Abstract and Keywords

This chapter discusses music theory's neglect of EDM as it relates to the dominant methodologies of the field and Philip Ewell's concept of the white racial frame, arguing that EDM is overlooked due to implicit biases against racial Otherness and against technological mediation, biases that runs deep enough in US culture to have impacted the trajectory of music theory as an academic field. The chapter examines unpitched percussion through analysis of performance, timbre, and texture in a Roland TR-909 drum machine "workout" performed by Jeff Mills. This analysis models one way that music theory might learn to take EDM seriously. By broadening the methodological toolbox, music theory can begin to course-correct and become more inclusive of music that challenges certain principles of Western music.

Keywords: Roland TR-909, analysis, functional layers, percussion, drum machines, Jeff Mills

The influence of EDM has permeated large swaths of mainstream popular music. Four of the top ten tracks currently on the *Billboard* Hot 100 (in May 2020) have a distinct EDM influence: "Blinding Lights" by The Weeknd, "Don't Start Now" by Dua Lipa, "Say So" by Doja Cat, and "Intentions" by Justin Bieber featuring Quavo. Even while it exerts this influence, EDM's reputation historically has been marred by perceptions of unsophistication and lack of skill. Such criticisms sound much like those levied at other genres, like "disco sucks" or the assertion that "rap isn't music."[1] With disco, EDM shares the critique that the music is boring, repetitive, derivative, and made only for dancing, not for deeper thought; EDM and rap both disrupt the paradigm of the pop star/rock band by often lacking a singer, a guitar player, and/or a drummer.

EDM's peculiar status is also evident in academic music theory, a discipline which, intentionally or not, has been relatively inattentive to EDM despite its popularity and influence. Based on my own experience as a music theorist with a conventional education in this field, I would postulate two interrelated reasons for this: first, theorists may assume EDM is not suitable for deep analysis and functions only as simple dance music, and sec-

ond, many of music theory's most common methodologies lose their power when confronted with the lack of (traditional) melody and complex teleological harmony in EDM.

Especially for those not interested in music theory academia, it may not seem particularly consequential that EDM has been overlooked in theory journals when considered in isolation, but this is just one facet of the larger tendencies throughout the field to overlook a great deal of music pioneered by people of color, including but not limited to EDM. The way EDM is treated within the field of music theory is a result and reflection of the systemic racism that structures academia in general and US society—a phenomenon that Philip Ewell refers to as "music theory's white racial frame."[2] Ewell shows how deeply entrenched classical music and the pitch-based methodologies designed for that repertoire remain in music theory (even though the field does include theory and analysis of popular musics), and how the dominance of those methodologies implicitly delegitimizes repertoires that do not prioritize pitched sounds. By extension, the white racial frame ends up undermining the work of scholars of color who might shed light on these cultures.

In this essay, I discuss music theory's neglect of EDM as it relates to the dominant methodologies of the field and Ewell's concept of the white racial frame. Specifically, I argue that overlooking EDM is motivated by implicit and explicit biases against racial Otherness and against technological mediation, a bias that runs deep enough in US culture to have impacted the trajectory of music theory as an academic field.[3] I examine unpitched percussion through analysis of performance, timbre, and texture in order to model one way that music theorists such as myself might learn to take EDM seriously. By broadening the methodological toolbox, music theory can begin to course-correct and become more inclusive of music that challenges certain principles of Western music.

Music-Theoretical Approaches to EDM

Music theory and analysis, as a field, is admittedly difficult to neatly separate from its parent discipline of musicology. Given this, theory generally focuses on close analysis of particular pieces of music (or the development of theories to enable such analysis) while musicology takes a broader approach to the study of music that often involves social context and history. Nothing about the field of music theory and its disciplinary boundaries inherently precludes theorists studying EDM, and yet compared to musicology, the field has produced relatively little work that directly addresses any sort of electronic dance music.

I don't mean to suggest that EDM is entirely neglected by music theory, since several scholars have published analytical studies of EDM. The most prolific and well-known music theorist working on EDM is Mark J. Butler, whose two books on this repertoire were published in 2006 and 2014. His first book, *Unlocking the Groove: Rhythm, Meter, and Musical Design in Electronic Dance Music*, identifies rhythm as one primary vehicle for exploring musical meaning in the context of EDM; his second, *Playing with Something That Runs: Technology, Improvisation, and Composition in DJ and Laptop Performance*, analyzes live performance and improvisation from the perspective of musical form and

texture.[4] Analysis of texture is a common thread in several theorists' approaches to EDM. Texture is the primary focus in Philip Tagg's relatively early analysis of EDM ("rave music" in his article), published in 1994, in which he describes EDM's main musical material as mainly relating to the background or accompanimental material of other genres.[5] Luis-Manuel Garcia likewise connects textural development and accumulation of sonic layers to formal structure and listener enjoyment in a 2005 article.[6] Garcia builds on Mark Spicer's concept of accumulative form; Spicer in his own 2004 article analyzes this phenomenon in pop music more broadly, but uses EDM for his exemplars of the technique.[7] Butler's first book, Spicer's article, and Garcia's article all were released in fairly quick succession in the years 2004–2006, perhaps indicating a kind of micro-trend in music analysis that briefly favored EDM. A second micro-trend has formed more recently, as EDM has become increasingly influential on mainstream pop music through the 2010s. Theorists have documented how elements of EDM have been borrowed to fit conventional pop forms. Alyssa Barna's 2020 article "The Dance Chorus in Recent Top-40 Music" discusses a phenomenon in which a pop song seems to have two choruses, one of which is the "dance chorus," derived from the drop of an EDM song.[8] This concept is bolstered by Asaf Peres's 2016 dissertation, "The Sonic Dimension as Dramatic Driver in 21st-Century Pop Music," which is entirely focused on the technological and sonic gestures that 2010s pop music borrowed from EDM.[9]

Surveying the approaches used by these existing analyses of EDM provides a clue as to why more authors have not endeavored to analyze EDM: the most-used tools of music theory are not suited to this genre. According to a study by Ben Duinker and Hubert Léveillé Gauvin, the top five most common methodologies used in music theory journal are articles set theory, form analysis, analysis of tonality, analysis of harmony, and Schenkerian analysis; four of these are concerned with pitch.[10] The approaches taken by the above-listed analysts of EDM, by contrast, are analysis of rhythm, texture, and form. Of these, only form is well-represented in theory journals, appearing in an average of 18.5 percent of articles across four journals; rhythm's status is also sizable, appearing in an average of 12 percent of articles; but texture—the most popular approach for analysts of EDM—is one of the worst-represented, at 1.5 percent.[11]

