Visualizing 1980s Timbres

by

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ABSTRACT

Current research lacks consensus on a detailed definition of timbre, complicating analytical techniques and discourse (Krumhansl 1989; Malloch 1997; Siedenburg and McAdams 2017). This thesis develops a methodology that relates timbral qualities to textural function in 1980s popular music. It adapts previous methods of analysis by applying a system of timbral binaries to Allan Moore's textural functions (Cogan 1984; Lavengood 2017, 2019, 2020; Moore 2012). Lavengood uses binaries to describe spectrograms of individual synthesizer presets. This research builds on her methodology by applying the analysis of spectrograms to timbres in full textures after the mixing and mastering process. Furthermore, this paper analyzes sounds from acoustic instruments and electroacoustic instruments in addition to synthesized sounds. It compares timbral trends in 1980s synthesizers, drum machines, and the wailing electric guitar with their acoustic analogs. Finally, this thesis explores the resurgence of these timbres in popular music released since 2010.

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CHAPTER I: INTRODUCTION

Timbre is difficult to define. Many authors provide their own interpretation of, and terminology for, timbre, often coining or citing definitions that lack detail or accuracy. A definition provided by the American National Standards Institute (ANSI), for example, is a favorite for authors to criticize.[1] That definition states that timbre is "that attribute of auditory sensation which enables a listener to judge that two nonidentical sounds, similarly presented and having the same loudness and pitch, are dissimilar."[2] This definition is troublesome because it is a definition of exclusion, showing what timbre is not rather than defining what it is. It also frames timbre in terms of other parameters of sound rather than providing specificity to the one parameter readers are looking to define. Though current research agrees that this definition is lacking, it also lacks a consensus on a more precise definition of timbre. The lack of consensus complicates analytical techniques and discourse based on timbre.

To address these issues, this thesis develops a methodology for describing a variety of timbral observations. In doing so, it contributes to the understanding of timbre through analysis of recorded audio. By utilizing audio tracks, the analysis focuses on the resulting timbres of acoustic, electronic, and electroacoustic instruments, as well as products of the mixing and mastering process. These are the timbres experienced by listeners.

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1. Siedenburg, Kai, and Stephen McAdams, "Four Distinctions for the Auditory "wastebasket" of Timbre," *Frontiers in Psychology* 8 (2017): 1747.

2. American National Standards Institute, *Psychoacoustic Terminology: Timbre,* (New York, New York: American National Standards Institute, 1960/1994)

This introductory chapter describes how this thesis engages with timbre. After a brief review of relevant perceptual and analytical literature, I describe my methodology for analyzing timbre using spectrograms and binary oppositions, building off of work by Robert Cogan, Allan Moore, and Megan Lavengood. After describing my methodology, I provide detailed definitions of the binary oppositions that appear in the analyses that follow.

Instead of dealing with strictly acoustic aspects of timbre, much of the research on timbre focuses on music perception and music psychology. Carol Krumhansl tests a multidimensional scaling model to see whether our perception of timbre relies on dissimilarities, or if some timbres have unique descriptors. She also deals with the problematic practice of utilizing pitch analogies to describe timbral relationships.[3] Kai Siedenburg and Stephen McAdams provide some clarification to perceptual aspects of timbre in their article, “Four Distinctions for the Auditory ‘Wastebasket of Timbre’.” Siedenburg, along with Charalampos Saitis and McAdams, also co-authored the first chapter of *Timbre: Acoustics, Perception, and Cognition*.[4] The chapter overviews the different angles from which researchers have approached timbre over the course of its study. McAdams has been exploring and contributing to this topic for over a decade and,

3. Krumhansl, Carol, “Why Is Timbre So Hard to Understand?” In *Structure and Perception of Electroacoustic Sound and Music,* Ed. Sören Nielzén and Olle Olsson (Amsterdam: Elsevier, 1989): 43-53.

4. Siedenburg and McAdams, "Four Distinctions for the Auditory "wastebasket" of Timbre"; Siedenburg, Kai, Charalampos Saitis, and Stephen McAdams, “The Present, Past, and Future of Timbre Research,” in *Timbre: Acoustics, Perception, and Cognition*, ed. Kai Siedenburg et al. (Switzerland: Springer, 2019), 1-22.

in addition to co-authoring some of the aforementioned research, is listed as primary or sole author for several documents on the perception of timbre.[5]

Other approaches to timbral analysis tend to focus on specific instruments or techniques. Kate Heidemann has developed a way to describe vocal timbre utilizing mimetic engagement and the physical sensations involved in vocal production.[6] Caroline Traube and Nicolas D'Alessandro have studied guitar timbre adjectives and their relation to vocal imitation of guitar.[7] Other authors like Jennifer Beavers take an approach that combines some elements of perceptual timbre research with discussions of timbre and orchestration that might inform formal analysis.[8]

Rather than examining how listeners perceive, process, and identify timbres, this project considers how artists craft, organize, and manipulate timbres in recorded audio. In other words, I approach timbre as a primary dimension of music, much like other analysis papers might approach harmony or form. Specifically, this thesis describes characteristics

5. McAdams, Stephen, "Perspectives on the Contribution of Timbre to Musical Structure, " *Computer music journal* 23, no. 3 (1999): 85-102; McAdams, Stephen, Philippe Depalle, and Eric Clarke, "Analyzing Musical Sound," in *Empirical Mosicology: Aims, Methods, and Prospects*, edited by Eric Clarke and Nicholas Cook (New York: Oxford University Press, 2004): 157-96; McAdams, Stephen, and Kai Siedenburg, "Perception and cognition of musical timbre," In *Foundations in music psychology: Theory and research*, ed. P. J. Rentfrow and D. J. Levitin (MIT Press, 2019): 71–120.

6. Heidemann, Kate, "A System for Describing Vocal Timbre in Popular Song," *Music Theory Online* 22, no. 1 (2016).

7. Traube, Caroline, and Nicolas D'Alessandro, "Vocal synthesis and graphical representation of the phonetic gestures underlying guitar timbre description," in *8th International Conference on Digital Audio Effects (DAFx'05)*, (2005): 104-109.

8. Beavers, Jennifer P, "Ravel's Sound: Timbre and Orchestration in His Late Works," *Music Theory Online* 27, no. 1 (2021).

and trends in 1980s popular music. 1980s popular music provides an ideal source for a timbral study of this nature due to the ubiquity of novel, identifiable timbres made available to artists via advances in synthesizer technology.[9] Furthermore, by focusing on this era and style of music, this paper contributes to the growing field of popular music analysis and expands the analytical canon.

