellis	JJJJJerome	<i>The Clearing</i> , “Punch Line”	2021	B3	WA	Ellis 2020
Ergün	Cenk	<i>Inseln</i>	2021	A½#	W	
Geaney	Susan	<i>Tape Melt</i>	2022	C#5	AG	
Haddad	Saad	<i>A Hummingbird Told Me</i>	2019	C6	WA	
Johns	Sullivan	<i>Pitched Variations</i>	2025	D4	AW	
Kamaru	Joseph	<i>Along A Wall</i>	2023	A♭2	A	
Kamaru	Joseph	<i>Argon</i>	2021	C4	A	Chattopadhyay 2022
Kamaru	Joseph	<i>falling dreams</i>	2021	F#3	A	
Kamaru	Joseph	<i>Imperceptible Perceptible</i>	2022	A♭4	W	
Kirkegaard	Jacob	<i>0102 Köln</i>	2002	B4	A	
Kirkegaard	Jacob	<i>0602 Köln</i>	2002	F#6	A	
Lee	Charmaine	<i>Market Slip</i>	2021	B♭4	W	
Lisel		<i>Polyphony for Voices</i>	2023	B♭4	W	
Lowe	Robert Aiki Aubrey	<i>Structural Swell</i>	2018	E♭4	fade	
Lowe	Robert Aiki Aubrey	<i>Wit's end</i>	2007	G4	WA	
Lucier	Alvin	<i>Charles Curtis</i>	2002	C4	W	Saunders and Lucier 2009 , 305–6; Rietbrock 2022 , 194–95
Lucier	Alvin	<i>Ever Present</i>	2002	C4	W	
Lucier	Alvin	<i>Fruits and Vegetables</i> , “Granny Smith Apple” and “Two Lemons”	2000	E3 and F3	W	Lucier 2002 , 261
Lucier	Alvin	<i>Kettles</i>	1987	A2	W	Lucier and Tenney 1988 , 11
Lucier	Alvin	<i>Music for Piano with Slow Sweep, Pure Wave Oscillators</i>	1992	E4	W	Lucier 2002 , 254–55
Lucier	Alvin	<i>On the carpet of leaves illuminated by the moon</i>	2000	F#4 or F#3	G	

Lucier	Alvin	<i>Six Geometries</i> , Mvts. 1 “Small Fish Logo,” 3 “Right Angle,” 4 “Triangle,” and 6 “Plums”	1992	G4, C4, G4, F#4	W, AW, WA, WA	Lucier 1995, 286; Lucier 2002, 255
Lucier	Alvin	<i>Still Lives</i> , Mvts. 1 “Sunlight Diamond,” 2 “Hammock,” 4 “Lamp Shade,” 5 “Three Floor Tiles”	1996	C#4, Bb5, F#4, F5	WA, G, WA, WA	Rietbrock 2022, 193
Lucier	Alvin	<i>Two Circles</i>	2012	E4	W	Rietbrock 2022, 202
Magnetic Coroner		<i>Cloned Ghost 1</i>	2023	E5	WA	
Mincek	Alex	<i>Glossolalia</i> , “Thread 2”	2019	C4	A	
Mitterer	Wolfgang	<i>Little Smile</i>	2011	F4	fade	
Mounir	Nancy	<i>Ana Bas Saktalak (with Fatma Serry)</i>	2022	C2	A	
Niblock	Phill	<i>A Cage of Stars</i>	2013	G4	A	
Niblock	Phill	<i>Feed Corn Ear</i>	2012	G3	A	
Niblock	Phill	<i>Harm</i>	2003	G2	AW	Demers 2010, 95–96
Niblock	Phill	<i>P K</i>	1990?	Eb4	WA	
Niblock	Phill	<i>S L S</i>	1990?	F4	WA	
Niblock	Phill	<i>Stosspeng</i>	2007	F2	A	
Noit	Hatis	<i>Aura</i>	2019	Bb3	W	
Noit	Hatis	<i>Aura</i>	2022	Bb3	W	
Oliveira	João Pedro	<i>Beyond</i>	2006	A5	G	
Poppe	Enno	<i>Rundfunk</i> , Mvt. 1	2018	C4 notated, C#4 sounding	AG	
Radigue	Éliane	<i>Adnos 3</i>	1980	D2	A	
Radigue	Éliane	<i>Kyema</i>	1994	A3	A	
Rangaswamy	Varun	<i>REINHERTANCE</i> , “wing joint alapana”	2023	D3	W	Carnatic <i>alapana</i> genre discussed in Viswanathan 1977, 56
Reider	C.	<i>sever the invisible hand</i> , “false divine”	2022	Bb4	A	
Rothwell	Carmen Q.	<i>Blissful Ignore</i>	2021	Bb3	A	
rousay	claire	<i>Sigh In My Ear</i>	2023	D	A	
rousay	claire	<i>Your First Armadillo</i>	2023	F#4	A	
Saariaho	Kaija	<i>Frises</i> , Mvts. 1 and 3	2011	D4	G	
Smylex Attack		<i>Aether / Flux</i>	2021	A4	A	
Tipp	Devon Osamu	<i>Good Morning if it is Good Morning</i>	2021	G4	WA	
Wincek	Thomas	<i>The desert of the real itself</i> , SIDE A	2020	F#4	A	
Young	Nina	<i>Kolokol</i>	2010	A6	A	
Z	Pamela	<i>Occupy</i> , “Site Four”	2017	F#3	A	
Z	Pamela	<i>Quatre Couches</i>	2015	Bb3	WA	Lansang 2019, 145–55
Z	Pamela	<i>Timepiece Triptych</i> , “Declaratives in the First Person”	2005	E3	G	