Pressing Buttons: Technology versus Performance

Several central defining features of EDM stand in opposition to the repertoire that music theory as a field was built to address (Western concert music), feeding into theory's neglect of this repertoire. EDM is defined partially through its use of music technology in place of traditional instruments. This practice can be traced to EDM's roots in disco, one of the earliest genres to rely extensively on turntables, synthesizers, sequencers, and vocoders. EDM and all its neighboring genres, such as synth pop or hip hop, continue to use technology to achieve a particular, markedly electronic sound. These genres' use of technology has ended up shaping the course of mainstream pop music. But innovation,

especially as it relates to music technology, proves to be a double-edged sword: many of these technologies alienate audiences who would define musical performance through virtuosic manual dexterity or spontaneity. For example, imagine a progressive rock fan enraptured by lengthy, involved drum solos from Rush's Neil Peart—this hypothetical listener would, understandably, not be amused if they went to a concert in which Peart instead used a repeating four-bar beat that came pre-programmed on the drum machine. Personal taste is just that, but our hypothetical prog rock fan could transmute their taste into a moral imperative, by saying that musicians who rely on drum machines and other similar technologies are cheating, taking some kind of shortcut rather than going on the difficult and time-consuming journey of learning an instrument. In 1986, *Keyboard* magazine featured the keyboardist of Duran Duran, Nick Rhodes, for its February issue cover story, and it elicited a number of vitriolic letters to the editor that were published in the next few issues, including "I am so sick of reading about these Fairlight [CMI, a sampling-based keyboard] and one-finger virtuosos. As a performer, Nick Rhodes is a joke. Why don't you interview a *real* keyboard player, like Rick Wakeman?," directly juxtaposing synth-pop as unsophisticated with the more "real" genre of prog rock.[12] Even if a professional music critic wouldn't go so far as to call it cheating, the idea that technology-infused music is of lesser artistic value persists as a subtext. A journalist in 1979 wrote a critique of disco stating that "after the poetry of the Beatles comes the monotonous bass-pedal bombardment of Donna Summer. After the rich Aristotelian dramas of plot and character played out in art and in life only 10 years ago, all we now have is special effects."[13] The juxtaposition of poetry and Aristotelian drama versus special effects makes it clear that for this journalist, technology is a lower art form, if it is art at all.

This idea of electronics-as-cheating stems from the fact that using electronics can take some of the physicality out of a performance. It's true that some amount of pre-programming goes into much of EDM, and this pre-programming relocates the physical work of creating the music to a different space and time, outside the on-stage performance. EDM's perceived lack of visceral embodied performance separates it from Western concert music and even rock music. As musicologist Simon Frith writes in an article discussing this fraught relationship between technology and pop music, "The explicit argument is that live performances allow for spontaneity, for performers' direct responses to their audiences; programmed instruments can't do this."[14] Frith is careful to note, however, that the truth content of this argument is dubious, and likewise, I show throughout this chapter that, regardless of their accuracy, assumptions are made about EDM that serve to devalue its music as a genre of music worthy of scholarly inquiry.Drum machines are a frequent scapegoat in discussions about inauthenticity in performance, especially in music of the 1970s and 1980s when the technology was first widely adopted. Frith supports this with an excellent example: a battle of the bands put on by the UK's Musician's Union, who had an official policy against the use of drum machines in the performances, and argued that unlike synthesizers, drum machines replaced instrumentalists, and thus were taking work away from drummers.[15] Then there's the "Drum Machines Have No Soul" bumper sticker campaign, put on by a so-called Society for the Rehumanization of American Music founded by a musician named John Wood.[16] In short, drum machines may

have come into their own in recent years, but in the not-so-distant past, the drum machine symbolized a lack of musical ability and, consequently, a superficiality in any kind of music that relies on it.

Disco, while not the focus of this chapter, put down many of the roots of EDM, and simultaneously offers a provoking example of the equivalences made between drum machines and frivolousness. Oliver Wang writes that disco "embraced the [drum machine]'s possibilities," yet gives only one example: Donna Summer's "Love to Love You Baby."[17] Other authors seem to take for granted that disco used drum machines: Ken McLeod asserts that there was a "heavy reliance" on "125–160 beat-per-minute synthesizer/drum machine rhythm tracks," and Andrew Goodwin with similar nonchalance states that "drum machines … are identified … with dance genres like disco," both without specific examples or additional citations.[18] The use of specific pieces of gear, like drum machines, is usually documented in music technology magazines like *Sound on Sound*, *Electronics and Music Maker*, *Keyboard*, or *Music Technology*; failing that, forum posts from gear enthusiasts will make accurate aural identifications. But after hours of research, I was unable to uncover any reliable information on disco's use of drum machines outside of a few oft-cited tracks, such as "Love to Love You Baby." Other examples don't seem representative of the disco genre, such as Blondie's "Heart of Glass," which was more of a one-off experiment in the genre for them, or Sly and the Family Stone's records, which are probably better categorized as funk rather than disco.

Why then do so many mistakenly assume that drum machines are used in disco? I provide two hypotheses, both of which are inevitably commixed with gendered and racialized stereotypes propagated by a majority white, cis, male, and straight group of gear aficionados and music critics (a point to which I will return). It's possible that drum machines were used in more of these tracks, but no one bothered to document it in music magazines, because the (white, cis, male, straight) readership would not have taken articles about disco seriously, or the kind of people who spend copious amounts of time on forums identifying guitar preamps and synthesizers (again, people who are likely white, cis, male, and straight) don't spend much time listening to disco, a genre largely created for and consumed by queer people of color. This would explain why scholarship perpetuates the association between drum machines and disco, but without details. Alternatively, a more insidious error could be made by the scholars: perhaps they assume that drum machines were used because of the quantity of rhetoric surrounding disco that characterized it as a superficial and repetitive genre completely reliant on machines, failing to recognize that this rhetoric often comes from people who are invested in dismissing the genre precisely because it stands in opposition to white/cis/male/straight culture.[19] In either explanation, though, the implication is that disco is a genre that doesn't need to be thoroughly researched by music academia. Music (perceived as being) composed and performed with machines, by and for people who are already marginalized in US society, can thus be devalued into irrelevance and safely ignored by the field of music theory.

EDM within Music Theory's White Racial Frame

Philip Ewell's widely circulated and critiqued article, "Music Theory and the White Racial Frame," condemns the field of music theory via an indictment of one of its foundational methodologies, Schenkerian analysis.[20] Ewell's argument against Schenkerian analysis is part of what motivates my own framing of the state of EDM analysis, and thus I summarize Ewell's points at length here. Described briefly, the Schenkerian approach to music analysis was created by the Viennese music theorist Heinrich Schenker (1868–1935) and is based on the idea of hierarchy among pitches in a piece of music—a hierarchy that Schenker explained through political and racial metaphors about servitude and dominance—as well as a hierarchy among types of music, in which Austro-German concert music reigned supreme over concert music from other nations and certainly over any popular or folk musics. But Ewell's article is not really about condemning Schenker as a person or suggesting that Schenkerian analysis ought to become taboo in the field; instead, Ewell argues that the endurance of Schenkerian analysis is emblematic of how racism festers within the field:

> I argue that this frame is very much active in music theory today, with respect to the composers we choose to analyze and teach, and the theorists we tend to study and admire…. What I stress, however, is not so much negative black stereotypes as positive white stereotypes … which are fundamental to music theory and which also spur a "racialized inclination to discriminate."[21]

In other words, even though music theorists would decry an outright and explicit dismissal of music created by people of color, this is effectively what happens when they continually choose to study music by white people to the exclusion of everything else. Ewell uses Feagan's concept of the white racial frame to define the ways in which music theory gives special privilege to contributions from white people.[22] He notes:

Music theory's white racial frame believes that:

1. The music and music theories of white persons represent the best, and in certain cases the only, framework for music theory.
2. Among these white persons, the music and music theories of whites from German-speaking lands of the eighteenth, nineteenth, and early-twentieth centuries represent the pinnacle of music-theoretical thought.
3. The institutions and structures of music theory have little or nothing to do with race or whiteness, and that to critically examine race and whiteness in music theory would be inappropriate or unfair.
4. The best scholarship in music theory rises to the top of the field in meritocratic fashion, irrespective of the author's race.
5. The language of "diversity" and "inclusivity" and the actions it effects will rectify racial disparities, and therefore racial injustices, in music theory.[23]