This thesis owes a tremendous debt to Lavengood's doctoral dissertation and subsequent publications. Her methodology, which she has clearly defined and organized, has provided the basis for my own project. For her analyses, Lavengood uses spectrograms generated in iZotope's RX4 program to examine synthesizer presets from the Yamaha DX7.[10] Through these spectrograms she compares various presets to a clean electric guitar signal. She uses a binary system to compare various parameters of timbre. This method of binary comparison is adapted from Robert Cogan's work.[11] Some of the binary parameters are the same between Cogan's analyses and Lavengood's, and others are clarified or renamed in Lavengood's charting. She also categorizes the characteristics based on three properties of timbre: the attack, the sustain, and pitch information.

The spectrograms in this thesis differ slightly from those found in Lavengood's work. While Lavengood uses the system of binaries to describe spectrograms of isolated

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9. Lavengood, Megan, "'What makes it sound'80s?': The Yamaha DX7 Electric Piano Sound," *Journal of Popular Music Studies* 31, no. 1 (2019): 73-93.

10. Lavengood, Megan, "A New Approach to the Analysis of Timbre," (PhD diss., City University of New York, 2017), ProQuest (10601325), iv.

11. Cogan, Robert, *New Images of Musical Sound,* (Cambridge, Massachusetts: Harvard University Press, 1984), 123-40.

synthesizer presets that she has identified in certain musical tracks, this thesis analyzes spectrograms that show full textures after the mixing and mastering process. Also, rather than comparing spectrograms against a single control timbre, this thesis compares timbres from different songs to acoustic control timbres selected based on textural function. Furthermore, this thesis applies this method of analysis to acoustic instruments, electroacoustic instruments, and synthesized sounds.

To create the spectrograms in this thesis, I use iZotope's RX8 software to read uncompressed audio files ripped from compact discs. I then adjust the spectrogram output using a cos3 window, the Mel frequency scale, the multicolor 2 color map, a cache size of 100MB, a high amplitude range of 0 decibels and a low amplitude range that I adjust as needed to account for varying file volumes, but which stay within the range of −100 decibels and −70 decibels (dB). In the side-by-side comparisons of one timbre to another, the lower threshold is matched for both figures. These spectrograms are a useful way to visualize audio information, but they may include information that our ears do not perceive. The settings described above attempt to visually capture the listener experience as accurately as possible.

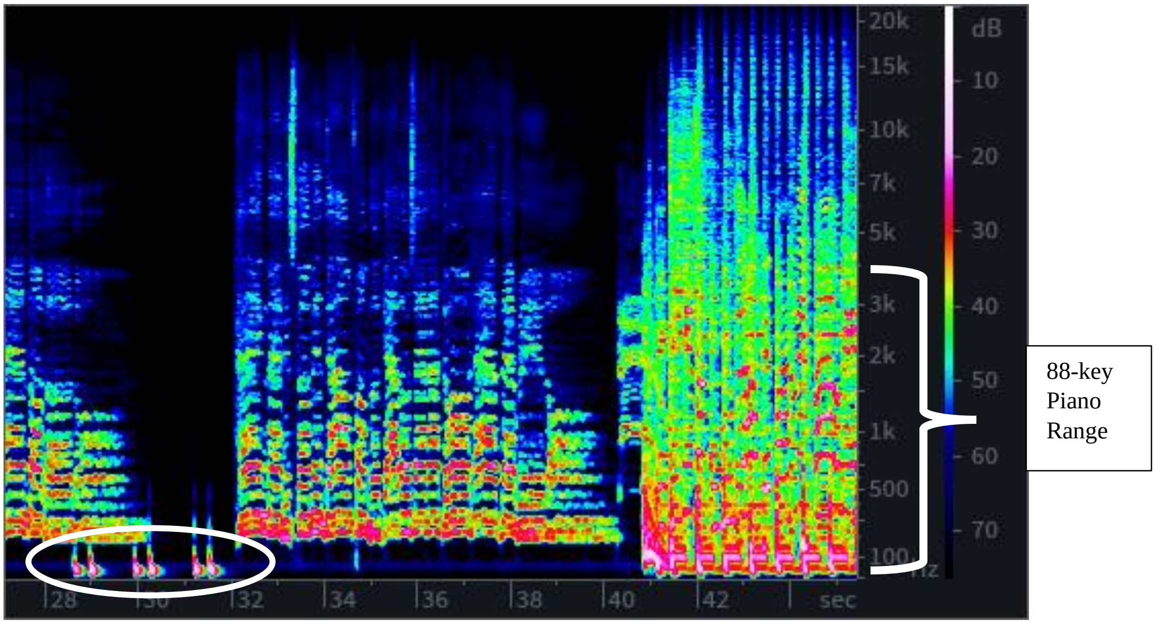

Figure 1.1: Spectrogram of “Renegade” – Styx, 1978 (0:27.5-0:44) −76.4 dB lower threshold

Figure 1.1 provides an example of a spectrogram generated by the criteria described above. The music is taken from the end of the introductory verse and first chorus entrance of “Renegade” by Styx (0:27-0:44). The x-axis measures time in seconds, and the y-axis measures frequency in Hertz (Hz). The frequency range represents the typical range of human hearing. The white brace indicates the range of fundamental frequencies for an 88-key piano, which spans from 27.5 Hz to 4186 Hz. The colors indicate sound intensity, measured in decibels (dB). The right side of the spectrogram includes a key for the color coding. The frequencies shown in red are typically perceived as louder than those in green or blue. Typically, the fundamental frequency associated with a given isolated sound event will appear in yellow or red, with upper partials represented in green or blue. The spectrogram above provides a visual representation of the sound events from this excerpt of the song. For example, the “heartbeat” percussion motive, circled in white, is represented with fundamentals below 100 Hz between the 28 and 32 second markers. This motive is preceded and followed by close harmony, a capella vocals until the 41 second mark, where the increase in visual information and overall shift in coloration denotes the point in time where the full ensemble enters for the chorus.

To describe a sound event’s attack, Lavengood uses two binaries: bright/dark and percussive/soft. Lavengood duplicates the bright/dark binary in the post-attack portion of the sound, and I address that binary in the post-attack portion rather than at the attack. Rather than percussive/soft, I use fast/slow as the binary descriptor for the attack portion of the sound. Fast/slow refers to how soon a sound reaches its peak amplitude and is visualized using the thickness of the bands of a sound’s components at its onset. A fast attack reaches peak amplitude at or very close to the onset of the sound and is indicated by a thicker band at the onset. A soft onset peaks in amplitude after the onset of the event and is indicated by a thinner band at the attack point. For example, standard hits on a drum kit have fast onsets.