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Footnotes

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1. In addition to Applebaum, Wolfgang Rüdiger (2001) and Andrey Molchanov (2016) have made similar observations about the prevalence of one-note passages, albeit not necessarily unisons or openings.

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2. This pair of definitions is standard in psychoacoustics (Hartmann 2005, 282–84; Oxenham 2018, 31; Parncutt 2024, 78) and philosophical discussions thereof (O’Callaghan 2007, 76–80). However, my terminology inevitably differs from others’. Parkhurst and Hammel (2018) use “pitch” for what I call “frequency” and “tone” for what I call “pitch.” Tenney himself, predating some modern psychoacoustics, uses “pitch” rather unclearly to mean what I call either “note” or “frequency” within the score of *Critical Band*.

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3. *Critical Band* is in just intonation, with frequencies and their ratios relative to A440 notated directly on the score. My calling it an [01234] cluster requires some rounding into a 12-equal division of the octave.

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4. For discussion of the role of critical bands in Critical Band specifically, see Fakhrtabatabaie and Jennings (2021) and Wannamaker (2021a, 227). For discussion of critical bandwidths in auditory perception more generally, see Hartmann (2005, 242–54), Huron (2016, 41–47), and Sterne (2012, 99–101).

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5. More precisely, all notes in the piece are partials of an inaudible 3.4375Hz conceptual fundamental—all beating in the piece is at this frequency or multiples of thereof. Because Tenney has constructed the piece around this fundamental, all beating will be clear and rhythmically perceptible, rather than creating a chorusing effect, as long as the musicians perform the indicated frequencies. (Tenney suggests using electronic tuners when performing.)

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6. More specifically, Helmholtz suggested that dissonance in larger dyads or chords results from beating among their upper partials (Helmholtz [1885] 1954, 179–97; Hui 2012, 95–96; Steege 2012, 13). The C4–F#4 tritone, for instance, is dissonant because of beating between G5 and F#5 overtones. In more recent research, prominent advocates for roughness as dissonance include Lahdelma, Eerola, and Armitage 2022; Milne et al. 2023; and Sethares 2005.

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7. This figure relies on Hutchinson and Knopoff’s 1978 formula. I chose this formula because among roughness models, it was the best predictor of listener rankings of consonance in Harrison and Pearce’s 2020 review. Accordingly, I computed roughness using Harrison and Pearce’s *dycon* package, available at <https://github.com/pmcharrison/dycon/>; note that this presumes a harmonic spectrum for all tones (as is almost certain in performance).

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8. One might also discuss “fundamental-oriented” vs “partial-oriented” listening strategies (Lenchitz 2021).

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9. While definitions of timbre remain contested and beyond this article’s scope, it suffices to define it here as the difference between two sounds perceived to have the same pitch. While this is approximately the “negative. . . umbrella term” in which timbre includes all aspects other than pitch, loudness, and duration (Wallmark 2022, 2), I would like to emphasize that the act of hearing a shared pitch (and separating out timbre) means that other frequencies in the sound, which one *could* hear as pitches, become less prominent in one’s perception (Bregman 1994, 314–43; Fales 2002, 68; Walden 2019; Lenchitz 2021).

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10. Note that the fifth and seventh staves, in the last few time brackets, are silent—that is, G4 and B4, partials 7 and 9 of the A1 harmonic series, exit to prepare the end of the piece.

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11. I calculated harmonicity according to Bowling’s algorithm (Bowling, Purves and Gill 2018) as documented in Friedman et al. (2021, 330). Informally speaking, this algorithm computes harmonicity as the fraction of relevant harmonics present over a passage’s implied fundamental. Computational implementation of the algorithm was my own. Note that decreases in harmonicity at 13 and 15 minutes in reflect odd-numbered high partials of A1 (not A2) that fill out the composition’s ascending soprano line.