Music theory's white racial frame has tangible effects on what music actually gets analyzed. Ewell uses a demographic breakdown of the composers of examples in undergraduate music theory textbooks as an example, showing that only 1.67 percent of examples in the top seven theory textbooks are by non-white composers.[24] Theory is much more than what we see in these textbooks, but the point is that the bias toward the study of white music begins very early, and in fact forms the foundation of the entire field. What Ewell has identified above as "music theories of whites from German-speaking lands of the eighteenth, nineteenth, and early-twentieth centuries" are overwhelmingly theories that address the musical domains of harmony and form. Ewell focuses his critique principally on Schenkerian analysis, which, while dwindling in popularity among published works of music analysis, has been essential in the development of professional music theory's notion of functional tonality—a theory of musical key and harmonic progression that insists on goal-directedness and hierarchy among chords. Analysis of functional tonality, though unsuitable for musics that do not organize harmonies in this way, remains the most developed and nuanced theory of harmony available to analysts, and, as such, it is part of a canon of analytical approaches that every theorist is expected to understand. Combined with the data collected by Duinker and Léveillé Gauvin, this explains how the familiarity of analysis of functional harmony inspires a great deal of analytical work in this vein and, in turn, reinforces the dominance of repertoire that can be effectively described with functional harmony.

Popular music analysis has also been able to thrive through this analytical lens of functional harmony, even though this approach was not developed for pop music. But the canon of pop artists that seems to be coalescing in pop music theory is alarmingly white for a genre that has always relied on the creativity of non-white musicians. Returning to Duinker and Léveillé Gauvin's data, there are forty-five different "Pop, World, Jazz, Film, or Stage" artists that appear in the abstracts of music theory publications.[25] Of these, 77 percent are white artists. Focusing only on pop artists makes the discrepancy even greater: 88 percent of pop artists discussed (twenty-one of twenty-five) are white. The only artists discussed that are proximate to EDM are Owl City and Radiohead—two white acts. While I was unable to cross-reference the artists to the analytical approaches used by the authors who wrote about them, I suspect that music theory's continual fondness for functional harmonic analysis motivates analysts to choose harmonically complex artists to study, who would tend to write in a style that borrows substantially from the history of white music. Viewed in this light, the marginalization of EDM in music analysis reflects the looming racial ideology that contaminates so much of music theory, one which assumes that music by non-white musicians is less worthy of our analytical attention. Put another way, if a theorist is armed with a toolbox mainly comprising approaches to functional harmony, then EDM looks too simple to be taken seriously.

Of course, plenty of music by non-white artists is harmonically complex—but strikingly, whether or not non-white music is harmonically complex is beside the point within a white racial frame. Assumptions about white music's unmatched harmonic complexity are pervasive (if subconscious and unscrutinized) and serve as an excuse for anyone not wanting to attend to non-white genres. A typical way of compensating for the inequity of

this notion is for music theorists instead to assert the complexity and dominance of rhythm in non-white music. Kofi Agawu addresses this phenomenon as it relates to the notion of a homogenized "African" music, noting that rhythm is "so persistently thematized in writings about African music that it has by now assumed the status of a commonplace, a topos"—one needn't offer proof for it.[26] Similarly, Ronald Radano shows that this notion was imported from Africans to African-Americans, writing of 1920s popular music that "racialized rhythm becomes the latest in the signatures of difference that served to distance and dislocate African-American otherness."[27] Robert Fink observes that this trope of rhythmic difference can be manipulated to neatly sidestep needing to address the music in any scholarly way: "If Afro-diasporic rhythmic practices are constructed by academics not just as different in emphasis from those of the European canon, but as radically different, different in a way that indexes the radical otherness of African bodies from those of Europeans, then an essentialized ideology of racial difference enacts unwitting symbolic violence against the culture(s) celebrated as different."[28] Fink finds a similar trend in scholarship surrounding disco, where he finds a tendency to cast disco as "absolutely non-teleological," a conclusion that he describes as "spectacularly destructive of analytical method."[29] EDM often is composed with repetition and Afro-diasporic rhythms, sampling grooves and drum breaks from disco and funk such as those that Fink studies in his work. As Fink suggests here, then, the trope that complex Afro-diasporic rhythms are just too different to be studied by traditional music-analytical tools might lead to traditionally trained music theorists—even those that specialize in rhythm—to ignore the entire genre.

The problem goes beyond rhythm. EDM's emphasis on timbre and texture likewise goes unnoticed by a listener focused on harmony or form, such as a traditionally trained music theorist might be. This goes for non-specialists as well as academics, as timbre specialist Cornelia Fales illustrates in her ethnography of a listserv for San Francisco EDM fans active in the 1990s.[30] Fales cites the psychological phenomenon of "attribute amnesia," in which listeners who are primed to focus on certain attributes will ignore other attributes for which they were not primed—even if those other attributes are more significant than the primed attributes. A listener who typically listens to rock-based genres may well be primed to attend to lyrics, harmony, or form in a song, and finding little interesting content in those domains, would be likely to consider EDM boring, repetitive, and simplistic. Fales's ethnography documents how, as listeners become better enculturated to EDM, they learn to attend to timbre as the most structurally significant musical domain; the ability to hear the primacy of timbre manipulations is considered "expert" listening in this community. She includes an example where listeners asked the listserv what to listen for in a new track, and all responses focused primarily on timbre. She writes that "the track had a good deal of pitch content, but very little of it was thought worthy of inclusion on the list of 'what to listen for.'"[31] The listener who approaches EDM and looks for excitement in the pitch content, ignoring timbre and texture, is likely to be disappointed.

Music analysis has long neglected to systematically approach timbre, despite the fact that music's timbre is immediately perceptible and intelligible to both musicians and non-musicians alike. Timbre analysis has, thankfully, matured considerably within the past

decade. As one might expect based on my suggestions thus far in the article, timbre studies have allowed for music analysis of genres that have been otherwise shortchanged in music analysis, such as indie music, black solo singers, and non-Western musics. In my own research, I have noted that many timbre scholars happen to be women (such as Emily Dolan, Cornelia Fales, Kate Heidemann, Rebecca Leydon, Danuta Mirka, Nina Sun Eidsheim, Isabella van Elferen) in a field otherwise dominated by men.[32] In short, I see the flourishing of timbre studies as having positive outcomes for diversity in music theory, both in terms of whose music gets studied as well as who does the studying.