For the portion of a sound after the attack, Lavengood charts six binary parameters: bright/dark, pure/noisy, full/hollow, rich/sparse, beatless/beating, and harmonic/inharmonic.[12] Beatless/beating refers to the presence of acoustic beats or regular fluctuations in volume, often created by dissonance. On a spectrogram, beating can be seen as a regular fluctuation in the thickness of a fundamental band. Beating can

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13. Rich/sparse and beatless/beating are taken directly from Cogan’s binaries. Bright/dark, pure/noisy, and full/hollow are binaries that Cogan describes but Lavengood has renamed. Harmonic/inharmonic is a parameter that Lavengood identifies that Cogan does not address.

be observed when sounds are isolated and sustained but full textures may obscure the effect, aurally; the sounds examined in this paper are not sustained long enough to exhibit any cycles of beating. Harmonic/inharmonic is determined by the rational relationships between the frequencies of the partials and the fundamental. Acoustic sounds are not perfectly harmonic, but if the partials are integer multiples of the fundamental, as with a well-tuned instrument in equal temperament, the sound event is described as harmonic. In contrast, carillon bells, like those that can be heard announcing the hour on some college campuses, are inharmonic because the upper partials are not integer multiples of the fundamental. Full/hollow describes the pattern of partials in the frequency spectrum. If partials appear in a regular pattern across the frequency spectrum, the sound is full. If any partials are absent or if some are sounded considerably less than others in an irregular pattern, the sound is described as hollow. For example, compared to most acoustic instruments, the clarinet only produces perceptible partials at odd numbers, and is therefore characterized as hollow. The harmonic/inharmonic and full/hollow binaries are better seen on a spectrum plot than a spectrogram and can be obscured if multiple events sound simultaneously.

Since these three binaries are difficult to examine in spectrograms of full texture audio tracks, this thesis focuses on the other three binaries of the sustain or decay portion of a sound, generically referred to as post-attack: bright/dark, pure/noisy, and rich/sparse. The bright/dark binary refers to the distance between the event's lowest sounding frequency – the fundamental – and its highest sounding partial. The fundamental typically contains the most energy and intensity and is the frequency that most musicians identify as the sound's "pitch". Partials refer to all of the frequencies produced by a given sound event. Partials above the fundamental typically sound with less intensity. They are not perceived as different notes or sounds but are perceptually combined with the fundamental as one complex sound. In a comparison of two sounds with the same pitch information, the sound event that exhibits color higher on the y axis, which measures frequency in Hertz, would be the brighter of the two. Pure/noisy has a similar definition to fast/slow, but refers to a sound's profile over time. Sounds whose spectrograms show thicker bands post-attack are described as noisy and sounds with thinner bands are described as pure. Rich/sparse refers to the number of partials present in a given sonority, or the wideness of the band for sounds without partials.

Lavengood also describes pitch. While pitch is often its own primary parameter of music, it also affects timbre. Pitch is, therefore, a secondary property of timbre that can affect timbre but is not a timbral property per se. For pitch components, Lavengood lists low/high and steady/wavering as parameters. Low/high refers to the pitch level of the sound. If the fundamental of a sound is high in pitch space, it may seem aurally bright despite a reduction in the number of perceivable higher partials. Since most of the examples in this thesis compare sounds that occupy similar pitch space and brightness is already considered, pitch height is not considered separately in my analyses. Steady/wavering describes an absence or presence of pitch fluctuations in vibrato. This thesis specifically examines frequency modulations present in vibrato, though amplitude modulations created by tremolo may also be present in the audio excerpts. On a spectrogram, straight lines indicate a steady sound and waving lines where individual partials may resemble sine waves indicate a wavering sound as it fluctuates in frequency.[13]

In addition to these definitions, Lavengood adopts and adjusts the textural functions first described by Allan Moore.[14] Lavengood describes three layers in popular music. First, she combines Moore's explicit beat layer, functional bass layer, and harmonic filler layer into one layer, which she dubs the "core textural function."[15] She keeps Moore's melodic textural layer as he describes it. Then she adds a new layer, the novelty layer, which "intermittently interject[s] decorative motives."[16] This thesis focuses on sounds that occupy the core and melodic textural functions and the timbre characteristics that tend to appear in each.

This thesis also takes cues from perceptual research on timbre. Timbre is a perceptual property.[17] The system of binaries described above uses descriptions based on perception, but a spectrogram cannot show perceptual properties, only measurable acoustic properties. The spectrogram settings attempt to capture these measurable properties in the way we might perceive them. Multidimensional scaling studies have

13. Descriptions of these binaries are paraphrased from Lavengood's "A New Approach to the Analysis of Timbre."

14. Moore, Allan F, *Song Means: Analysing and Interpreting Recorded Popular Song.* (Ashgate, 2012), 19-21.

15. Moore, *Song Means: Analysing and Interpreting Recorded Popular Song*, 19-21.

16. Lavengood, "A New Approach to the Analysis of Timbre," 63.

17. Siedenburg and McAdams, "Four Distinctions for the Auditory "wastebasket" of Timbre."

demonstrated that the measurable auditory properties shown in a spectrogram are the primary factors that influence our perception of timbre.[18] These perceptual studies ask participants to compare two sound events per response and rate them in terms of dissimilarity. Studies like those from Krumhansl and McAdams identify three main auditory elements to timbre perception: log attack time, spectral centroid, and spectral flux.

The dimension of log attack time "is the time it takes to progress from a threshold energy level to the maximum in the rms amplitude envelope."[19] Essentially, it is the amount of time it takes for the sound to get from the onset to its maximum energy. This element matches with the fast/slow binary component of the attack. The "spectral centroid is the center of gravity of the long-term amplitude spectrum."[20] This component describes the high/low pitch space and relates to the timbral binaries of bright/dark, rich/sparse, and full/hollow. Spectral flux is "the degree of variation of the spectrum over time."[21] While not directly based on this component, beatless/beating and steady/wavering are descriptive of temporal variations during a sound's sustain and/or decay.

Sustain and decay are parts of a sound envelope. Sound events are usually discussed in a four-part structure: attack, sustain, decay, and release, especially when the

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18. Krumhansl, "Why Is Timbre So Hard to Understand?" 43-53; McAdams, "Perspectives on the Contribution of Timbre to Musical Structure," 85-102.

19. McAdams, "Perspectives on the Contribution of Timbre to Musical Structure," 90.

20 . McAdams 1999, 90.