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12. The concept of tonal fusion originated with Stumpf’s *Tone Psychology* ([1890] 1965; see also Marvin 1987, 65; Fisette [2009] 2019) and was taken up as a predictor of consonance by modern-day music-psychological research following DeWitt and Crowder (1987; see also Bregman 1994, 507). More recent advocates for the importance of contribution of harmonicity (rather than roughness) to consonance include Bowling, Purves, and Gill (Bowling, Purves and Gill 2018) and McDermott, Lehr, and Oxenham (2010). The former article argues that consonance relies on acoustic similarity to speech sounds, which are ecologically important to the human auditory system.

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13. Tenney’s third and fourth concepts are applicable only to specific contexts in Western music (counterpoint and chord-root analysis), and he does not use them extensively in his own music. His first concept refers to consonance between *melodically* related notes, and although it is crucial to some of his other pieces, it is harder to apply to pieces like *Critical Band* that are so static (Wannamaker 2021a, 136–47).

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14. See footnotes 6 and 12 above for the current relevance of smoothness and harmonicity in particular. Their relative contributions remain debated—because most instruments and voices have harmonic spectra, intervals with high harmonicity usually have smooth spectra when performed, and vice versa. Many current researchers prefer a hybrid approach in which smoothness and harmonicity *together* form consonance; see for example Harrison and Pearce (2020), Friedman et al. (2021), and Parncutt (2024, 229–32).

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15. Tenney may also have learned about critical bandwidths at Bell Labs—although his own research was timbre-focused and reliant on digital technology, critical bandwidths had been extensively studied at Bell Labs using analog technology decades prior (Sterne 2012, 97–98).

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16. One could find any number of definitions for a style or genre that would encompass many, if not nearly all, of the composers discussed herein. One could enumerate features of their music and work—such as those of Seth Brodsky’s seven-circle Venn diagram beginning with the premise that such composers “call themselves composers” (2017, 108–9). One might also follow actor-network lines, tracing the communities created by and around certain people and institutions—few if any composers discussed in this paper are more than a few steps from the overlapping circles of John Cage (Piekut 2011, 6–19, 2014, 207), IRCAM (Cagney 2025, 278–90; Morrison 2019, 11–23), and Darmstadt (Beal 2006, 91–113). However, the influence of schematic vocabulary tends wider than a strict institutional focus would allow, and I provide no explicit geographical-institutional bounds on the examples I discuss.

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17. While I acknowledge that Eastman’s use of this slur is important to the composition and its poetics, I nonetheless avoid stating it in this article, being one of “many [who] do not wish to utter or circulate the titles of these works” (Hisama 2014, 273). As Matthew Mendez notes, such censorship helps to minimize the harm caused by use of such words even now (2024, 228). I do admit, however, that much as my analysis’ exclusive focus on pitch collections strips away part of the work’s essence, so does my censorship of the title. Indeed, Eastman’s titles are famous specifically for their controversial use of slurs. In his spoken introduction to the 1980 concert at Northwestern University at which this piece was premiered, he contextualizes his use of the n-word (against protests from Black students at the same university) by redefining it as “that which is fundamental,” which he takes as essential to his musical aesthetic (Eastman [1980] 2023, 279). Within his broad social context, some interpret him as “seizing” (Jean-Francois 2020, 18) or “repurposing” (Dohoney 2015, 124) the slur for his own purposes, in dialogue with contemporaneous Black literature (Lewis 2015, xii–xiii). Within the narrower context of his musical world, the terms calls attention to his subject position as a music maker, in opposition to a certain detached quasi-objectivity of his (White) minimalist colleagues (Adams 2019, 216; see also Mendez 2024, 165).

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18. In all three available recordings of the piece, the harmonic series is performed at pitch despite the initial instructions in the score—most likely, the recognizability of a harmonic series overrides the rest of the piece’s practice. Further highlighting the acoustic reference, the harmonic series is performed in matching rhythmic proportions, in the style of Henry Cowell ([1930] 1996, 46–66)—that is, the 2nd partial is played twice as often as the fundamental, the 3rd partial thrice as often, etc. This rhythm is notated in the score through the numbers underneath the notes, which suggest how many metric units a performer should count before rearticulating their note. For example, the fundamental is played every 4×10 , or 40, units, whereas the third partial is played every $8 + 5$, or 13, units, and 13 approximates $40/3$. (Eastman’s notation is not entirely consistent: later on the page, “+” should be interpreted as alternating between durations. For example, G5 approximates the 11th partial, and $40/11$ is between 3 and 4, so “3+4” means it should be played every 3 or 4 units.)