But, as progressive as any analysis of timbre inherently is, existing timbre methodologies have their own shortcoming that reifies a white racial frame: they attend primarily to pitched sounds, rather than unpitched sounds, reifying the importance of pitch and continuing the study of musics (often white music) that emphasize pitch. Put another way, percussion timbre is largely passed over in these analyses, despite its central role in popular music and especially in EDM. To give a few examples, my own prior work defines several timbral attributes to apply to pitched sounds, but only a few that would apply to percussion; none of my close analyses of particular pop tracks focus on the role of percussion, but instead on melodies and harmonies produced by synthesizers.[33] This reflects the biases I have inherited from a conventional training in music theory. Similarly, music perception studies on timbre commonly do not address percussion in any way—for reasons that are completely valid, to be sure.[34] Dealing with percussion timbre seems to demand a separate toolbox. Percussion's outlier status in timbre study is confirmed in Zachary Wallmark's "A Corpus Analysis of Timbre Semantics in Orchestration Treatises," which includes a study of both percussive and non-percussive instruments.[35] Like other perception- and data-based studies of timbre, Wallmark's work necessarily disregards percussion for much of the article, due to its categorical differences from other instrument families; however, an especially tantalizing aside evidences that Wallmark did attend to the unique status of percussion in discussions of timbre. Wallmark defines seven categories of timbre descriptor—affect, matter, cross-modal correspondence, mimesis, action, acoustics, and onomatopoeia—and notes that onomatopoeia is the least-used category for timbre description, but very commonly used to describe percussion timbres. He then deftly acknowledges the effect of sociocultural norms on this data, writing, "There is a likely cultural component to the paucity of onomatopoeia: writers may have been reluctant to describe the timbral repertory of the august symphony orchestra using such 'wild' terminology."[36] Several of his figures include data on percussion, even while not explicitly addressing it, and percussion's Othered status becomes even clearer: percussion is over 10 percent less likely to be discussed in terms of affect, and over 5 percent more likely to be discussed in terms of materials or onomatopoeia. The other instrument families hew much more closely to the mean. The toolbox for describing percussion timbre, then, is markedly less prestigious or refined than for describing pitched music and is instead saturated with language that connotes childishness and a lack of refinement.

I interpret Wallmark's data to support the idea that percussion instruments are often understood as more base or primitive than pitched instruments: the terms used to describe percussion timbre are limited to more immediate and more factual observations—descrip-

tions of materials (i.e., what they are made of) or onomatopoeic mimicry—rather than poetically relating their timbre to affect and emotion. Juxtapose this lower-level thinking about percussion timbre with the typical characterizations of Black and Latinx popular musics as uniquely driven by percussion and rhythm, and it's easy to see a racial undertone in the way many listeners conceive of percussion that encourages stereotyping these musics as more primitive than their white counterparts.

As for texture, Allan Moore has theorized that popular music generally has four primary "functional layers" that define its textures—the explicit beat layer, the functional bass layer, the melodic layer, and the harmonic filler layer—all of which are defined through pitch-based concepts.[37] Moore notes that popular music generally exhibits all four of these functional layers, and that even if one or more is missing from a particular song, the song is notably distinct because of this change from the norm—the exception proves the rule, in other words. According to Moore, the groove of a piece comprises the explicit beat layer, an unpitched layer whose function is to "articulate an explicit pattern of beats" (20), and the functional bass layer, which functions to connect root position harmonies and add another rhythmic component to the groove. Next, Moore introduces the melodic layer, which is somewhat vaguely defined, but is clearly tied to the voice as an instrument, is equivalent to "the tune" (20), and communicates lyrics. Moore, with reason, relies on the reader's intuited familiarity with the melodic layer to fill in the definitional gaps here. The final layer is the harmonic filler layer, which Moore says can be filled by any number of (pitched) instruments, and functions to fill the space between the melodic and functional bass layers.

For a great deal of popular music, this texture typology works, but in other cases, as I have argued previously, Moore's theory needs to be supplemented with additional nuance.[38] Pitch properties are an essential defining feature of each of Moore's layers—even the explicit beat layer is defined through pitch (that is, the absence of it). This move is understandable, as pitch is a very salient domain for most listeners. But for music that does not use traditional melodies or harmonies as building blocks, Moore's definitions are not helpful in defining textural layers. That is, in genres such as EDM, simply bracketing off all unpitched percussion as the "beat layer" does little to elucidate the intricacies of a track's texture.

Analysis: Performance, Timbre, and Texture in Jeff Mills's TR-909 Workout

I use my remaining space in this chapter to take a small step toward compensating for these gaps in the existing literature through an analysis of performance, timbre, and texture in an EDM track composed entirely with unpitched percussion. Jeff Mills, a well-known pioneer of early EDM and an artist frequently studied by Butler, created a documentary, *Exhibitionist 2* (2015), that included a track with the utilitarian title "Exhibitionist Mix 3 TR-909 Workout", which I will hereafter refer to as simply "the workout."[39] In the workout, Mills apparently improvises a dynamic and fully-fledged EDM track with no

other equipment but the Roland TR-909 drum machine. The use of the TR-909 is signifi-cant to me personally due to a combination of factors: first, and speaking practically, I have access to this hardware and do not need to rely on virtual instruments to recreate the experience of using this instrument; second, the TR-909 was used extensively in early EDM.[40] In the following analysis, I will discuss how Mills's video showcases EDM as an embodied performance, and use timbre analysis to discuss how Mills creates differentiat-ed textural layers without needing to use any sort of pitched instrument.[41] My goal is to show what new terrain music theory can cover by doing close analysis of music that em-phasizes percussion performance, instead of returning to the more well-worn paths of an-alyzing music that focuses on pitch.

Any readers not already familiar with the TR-909 drum machine will benefit from a short explanation of its place in the history of music technology. The TR-909, released in 1983, was the successor to the better-known TR-808 (a drum machine that retains its iconic sta-tus even today, especially within hip hop). The TR-909 incorporates several different drum sounds, referred to (by Roland and within this essay) as "instruments": bass drum, snare drum, low tom, mid tom, hi tom, rim shot, hand clap, closed and open hi hat, crash cym-bal, and ride cymbal.

While the TR-808 was an entirely analog machine, the TR-909 used both analog sounds and digitally sampled sounds, a move that was meant to allow flexibility for whichever suited a given instrument best. But rather than combining the best of both worlds, Roland's founder Ikutaro Kakehashi explains that this move seemed to be the TR-909's main drawback to 1983's consumers:

> The cymbal in the TR-909 was generated using digital technology, but the kick drum, snare, and other parts were made by analog circuits. We felt that was the best combination, but at that time … digital had a better sound quality, and every-body liked to have all digital…. That's why we couldn't continue to manufacture the TR-909. It was replaced in 1984 by a machine called the TR-707, which had all [digitally sampled] sounds.[42]

The TR-909, in short, was not popular at the time it was being made, and as such was produced for only one year. The analog sounds of the TR-808 and -909 went out of fash-ion. The machines started piling up in resale shops, thus becoming cheap options for en-terprising DJs creating percussion for EDM and hip hop tracks. As these genres became more and more popular, the TR-808 and -909 came back into demand, years after produc-tion on both was discontinued. They remain available in resale shops but are certainly not cheap anymore. Mills's TR-909 workout is both a tribute to the drum machine's status in EDM as well as a demonstration of Mills's incredible proficiency with the instrument, composition, and improvisation.