21. McAdams 1999, 90.

events are synthesized sounds. The attack portion of the sound is critical in source identification for acoustic instruments. While the attack portions of sounds in this thesis are fairly easy to identify, comparing the timbres of acoustic, electroacoustic, and synthesized sounds problematizes labels such as sustain, decay, and release. Acoustic decay occurs when the agent acting on the sound, the person providing the air for the instrument or the hammer hitting the string, no longer acts on the sound and additional energy is no longer being fed to the sound event. Synthesized sounds can be programmed to mimic acoustic decay of instruments as well as acoustics of various rooms. The philosophical debate over whether or not a weakening electrical signal should be described as decrescendo or decay is beyond the scope of this thesis. Therefore, this thesis introduces the term "post-attack" to include all spectrogram readings that occur after the sound event's attack. This term facilitates the comparison of timbres over time.

In order to find and track timbral trends in 1980s popular music, I examined spectrograms from multiple tracks from 45 CDs. The spectrograms included in the following chapters provide some of the clearest representations of those trends. Chapters 2 and 3 examine sounds produced by synthesizers and drum-machines, respectively. By comparing spectrograms of these 1980s timbres to their acoustic counterparts, these chapters highlight similarities and differences and create a general timbre profile for these particular 80s sounds. Chapter 4 discusses an additional electroacoustic element present in many 1980s tracks: the wailing guitar. After defining the term, this chapter describes its signature timbral features. Chapter 5 examines select songs released after 2010. Comparing the spectrograms of these tracks with those from the 1980s reveals timbral characteristics as a contributing factor to these songs' ability to evoke a sense of nostalgia.

CHAPTER II: 1980s SYNTHESIZERS

Synthesizers can play a variety of roles in a popular song. This chapter uses spectrograms to examine the timbral characteristics of synthesizers that contribute to core textures by sounding block chords. I refer to these as chording synthesizers. First, this chapter compares the sounds of synthesizers to those of an acoustic piano. Then it compares sounds of different synthesizers. By comparing these spectrograms, we can begin to identify the timbral characteristics that lend chording synthesizers to a core textural function as well as those that set chording synthesizers apart from other core texture sounds.

Synthesizers often play a similar textural role to chording instruments such as pianos and rhythm guitars.[22] In comparison to the acoustic piano, the timbres of these chording synthesizers are slower in their attack, and the overall sound profiles are brighter, noisier, and richer. To demonstrate these timbral comparisons, Figures 2.1 and 2.2 provide spectrograms from introductory sections in Billy Joel's "Piano Man" and Van Halen's "Jump," respectively. To facilitate visual comparison, Figure 2.3 places single chords from each song side by side. In each of these figures, white rectangles denote block chords from the chording instruments. Table 2.1 summarizes the comparisons along timbral binaries.

22. Lavengood 2017, 63.

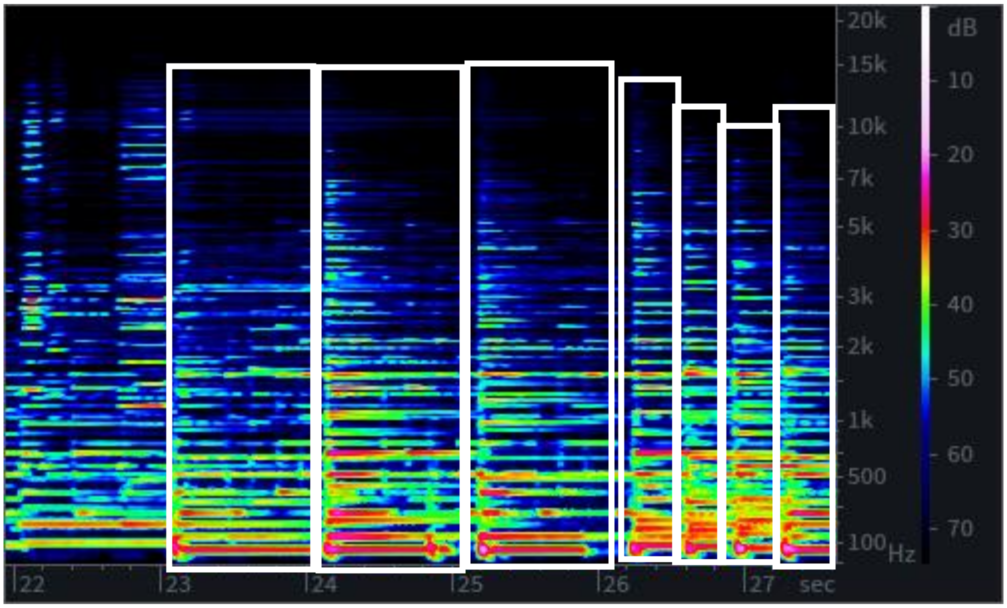


Figure 2.1: Spectrogram of “Piano Man” – Billy Joel, 1973 (0:22-0:27.6) −74.6 dB lower threshold

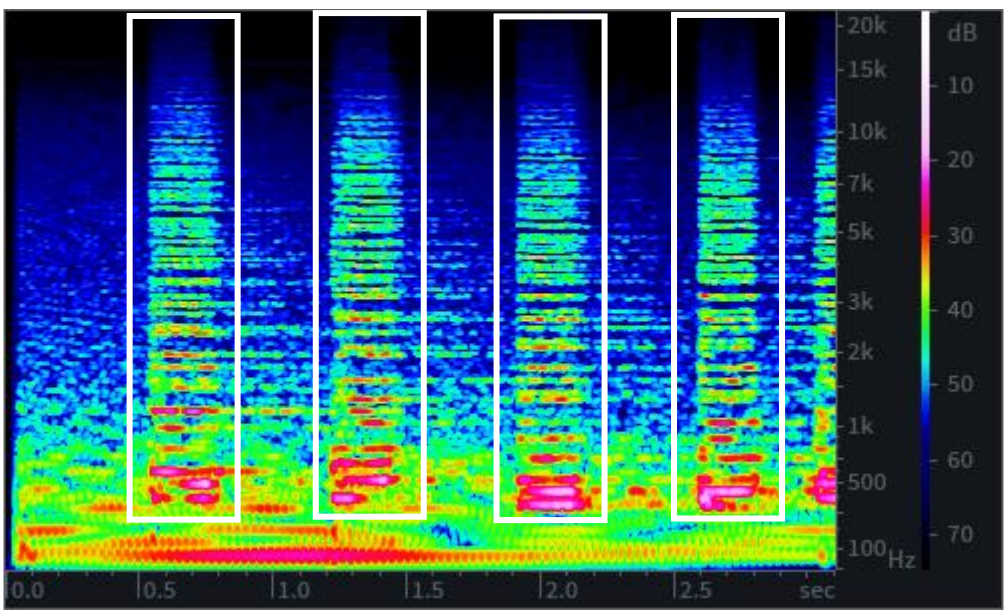


Figure 2.2: Spectrogram of “Jump” – Van Halen, 1984 (0:00-0:03) −74.6 dB lower threshold