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19. This moment is better known as the opening to *Partiels* (see for instance Cross 2018, 108; Drott 2013, 19; Fineberg 2000; Hasegawa 2009; Leroux 2004; Schäfer and Kursell 2016), which Grisey composed a year later while expanding *Périodes* into the *Les espaces acoustiques* cycle (Féron 2021, 172, 191–96).

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20. Indeed, *Périodes* is Grisey’s first work to use actual spectra as determined by spectral analysis, rather than an idealized harmonic series (Baillet 2000; Féron 2010; 2021; Cagney 2023, 172).

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21. Cagney (2023, 141) briefly examines this unison as a borrowing of technique from Scelsi, but does not connect it to the piece’s underlying harmonic series.

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22. Example 4 also includes Lamb’s *divisio spiralis*, which uses similar techniques. I focus here on *Prisma Interius X* on account of its greater conceptual clarity.

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23. This corresponds to an Eb4 being 320Hz, but with A4 = 440Hz and 12-tone equal temperament, Eb4 would instead be $220\sqrt{2}$ Hz, approximately 311Hz. The difference is almost a quarter tone, requiring extensive scordatura in conjunction with her use of natural harmonics.

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24. Their ratio, 81:80, is the *syntonic comma*, or the difference between a Pythagorean and just-intonation major third (Rasch 2002, 196–98; Willis 2025, 7–8).

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25. For more on Scelsi’s four pieces, see DeLio ([2007] 2021), Elezovic (2007), Murail ([1999] 2005b), and Reish (2006). While many take Scelsi as a precursor to some composers I discuss here—particularly French spectralists (Murail [1999] 2005b; Cagney 2023, 136–41), I find that such trends persist beyond any one

lineage.

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26. The connection to wedges is strengthened through comparison to *L'âme ailée*, which moves instead by wedge but lacks precise notation of beat frequencies; see DeLio (2017) for a more thorough comparison.

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27. Nørgård re-notated the piece in standard tuning in 1988, and the later version is more common in libraries. My examples focus on the original version because the beating is more often notated explicitly, even when the sonority in the revised version is the same. Interested readers can find passages corresponding to my examples on pages 1, 3, 9, 11, and 13 of the published 1988 score.

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28. Scelsi is often taken as a precursor to spectral music; see for instance (Drott 2013, 17–18; Murail [1999] 2005b). To my knowledge, relatively few such claims are made about Nørgård (with some notable exceptions including Anderson 2000, 14; Jakubowski 2019, 186–90).

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29. Nørgård's *Inscape* began with unison open-string and stopped-note D4s, as well as with natural harmonics on the same note. Among compositions listed in Example 14 (Appendix 2) but not otherwise discussed in this article, open strings also begin Pluta's *Broken Symmetries* (2012) and Lucier's *Corner Church and High* (2019), paralleled by natural harmonics in Lucier's *Step Slide and Sustain* (2014) and Harvey's *Bhakti* (1982).

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30. A few examples excluded on account of temporal scope are Frédéric Chopin's Waltz Op. 18 and Mazurka Op. 30 No. 3, as well as the second of André Jolivet's *Cinq Incantations* (Venturino 2022, 264).

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31. See Bauer (2004, 121–30), Bernard (1987, 228–33), Levy (2017, 200–205), Iverson (2009a, 157–73), Morgan (1977, 49–50), and Reiprich (1978).

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32. While such influence is clearest with earlier works—*Apparitions* and *Atmosphères* famously repurpose Ligeti's electronic-studio techniques and sketches for acoustic ensembles (Levy 2009; 2017, 85–127; Iverson 2009b; 2010; 2019, 97–103)—*Lontano* was written less than a decade later and is considered to share sound-mass techniques (Bauer 2001, 37–38, 45; Iverson 2009a, 2; Levy 2017, 210; Noble and McAdams 2020).

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33. Figures nearly identical to Levy's and Bauer's can be found in Jonathan Bernard's analysis of the same piece (1987, 228–31).

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34. See <https://youtu.be/m-UtOmbstlg>. Fittingly, *Quatre Couches* opens the set here.

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35. Both transcriptions are my own. I do not claim that my choices of time signature are in any way final—in transcribing, I have not chosen a meter that necessarily represents my own first hearing of the piece, but rather one that minimizes meter changes and that I can hear consistently should I choose to do so.

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36. In this and the next figure, timestamps refer to the two tracks of the piece available at <https://ericwubbels.bandcamp.com/album/duos-with-piano>.

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37. This entrance is prepared by a shorter unison before it, on D5. It is also worth noting that E5 was the pitch at the start of the piece just after the brief B♭6. For an alternate analysis of this passage, see Colombat (2020).

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Prepared by Andrew Blake, Managing Editor