Listening and Viewing Guide

The video for the TR-909 workout shows Mills in a completely white room or space, devoid of any furniture. In contrast to other performance videos in the documentary, where Mills performs at a table with a few pieces of equipment, here he crouches at a TR-909 on the floor. The advantage of the video format is the ability to witness the way that Mills fully embodies his performance, playing the TR-909 the way another musician might play the guitar or flute. Mills's movement and attention here contrasts sharply with the conception of drum machines as a kind of "cheating" in which you create a beat by pressing a button and walking away. In an interview with Roland, Mills discusses his approach to performing with the TR-909, describing it in just such terms:

> [With the TR-909, you can] really play the machine, not just program it…. You can manipulate it as if you're playing a sample, and if you're really good, almost as if you're a live drummer playing a drum kit. Another thing would be the ways you can tune and pot up the sound…. You can manipulate that by learning how to work the knobs in that type of manner…. If you know this machine well enough, you could really create that feel or effect that you are playing a real drum set.[43]

Mills uses many of the instruments mainly within loops, certainly, but even these looped rhythms feel performed, because Mills inputs the rhythms through the Tap mode—playing the rhythms at tempo—rather than programming them out-of-time in Step mode. While the track continues to play, we the viewers see Mills turn the volume of an instrument all the way down (each instrument has its own volume knob) and tap in a rhythm that we can't yet hear. Mills creates audience anticipation this way: after watching him silently add a new rhythm, I eagerly await the moment when Mills will flick his wrist, turn the volume up, and draw back the curtain to reveal the new element of the groove. Throughout the video, we see Mills obsessively fine-tuning the volume of the different instruments with micro-motions, tiny twists of the wrist and fingers.

The timbres of the snare drum and hi hat cymbals are changing constantly, to the point that the instruments feel completely dynamic and not at all pre-programmed. There are still repeating rhythms in these instruments, but Mills manipulates the volume, tone/snappiness of the snare drum, and decay of the hi hat to create vigorous sonic gestures that are palpably live—a phenomenon that I'll refer to as Mills "playing the knobs" of the TR-909. A rough summary of how the instruments are deployed throughout the track is summarized in Figure 1. Each instrument uses multiple rhythmic motives as the piece progresses; these motives are summarized in Figure 2.
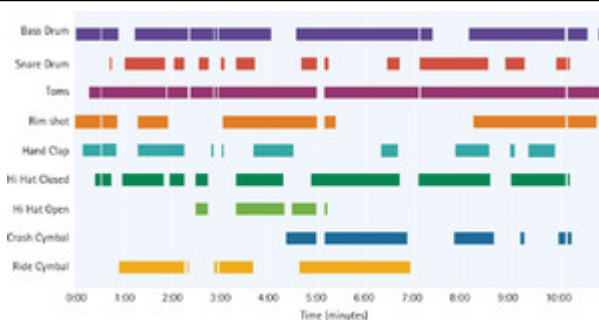
Figure 1 Overview of instrumentation throughout the track.

Figure 2 Transcriptions of motives.

In the TR-909 workout, Mills's virtuosic performance creates an ensemble-like textural complexity with an instrument more typically used to create a single layer within a texture. The workout makes Moore's functional layers somewhat difficult to discern within the texture—though, as I will argue, not obsolete.

Groove Layer: Explicit Beat and Functional Bass

Moore identifies the functional bass and explicit beat layers as together creating the groove of a piece. Because separating out the functional bass from the explicit beat does not seem to be an analytically beneficial move in the context of the TR-909 workout, instead, working from Moore's definition of "groove," I prefer to think of these layers as fused into one groove layer. Another advantage of this term is that the word "groove" does a lot of work to implicitly define non-pitch features of these layers. A song's groove functions as its backdrop and persists throughout a track.[44] Returning to the chart in Figure 1, the most consistently present instruments are the bass drum, toms, hand clap, and closed hi hat.

Each of these instruments also features very little timbral variation as the track progresses—Mills doesn't appear to play the knobs of these instruments as much as others. The consistency of timbre allows the instruments to form a secure grounding for the listener. The consistency is augmented by the small repertoire of individual rhythmic motives used by each instrument. The opening motive in the toms is the anchor of this piece: not only are toms practically omnipresent in the track, but the toms also repeat the same motive

for the entire duration (other motives are layered on top of the initial motive, rather than replacing it). The bass drum mainly articulates the four-on-the-floor quarter note beat, varying this only by adding a pickup note to the second quarter note, and toward the end of the piece increasing intensity by switching to a stream of eighth notes. The closed hi hat mainly plays a stream of sixteenth notes; the ride cymbal a stream of eighths.

The most motivically diverse of these instruments is the hand clap, which I hear as switching layers as the track progresses. I only hear its earliest motive, composed of simple offbeat eighth notes, as belonging to the groove layer. I reached this conclusion first by intuition, but in retrospect, it reveals another aspect of the groove layer in this track: that instruments in the groove layer are likely to have even rhythms, rather than syncopations or diatonic rhythms like 3+3+2.[45] Nicole Biamonte's work on metric and rhythmic dissonance supports this, as she observes that while rhythmic and metric dissonance are extremely common, even necessary, in other layers of a pop song, the groove layer ("accompaniment pattern" for Biamonte) will overtly articulate the typical 4/4 meter through short "generally regular" patterns.[46]

In sum, then, I've augmented Moore's existing definitions to say that the groove layer is:

- • pervasive throughout the entire track,
- • consistent in its rhythmic profile, and
- • likely to be made up of mainly even rhythms.

Not every one of these points is necessarily true of each element of the groove layer—the handclaps are only in the groove layer for a short time, and the toms are syncopated and not straight—but these are discernible characteristics of the groove layer as a whole.

Melodic Layer

Considering an unpitched percussion instrument as a melodic instrument can seem nearly oxymoronic—melody as a concept is very closely bound to pitch. Moore's definition of the melodic layer ties it to the voice as an instrument, which of course will not be helpful in considering unpitched instruments as melodic instruments, but considering the timbral and rhythmic properties of the voice in pop contexts can provide a guide for defining a melodic layer in the TR-909 workout. The voice is probably the most timbrally sensitive and variable instrument in pop music, and I would argue that this timbral fluidity is a defining characteristic of melodic layers more broadly. Lyrics necessitate timbral changes, as different vowels and consonants create different spectro-temporal profiles, and beyond that, vocalists can alter their timbre further depending on the emotional effect needed for a particular song or lyric.

When a non-vocal instrument takes on the melodic layer, that instrument will often go to extra lengths fluctuate that instrument's timbre in a way that mimics the voice. For example, many instruments can implement slides or bends between notes, creating a change in pitch without re-articulating and regenerating the (often) harsh spectral profile of its on-

sets, and imitating the particularly smooth melismas of the voice. Instruments may also create vibrato to mimic one of the voice's most characteristic timbral qualities.

No drum sound on the TR-909 (or maybe on any drum machine!) incorporates techniques like bends and vibrato by default, but in the TR-909 workout, Mills creates just this sort of timbral dynamism by playing the knobs of certain sounds, particularly the "snappy" knob of the snare drum. The TR-909 has four knobs for adjusting the sound of the snare drum, two of which are unique to the snare drum: "tone" and "snappy." Most other instruments can have their volume, intonation, and decay adjusted with knobs, but the basic timbral profile is fairly consistent no matter how the knobs are set. The snare drum, on the other hand, has a fairly wide variety of timbral profiles depending on how one configures the knobs. Mills is clearly aware of the unique capabilities of the TR-909 snare sound, as he manipulates the tone and snappy knobs constantly throughout the TR-909 workout.