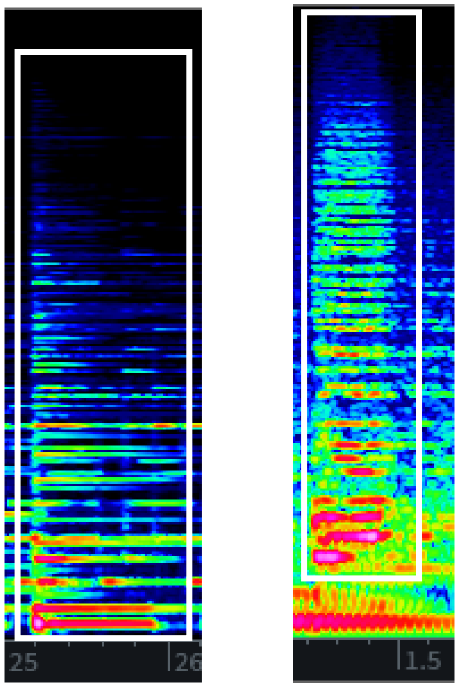


Figure 2.3: Side-by-side of a single block chord from "Piano Man" (left) and "Jump" (right)

Table 2.1: Timbral Binary Oppositions of "Piano Man" and "Jump" Block Chords

	Acoustic Piano	"Jump" Synthesizer
ATTACK		
Fast/Slow	Fast	Slow
POST-ATTACK	(DECAY)	(SUSTAIN)
Bright/Dark	Dark	Bright
Pure/Noisy	Pure	Noisy
Rich/Sparse	Sparse	Rich
PITCH	Steady	Steady

Since the sound's attack occurs first chronologically and serves as a primary factor in our ability to differentiate instruments, that is where this comparison begins. The attack of the acoustic piano is faster than that of the synthesizer. Note the halo and increase in thickness around the beginning of the bands in the "Piano Man" spectrogram.

Now compare the differences in the two sound profiles over time, after the attack. Notice how much higher the present partials are in the frequency range for the synthesizers that open "Jump" in comparison to the acoustic piano chords in the opening of "Piano Man." The acoustic piano partials begin to fade around 7,000 Hz, whereas the synthesizer partials fade around 12,000 Hz. These higher partials indicate the increased brightness of this timbre. In addition to the brightness of the synthesizer's sustain, note how much thicker the bands are overall in the synthesizer. This thickness is most visually apparent in the lowest fundamental bands and the first few additional harmonics. The thick frequency bands indicate a greater energy around the harmonics, representing a sound that is noisier in comparison to the acoustic piano. The timbres of chording synthesizers also tend to be richer in comparison to their acoustic counterparts, as evidenced by their greater intensities at higher harmonics in Figure 2.2. The color scale provides the visualization for this information on the spectrogram.

The comparison of energy profiles in the post-attack portion of the sound provides a point of stark contrast between "Piano Man" and "Jump." Since the piano is a percussive instrument, the sound profile of the acoustic piano over time is characterized by decay. This decay occurs because the entirety of the energy given to make the piano sound is delivered by the hammer at the attack. Some energy may be retained in the sound, but no additional energy is provided after the attack. The chords in "Piano Man" begin to decay immediately following the attack. The decay can be seen in the energy reduction and disappearance of bands in the upper partials, then in the mid frequency range and, eventually, in the fundamental. This process results in a curve shape in the upper partials on the spectrogram. In contrast, the chording synthesizer sounds are fed additional energy after the attack. For the synthesizers in “Jump,” this additional energy is continued until the performer stops pressing the keys. The presence of additional energy after the attack allows the sound to sustain rather than immediately begin to decay. Note the consistency in the shape of the “Jump” synthesizer’s profile post-attack. The retention of color on the spectrogram indicates the retention of energy provided by the sustain capability. Synthesizers tend to have a very quick decay, which may be imperceptible, especially in up-tempo or full texture music. Rather than experiencing decay, listeners may perceive an abrupt end to the sound event when the performer releases the keys.

The secondary parameter to timbre, the pitch component, does not provide any contrast in these two examples since both feature steady pitches without pitch bends, vibrato, or anything else that would contribute to a wavering pitch. Since a steady pitch is a feature in these two, and all of the following harmonic texture examples, it is likely common to most instruments in that textural function.

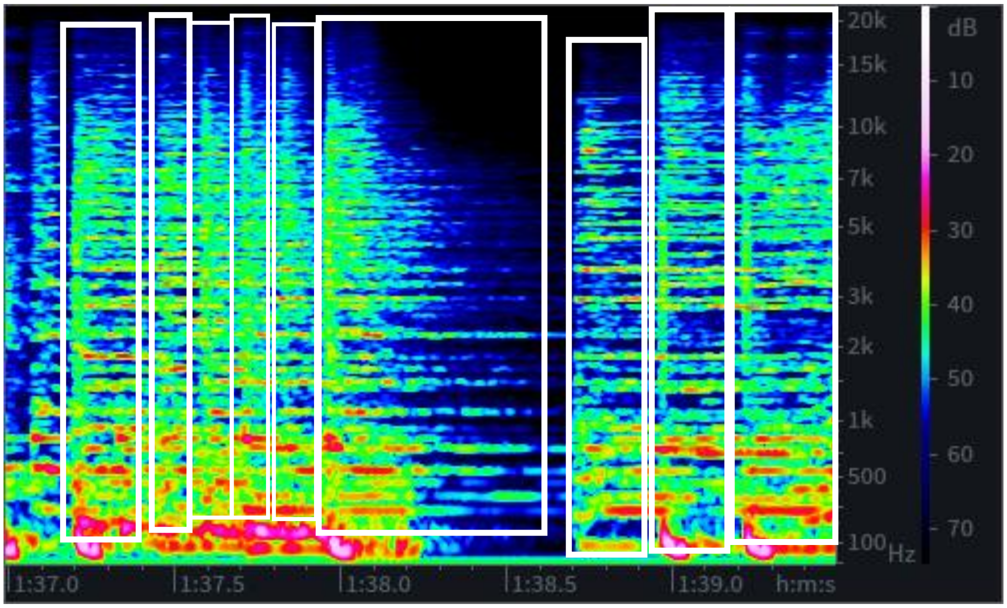


Figure 2.4: Spectrogram of “I Wanna Dance with Somebody” – Whitney Houston, 1987 (1:37.0-1:39.5) −74.6 dB lower threshold

Whitney Houston’s “I Wanna Dance with Somebody” employs chording synthesizers with timbral characteristics that are similar to the synthesizer used in “Jump” (Figure 2.2). The introduction to the second verse is excerpted in Figure 2.4. Each chord is denoted with a solid white rectangle. Like the synthesizer in “Jump,” the attack of this sound is soft and the overall timbre is bright. The brightness of these chords is shown in the amount of energy and intensity in the upper partials, indicated by the amount of green (around −40 dB) in the range from 1,000 to 10,000 Hertz. This brightness profile is similar to the synthesizers in “Jump” (Figure 2.2) and much more present than the acoustic piano in “Piano Man” (Figure 2.1), which reduce to −50 dB and lower between 2,000 and 3,000 Hz.