The snappy knob has the biggest impact, as it adjusts the amount of buzzing of the virtual snares. Figure 3 is a spectrogram that samples the snare drum with the snappy knob turned progressively higher on each subsequent onset, from its minimum to its maximum setting. With the snappy knob set to its minimum there is no snare buzzing at all, and only the sound of the drum head remains. The timbre in this case is *pure*, visible in the spectrogram by the presence of distinct horizontal strands, representing a fundamental and overtones above it, and yielding a perceptible pitch to the sound (171 Hz, around F_3).[47] As the snappy knob gets dialed up, gradually, the pure and pitched components of the sound become obscured by the *noise* of the snare buzzing, visible in the spectrogram as thick vertical bands.[48] Because noise involves an equal distribution of spectral energy across a large frequency band, it obscures the more discrete strands of energy of a pure sound, visually in the spectrogram as well as aurally in the perceived timbre. By the time snappy is at its maximum setting, the fundamental F_3 is still visible, but the other upper partials have been covered by the noise of the snare. In addition to shifting the overall sound of the snare from timbrally pure to noisy, turning up the snappy knob also shifts the brightness of the sound. Brightness is typically defined as relating to the proportion of higher-range spectral activity to lower-range activity. Figure 4 visualizes the progression of brightness across each of the samples in Figure 3, measured as the percentage of high-frequency energy (>1500 Hz, around G6) in each sample. Between the spectrogram and the brightness graph, one can see the wide-ranging timbral capabilities of the snare that are available to Mills just by manipulating the snappy knob.
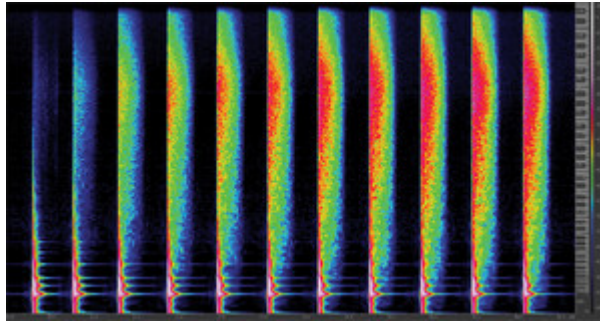
Figure 3 Samples of the TR-909 snare drum with the snappy knob progressing from minimum to maximum.
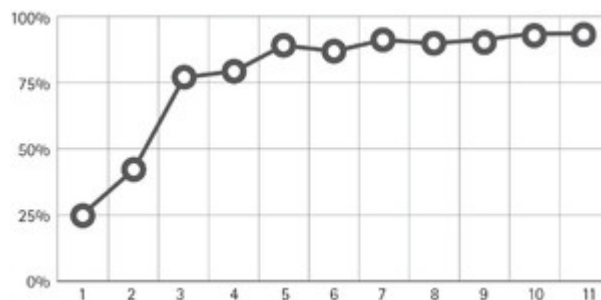

Figure 4 The percentage of high-frequency energy for each of the eleven samples in Figure 3.

The tone knob provides some additional possibilities, though their effects are not so stark as the snappy knob. The tone knob essentially adjusts the duration of the snare buzzing, which can be observed in the spectrogram in Figure 5. While this doesn't affect the timbre of the snare as noticeably, it makes quite a difference when dealing with the sixteenth-note rhythms used in the snare in the TR-909 workout. With a BPM of 135, sixteenth notes in the TR-909 workout last 111 milliseconds. Even with the tone knob turned down to the minimum, the sound signal lasts 113 ms. By the time the tone knob is maximized, the length of the sound signal has grown to 304 ms—more than double the length of its note value. Manipulating the tone knob, then, can transform the snare drum's sixteenth note streams from dry, crisp, rapid fire into a wet wash of noise.
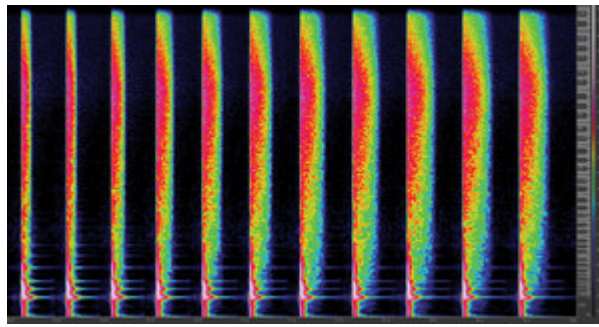
Figure 5 Samples of the TR-909 snare drum with the
tone knob progressing from minimum to maximum.

The snare drum is the principal melodic instrument in this track, but Mills occasionally plays the knobs of the cymbals as well. The open and closed hi hat each have a decay knob, which adjusts the duration of the decay. Mills uses this knob to create a similar effect as the tone knob of the snare. The crash and ride cymbals substitute a tune knob for the decay knob, which changes the intonation of the cymbal. For whatever reason, Mills does not play the tune knob of the ride or crash cymbals (with one very short exception at 2:50 into the track, lasting about 5 seconds, which actually strikes me as Mills improvising off a mistake), but does fade them in and out with the level knob. Comparing the *brightness* of the cymbals and snare against the other instruments of the TR-909 reveals that the snare and the cymbals are by far the brightest instruments available to Mills (Figure 6). Perhaps Mills intuits this, and for this reason tends to reach for these instruments to create dynamic melodic interest.
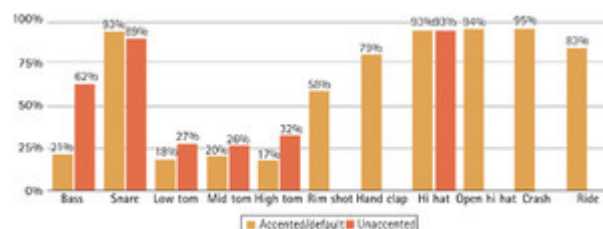

Figure 6 Brightness measurements for each instrument of the TR-909.

To expand on Moore's definition of the melodic layer, I would still use the voice as the exemplar of the melodic layer. But my analysis suggests that any other instrument that has a high degree of timbral flexibility, and particularly instruments that are bright relative to the surrounding texture, facilitates hearing that instrument as constitutive of the melodic layer.

The melodic layer here is also one of the most visibly "performed" aspects of Mills's composition. Mills is constantly adjusting volume and often inputting new loops on all the instruments in the track, but these actions require relatively small motions from Mills. By contrast, adjusting the timbre of the snare drum demands more dramatic gestures as the

knobs are rapidly twisted from min to max. Just as timbral flexibility is a hallmark of the melodic layer in both its vocal and percussive manifestations, the flexibility is also rendered visually through the motions that Mills makes as he performs the workout.

Harmonic Filler Layer

The only remaining layer established by Moore is the harmonic filler layer. Moore defines this layer as functioning to "[fill] the 'registral' space" between the groove and melodic layers, but it's important to note that Moore's use of scare quotes seems to indicate "registral" as a metaphor, rather than speaking strictly of high-, mid-, and low-range frequency registers. I view the harmonic filler layer in this workout as characterized primarily by the use of syncopated and diatonic motives in instruments that otherwise tend to be static in terms of timbre and volume. These instruments are the rim shot, ride cymbal, and crash cymbal, along with certain motives in the hand clap, summarized in Figure 7. Given that no harmony is present in this track, perhaps a more suitable or succinct term for this layer might simply be the "filler layer," but this places undue emphasis on the word "filler," and seems to diminish the importance of this layer. The word "filler" in this term is somewhat misleading in general, as Moore observes that it is "arguably the constitution of this layer, and the way it is actualized, that has the greatest impact on the attribution of a particular style by any naive listener."[49] While Moore seems to mean this in a primarily instrumentational sense—in the following sentence, he describes different genres' use of keyboard, guitars, or something else in this layer—his observation also accords with the saturation of diatonic and syncopated motives presented here, and with Butler's assertions that syncopated and diatonic rhythms are essential style markers for EDM. Removing the filler layer identified here would not only yield an unusually thin texture but also remove its intricate rhythmic profile, and thus a large chunk of its identity. Mills's creation of a harmonic filler layer, as with the melodic layer, is what makes the TR-909 workout a full EDM track and not a background drumbeat.