The noisy component of the synthesizers’ sustain is most clear in the fundamental for these figures. Shown in red due to its sound intensity, the fundamental clearly exhibits the bands' thick, irregular shape in "I Wanna Dance with Somebody" and "Jump" compared to the thin lines in "Piano Man." There is a lack of vertical space between the bands of color, indicating a rich timbre. Compare the shape of the bands, especially the fundamentals, of all three, circled in white and shown side-by-side in Figure 2.5. The synthesizer in "I Wanna Dance with Somebody," like that of "Jump," features sustain and an immediate decay. Table 2.2 summarizes the comparisons between the acoustic piano and the synthesizer from "I Wanna Dance with Somebody."

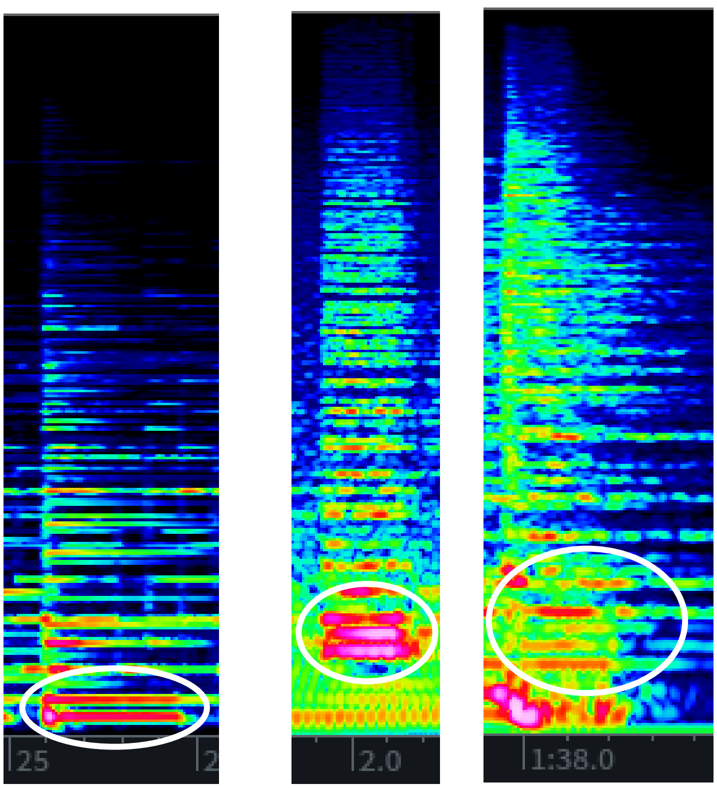


Figure 2.5: Side-by-side of a single block chord from "Piano Man" (left), "Jump" (center), and "I Wanna Dance with Somebody" (right)

Table 2.2: Timbral Binary Oppositions of "Piano Man" and "I Wanna Dance with Somebody" Block Chords

	Acoustic Piano	"I Wanna Dance with Somebody" Synthesizer
ATTACK		
Fast/Slow	Fast	Slow
POST-ATTACK	(DECAY)	(SUSTAIN)
Bright/Dark	Dark	Bright
Pure/Noisy	Pure	Noisy
Rich/Sparse	Sparse	Rich
PITCH	Steady	Steady

Synthesizers allow programmers to control many aspects of a sound. Though the process gives the programmer an extreme amount of control, it can also be complicated and time-consuming. Instead of programming sounds themselves, some musicians may opt to use the pre-programmed sounds, or presets, that come with a given synthesizer. Lavengood identifies the Yamaha DX7's Electric Piano (E. Piano 1) sound as a particularly pervasive timbre of 1980s chart toppers. She identifies Chicago's "Hard Habit to Break" as one of many tracks to utilize the E. Piano 1 preset for the harmonic core texture. [23]

Figure 2.6 shows a spectrogram of the E. Piano 1 chording synthesizer, along with drums and vocals at the entrance of the second chorus. Each articulation of the chord is boxed in white. Since the E. Piano 1 preset includes "piano" in its name, it is no surprise that this is the chording synthesizer example that most closely resembles the spectrogram of the acoustic piano in Figure 2.1. Still, it exhibits timbral trends of the other chording synthesizers. Compare the block chord spectrograms of all four songs examined in this

23. Lavengood, 2019.

chapter side-by-side in Figure 2.7. The fundamentals of the synthesized sounds are all noisier than those from the acoustic piano. The upper partials of the synthesized sounds are still greater in intensity and are visible in the spectrogram farther up the y axis of frequency. Compared to the synthesizers in "Jump" and "I Wanna Dance with Somebody," the E. Piano 1 from "Hard Habit to Break" does exhibit a faster onset, which matches the faster onset of an acoustic piano. The shapes of the post-attack sound profiles are similar between the acoustic piano and the E. Piano 1 preset, but the synthesizer does not have an acoustic decay. Instead, the sustain on the E. Piano 1 preset is programmed to mimic decay. This manufactured decay is marked with an asterisk in the post-attack categorization. Table 2.3 shows the binary oppositions between the acoustic piano and the E. Piano 1. Table 2.4 shows binary oppositions between the synthesizer from "Jump" and the E. Piano 1 preset from "Hard Habit to Break."