Figure 7 Rhythmic motives that constitute the harmonic filler layer.

Conclusion

The TR-909 workout challenges Moore's definitions of functional layers but does not obviate them; instead, the workout illuminates how musical domains beyond pitch contribute to the perception of these distinct layers, at least for me as a listener. I hear the groove layer as comprising those instruments that are a consistent anchor throughout the track, are stable in their rhythmic content, and are predominantly rhythmically even (as op-

posed to syncopated). The harmonic filler layer is where the particular thumbprint of Jeff Mills and his style of EDM is articulated: where the syncopated and diatonic rhythmic motives create the kaleidoscopic assemblages that gradually develop through the whole track. The melodic layer doesn't involve a memorable tune in this workout, of course, but nevertheless this layer creates a sense of dynamism and progression through timbre as well as Mills's physical performance in the video, just as it might through the performance of a singer. This analysis has only scratched the surface of what is exciting and interesting about the TR-909 workout, but even this brief excursion reveals how existing methodologies could be refined and developed by engaging with music that doesn't have the same structures as traditional Western concert music or rock music.

I caution fellow theorists and scholars to notice the temptation to use EDM's emphasis on rhythm, texture, and timbre as a reason not to engage with that repertoire at all. Many theorists, including myself, were not formally educated to deal with these musical domains, due in part to music theory's white racial frame, which has privileged the study of pitch and form as the most important domains of music. The same biases will continue to frame the discipline as long as they remain foregone conclusions, and they will mutate facts of difference into segregation and devaluation. The fact that the TR-909 workout is substantially different in construction than, say, a Simon and Garfunkel song can easily dovetail into an opinion that the workout has no artistic or scholarly value because value does not appear in the same places as in the Simon and Garfunkel song. Perhaps more importantly, a lack of engagement with or understanding of EDM can *seem* a lot like a dismissal of it. This is true even when motivated by the practical problem of lacking the right methodological tools, rather than a negative attitude about the music itself. Those negative attitudes about EDM are pervasive enough that avoiding EDM inevitably resonates with the technology-as-cheating, EDM-as-not-music line of thought.

If music theory isn't built to deal with EDM, that discourages many musicians who would otherwise be excited to study music in a scholarly way. Given EDM's roots as a music for queer people of color, these scholars could likewise have marginalized identities, whose voices we desperately need in music theory. Many people choose to research topics on which they are uniquely qualified to speak: musics they have grown up with, listened to, and performed their entire lives. Imagine a scenario in which an aspiring music scholar wants to capitalize on this type of background in EDM, but their mentor has neither any ideas for how to engage with EDM nor any awareness of literature that does. This scholar could easily get the impression that this kind of inquiry doesn't belong in the field at all. And when their chosen repertoire is personally significant to them, this can by extension feel like a rejection of the scholar themselves. My own interest in EDM came relatively recently into my life, when I became interested in synthesizers while writing my dissertation. While am happy to contribute my perspective in this volume and hope that it helps rectify music theory's imbalances, the field would be enriched further by including people who, unlike myself, have extensively participated in EDM's community—and validating their scholarship. As music theory works to welcome different kinds of people into its ranks, re-evaluating the type of analytical work we do can also help to combat the white racial frame that surrounds our field, musicology, and academia more broadly.Instead of

focusing so much on pitch and form, we theorists can zoom out and see them as only two domains of music that combine with many others to generate music of different styles and value systems, and add timbre, texture, and study of performance to our methodological toolbox. This of course benefits EDM studies, but even the study of music theory's traditional repertoires would be enriched. EDM does not have a monopoly on percussion, timbre, texture, rhythm, or performance, but by stripping away traditional structures of pitch and form, EDM highlights these understudied domains. The development and spread of methodologies for analyzing EDM will likewise equip music theorists to deal with all sorts of music that subvert traditional Western expectations.

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Notes:

(1) "Disco sucks" was the catchphrase of the backlash against disco that culminated in the 1979 "Disco Demolition" headed by radio DJ Steve Dahl. A recent highly visible "rap isn't music" argument occurred in response to political commentator Ben Shapiro's interview show in which he defined music to exclude rap (Ben Shapiro, "Zuby | The Ben Shapiro Show Sunday Special Ep. 68," September 15, 2019, YouTube video, https://www.youtube.com/watch?v=N4KYf10lxdI.

(2) Philip A. Ewell, "Music Theory and the White Racial Frame," *Music Theory Online* 26, no. 2 (2020), https://mtosmt.org/issues/mto.20.26.2/mto.20.26.2.ewell.html.

(3) There have been a number of publications that examine how these biases against races and technologies are often intertwined. Catherine Provenzano contrasts T-Pain's reception as an unserious artist due to his use of Auto-Tune with Taylor Swift's presentation as a skilled singer despite also using Auto-Tune. Robin James identifies white patriarchal anxieties toward technological mediation in the presentation and perception of Black female artists, such as Rihanna and Beyoncé, as robots. Wayne Marshall, documenting "treble culture" and the phenomenon of playing music from cell phones in public spaces, notes that complaints often implicitly involve race, due in part to the fact that the music played is often of a Black-diasporic genre even if the people playing the music are white. See Robin James, "'Robo-Diva R&B': Aesthetics, Politics, and Black Female Robots in Contemporary Popular Music," *Journal of Popular Music Studies* 20, no. 4 (December 2008): 402–423; Wayne Marshall, "Treble Culture," in *The Oxford Handbook of Mobile Music Studies*, ed. Sumanth Gopinath and Jason Stanyek, vol. 2 (Oxford University Press, 2014), 43–76; and Catherine Provenzano, "Auto-Tune, Labor, and the Pop Music Voice," in *The Relentless Pursuit of Tone: Timbre in Popular Music*, ed. Robert Wallace Fink, Melinda Latour, and Zachary Wallmark (New York: Oxford University Press, 2018), 141–158.

(4) Mark J. Butler, *Unlocking the Groove: Rhythm, Meter, and Musical Design in Electronic Dance Music* (Indiana University Press, 2006); Mark J. Butler, *Playing with Something That Runs: Technology, Improvisation, and Composition in DJ and Laptop Performance* (New York: Oxford University Press, 2014).

(5) Philip Tagg, "From Refrain to Rave: The Decline of Figure and the Rise of Ground 1," *Popular Music* 13, no. 2 (1994): 209–222.

(6) Luis-Manuel Garcia, "On and On: Repetition as Process and Pleasure in Electronic Dance Music," *Music Theory Online* 11, no. 4 (2005), https://mtosmt.org/issues/mto.05.11.4/mto.05.11.4.garcia.html.

(7) Mark Spicer, "(Ac)Cumulative Form in Pop-Rock Music," *Twentieth-Century Music* 1, no. 1 (2004): 29–64.

(8) Alyssa Barna, "The Dance Chorus in Recent Top-40 Music," *SMT-V* 6.4 (2020).

(9) Asaf Peres, "The Sonic Dimension as Dramatic Driver in 21st-Century Pop Music" (PhD diss., Ann Arbor, University of Michigan, 2016). While many dissertations do not circulate much, Peres has made a name for himself and his research following his degree completion by pioneering a blog, Top40 Theory, dedicated to writing about music theory for pop songwriters and producers (www.top40theory.com).

(10) Ben Duinker and Hubert Léveillé Gauvin, "Changing Content in Flagship Music Theory Journals, 1979–2014," *Music Theory Online* 23, no. 4 (2017), https://mtosmt.org/issues/mto.17.23.4/mto.17.23.4.duinker.html.

(11) I calculated these percentages from Duinker and Léveillé Gauvin's Example 2, averaging together the percentages in each given row.

(12) Steve Cross, letter to the editor, *Keyboard*, May 1986, 6. Emphasis original.

(13) Robert Vare, "Discophobia," *The New York Times*, July 10, 1979.

(14) Simon Frith, "Art versus Technology: The Strange Case of Popular Music," *Media, Culture & Society* 8 (1986): 268.

(15) Frith, "Art versus Technology," 264.

(16) Sonya Geis, "The Revolution Will Be Posterized," *L.A. Weekly*, May 27, 2004, https://www.laweekly.com/the-revolution-will-be-posterized/.

(17) Oliver Wang, "Hear the Drum Machine Get Wicked," *Journal of Popular Music Studies* 26, no. 2–3 (2014): 222.

(18) Ken McLeod, "'A Fifth of Beethoven': Disco, Classical Music, and the Politics of Inclusion," *American Music* 24, no. 3 (2006): 348; Andrew Goodwin, "Sample and Hold: Pop Music in the Digital Age of Reproduction," *Critical Quarterly* 30, no. 3 (1988): 38.

(19) Gillian Frank, "Discophobia: Antigay Prejudice and the 1979 Backlash against Disco," *Journal of the History of Sexuality* 16, no. 2 (2007): 276–306.

(20) Ewell, "Music Theory and the White Racial Frame." This article is the most thorough presentation of Ewell's ideas and was also the basis of Ewell's plenary talk at the forty-second annual meeting of the Society for Music Theory and his blog series (https://musictheoryswhiteracialframe.wordpress.com).

(21) Ewell, "Music Theory and the White Racial Frame," 2.1.

(22) Joe R. Feagin, *The White Racial Frame: Centuries of Racial Framing and Counter-Framing* (New York: Routledge, 2009).

(23) Ewell, "Music Theory and the White Racial Frame," 2.4.

(24) Ibid., 1.

(25) Duinker and Léveillé Gauvin, "Changing Content in Flagship Music Theory Journals," 6.7.

(26) Kofi Agawu, "The Invention of 'African Rhythm,'" *Journal of the American Musicological Society* 48, no. 3 (1995): 380.

(27) Ronald Michael Radano, *Lying up a Nation: Race and Black Music* (Chicago: University of Chicago Press, 2003), 236.

(28) Robert Fink, "Goal-Directed Soul? Analyzing Rhythmic Teleology in African American Popular Music," *Journal of the American Musicological Society* 64, no. 1 (April 2011): 194.

(29) Robert Fink, *Repeating Ourselves: American Minimal Music as Cultural Practice* American Minimal Music as Cultural Practice (University of California Press, 2005): 39.

(30) Cornelia Fales, "Hearing Timbre: Perceptual Learning among Early Bay Area Ravers," in *The Relentless Pursuit of Tone: Timbre in Popular Music*, ed. Robert Wallace Fink, Melinda Latour, and Zachary Wallmark (New York: Oxford University Press, 2018).

(31) Fales, "Hearing Timbre," 32.

(32) This is observable in the demographic data of the Society for Music Theory, which can be accessed at https://societymusictheory.org/administration/demographics.

(33) Megan L. Lavengood, "The Cultural Significance of Timbre Analysis: A Case Study in 1980s Pop Music, Texture, and Narrative," *Music Theory Online* 26, no. 3 (2020), https://www.mtosmt.org/ojs/index.php/mto/article/view/515.

(34) As an example, see Stephen McAdams et al., "Perceptual Scaling of Synthesized Musical Timbres: Common Dimensions, Specificities, and Latent Subject Classes," *Psychological Research* 58 (1995): 177–192.

(35) Zachary Wallmark, "A Corpus Analysis of Timbre Semantics in Orchestration Treatises," *Psychology of Music* 47, no. 4 (2018): 585–605.

(36) Wallmark, "A Corpus Analysis," 596.

(37) Allan F Moore, *Song Means: Analysing and Interpreting Recorded Popular Song* (Burlington, VT: Ashgate Publishing Company, 2012).

(38) In a forthcoming article, I have argued for a fifth textural layer to be added: the novelty layer. See Lavengood, "The Cultural Significance of Timbre Analysis."

(39) Jeff Mills, *Exhibitionist 2* (Axis Records, 2015), DVD, https://www.axisrecords.com/product/exhibitionist-2/.

(40) I am lucky that George Mason University's School of Music has an impressive library of vintage music hardware, and thankful to Profs. Robert Gillam and Jesse Guessford for helping me access it.

(41) Throughout my analysis, my use of the term "layer" differs from the way Butler uses it. Butler uses "layer" in a more surface-level way, to refer to a particular sample or loop, while I am grouping several such loops together into larger functional layers.

(42) Mark Vail, "Roland CR-78, TR-808, and TR-909: Classic Beat Boxes," in *Keyboard Presents the Evolution of Electronic Dance Music*, ed. Peter Kirn (1994; repr., Milwaukee, WI: Backbeat Books, 2011), 91.

(43) Roland, "Jeff Mills Celebrates the Iconic Roland TR-909 through His History and Cherished Secrets," *Mixmag*, September 9, 2018, https://mixmag.net/feature/909-brand-ededitorial.

(44) This term is used in a definition of groove written by Mark Spicer, in "(Ac)Cumulative Form in Pop-Rock Music," *Twentieth-Century Music* 1, no. 1 (March 2004): 30, footnote 6.

(45) These categorizations of rhythmic profiles come from Butler, *Unlocking the Groove*. Even rhythms are those that divide the beat into pure duple subdivisions. Syncopated rhythms are generated by displacement dissonance, such as a note arriving slightly early or slightly late. Diatonic rhythms are rhythms that divide the measure into non-duple parts as evenly as possible, such as the common *tresillo* rhythm of 3+3+2 eighth notes in a bar of 4/4 time. Butler's book extensively theorizes each of these categories.

(46) Nicole Biamonte, "Formal Functions of Metric Dissonance in Rock Music," *Music Theory Online* 20, no. 2 (2014), http://www.mtosmt.org/issues/mto.14.20.2/mto.14.20.2.biamonte.html.

(47) In this chapter I use terms like *pure, noisy,* and *bright* in very specific senses as they relate to timbre analysis. I have tried to explain these terms sufficiently in this article, but readers curious to know more what is meant by these terms should see Lavengood, "The Cultural Significance of Timbre Analysis."

(48) I don't use "noise" pejoratively here; I'm referring to noise in an acoustic sense, as a sound signal that evenly activates a very broad range of audible frequencies.

(49) Moore, *Song Means*, 21.

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