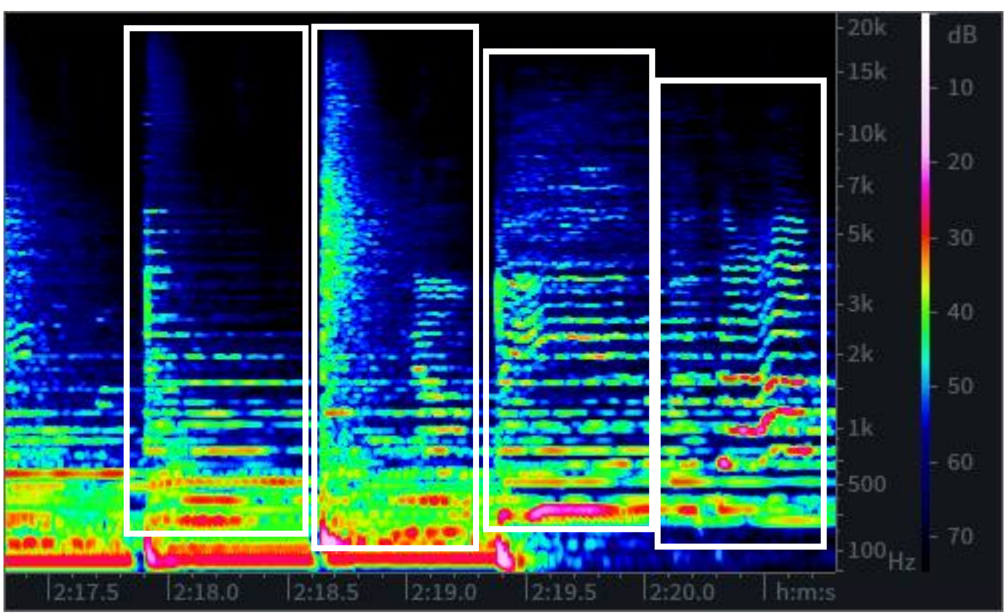


Figure 2.6: Spectrogram of "Hard Habit to Break" – Chicago, 1984 (2:17.3-2:20.8) −74.6 dB lower threshold

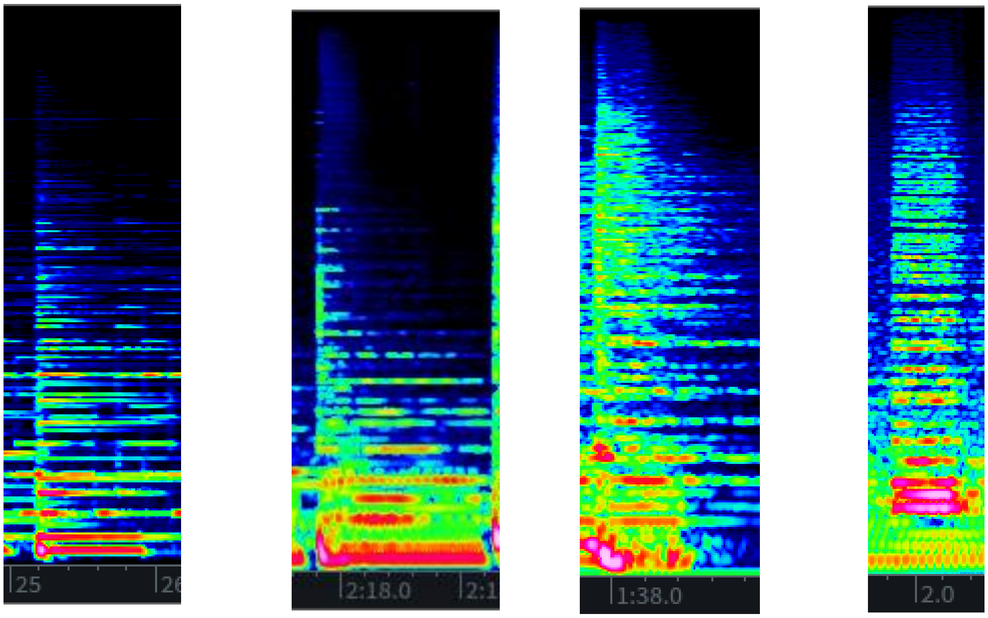


Figure 2.7: Side-by-side of a single block chord from (left to right) “Piano Man,” “Hard Habit to Break,” “I Wanna Dance with Somebody,” and “Jump”

Table 2.3: Timbral Binary Oppositions of “Piano Man” and “Hard Habit to Break” Block Chords (*The E. Piano 1 has a sustain that is programmed to mimic the decay of an acoustic piano)

	Acoustic Piano	E. Piano 1
ATTACK		
Fast	Fast	Fast
POST-ATTACK	(DECAY)	(DECAY*)
Bright/Dark	Dark	Bright
Pure/Noisy	Pure	Noisy
Rich/Sparse	Sparse	Rich
PITCH	Steady	Steady

Table 2.4: Timbral Binary Oppositions of “Jump” and “Hard Habit to Break” Block Chords (*The E. Piano 1 has a sustain that is programmed to mimic the decay of an acoustic piano)

	“Jump” Synthesizer	E. Piano 1
ATTACK		
Fast/Slow	Slow	Fast
POST-ATTACK	(SUSTAIN)	(DECAY*)
Bright/Dark	Bright	Dark
Pure/Noisy	Noisy	Noisy
Rich/Sparse	Rich	Sparse
PITCH	Steady	Steady

In summary, comparison of the spectrograms of chording synthesizers and acoustic pianos clarifies both their timbral similarities and differences. All of these examples feature steady pitches. The acoustic piano and E. Piano 1 preset share a faster than the other synthesizer presets and similar decay profiles, though the E. Piano 1 decay is manufactured. Timbral brightness and noisiness are significant features of all of the synthesizer examples. Brightness is represented in the spectrograms in the frequency height, intensity is represented in decibels of the sounding partials, and noisiness is represented by the thick and irregular shape of the partial bands, especially evident in the fundamental.

The inclusion of the E. Piano 1 comparison highlights limitations to this methodology. This method forces binary comparison, but the E. Piano 1 lies somewhere in the middle of a spectrum of timbral possibilities. The E. Piano 1 synthesizer preset is bright and rich when compared to the acoustic piano, but dark and sparse when compared to the synthesizer from “Jump.” Taken together, Tables 2.3 and 2.4 indicate that the E. Piano 1 preset occupies a middle ground of brightness and richness but cannot say whether it is closer to the brightness and richness of the other synthesizers examined in this chapter or closer to the dark and sparse character of the acoustic piano on the spectra of possibilities. At this time there is no definitive scale that indicates whether the E. Piano 1 qualifies as a sound with an absolutely fast attack. The characterization of a fast attack in comparison to the acoustic piano is based on my own observation. Another analyst may interpret this sound to be softer than the acoustic piano and produce a different chart. In future research, a more comprehensive understanding of timbre may help us to qualify these characteristics in more contexts than binary comparisons.

CHAPTER III: DRUMS AND DRUM MACHINES

Spectrograms also reveal timbral similarities and differences between acoustic drums and drum machines. The timbral comparisons in this chapter focus on elements of the post-attack portion of the sound since all of the examples share the fast attacks that characterizes most percussion instruments. The percussion instruments examined here do not have any acoustic sustain. They begin to decay immediately after being struck. The post-attack sound profile is a result of any combination of natural energy-loss profiles of various percussion instruments, recording room acoustics, electronic programming, and post-recording processing. This chapter examines kick and snare drum sounds in songs by Aerosmith, The Pointer Sisters, and Prince.

The attack is the part of the timbre that most distinguishes percussion instruments from other instruments. The sound profiles of both acoustic and synthesized drums tend to exhibit a similar initial spike in energy through the full frequency spectrum, followed by a swift disappearance of the upper partials. The features exhibited on a spectrogram after this moment provide the best comparison for differences in the sounds.

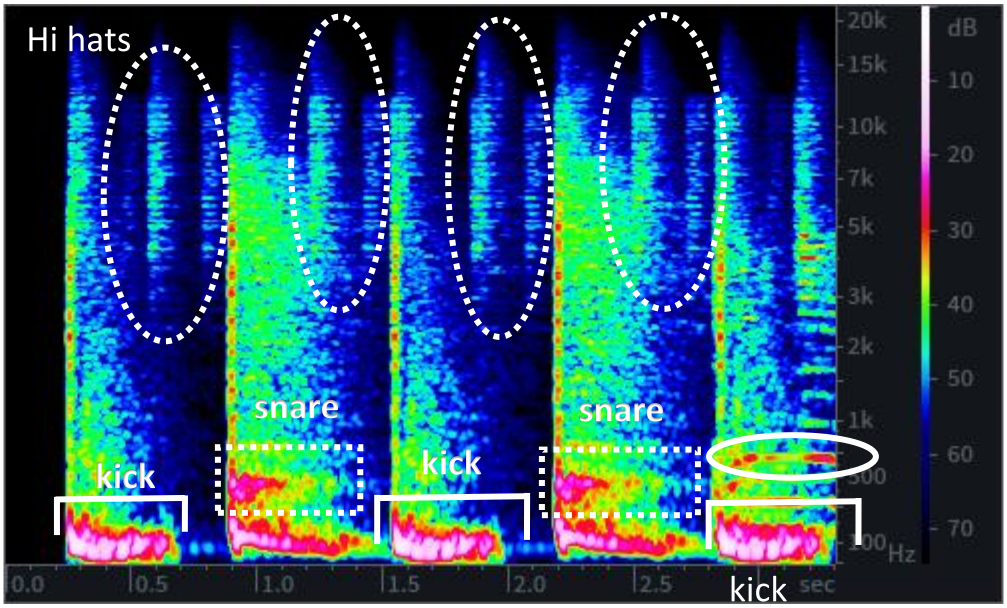


Figure 3.1: Spectrogram of "Rag Doll" – Aerosmith, 1987 (0:00-0:03) −74.6 dB lower threshold

First, let us examine the properties of an acoustic drum pattern. Figure 3.1 shows the alternating kick-snare pattern from the opening of Aerosmith's "Rag Doll." Solid lines bracket the fundamental of the kick drum, centered around 100 Hz. Dashed boxes indicate the fundamental of the snare, which sits above the kick-drum fundamental, near 500 Hz. The presence of partials extending to 7,000 Hz for the kick drum and 10,000 Hz for the snare indicate that these drums are bright. In addition, there is an overall thickness of the band surrounding the fundamental frequency. Compare the thickness of this band to the entrance of a pitched instrument, specifically a guitar, indicated with a solid circle near the 3 second mark. This thickness reflects the noisy component of non-pitched percussion. Even though musicians typically describe some percussion as non-pitched, there is often still a single, measurable fundamental frequency; however, the high energy around the fundamental and any present partials, i.e. the noisy component of the timbre, obscures the pitch to the point that it is not perceptible to our ears as a specific pitch. Also note the clear reduction in thickness after the snare drum's attack. The resulting shape is similar to a pyramid turned 90 degrees clockwise. This shape is a result of the snare drum's decay, the way in which it loses energy.

Next, let's compare those elements to sounds from a synthesized drum machine. Figure 3.2 shows a spectrogram of the opening percussion from "Jump (For My Love)" by The Pointer Sisters. Solid lines bracket the kick drums, dashed boxes indicate the snares, and dashed ovals circle the hi hats. The snare's fundamental lies a little lower than the snare in "Rag Doll," close to 300 Hz. The kick-drum decays in this excerpt have a very different shape compared with those from "Rag Doll." The acoustic kick drums tend to retain energy at the fundamental, while the drum-machine kick drums have a curved decay shape, indicating that even the fundamental loses energy rather quickly.

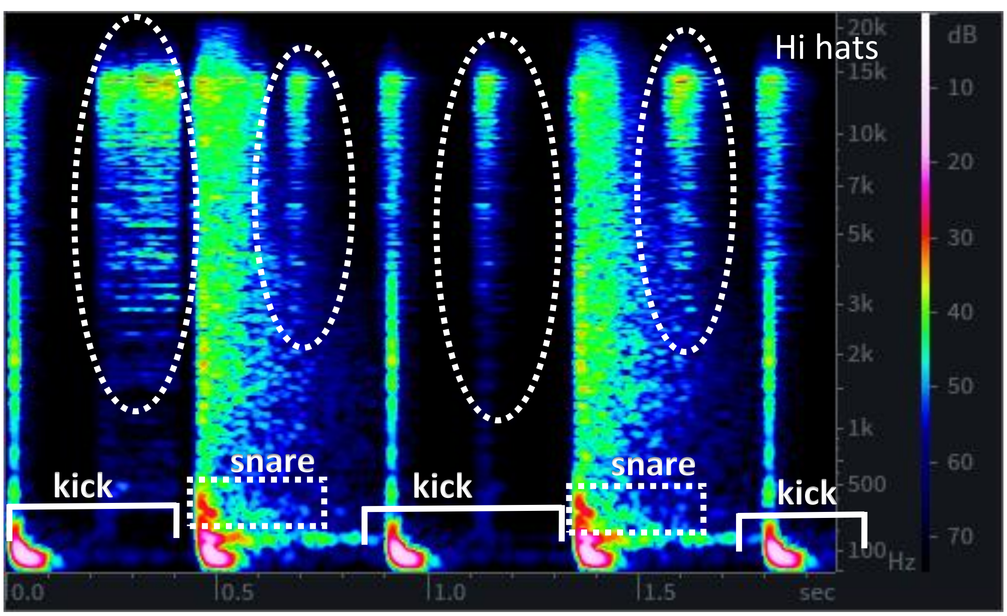


Figure 3.2: Spectrogram of "Jump (For My Love)" – The Pointer Sisters, 1983 (0:00-0:02) −74.6 dB lower threshold

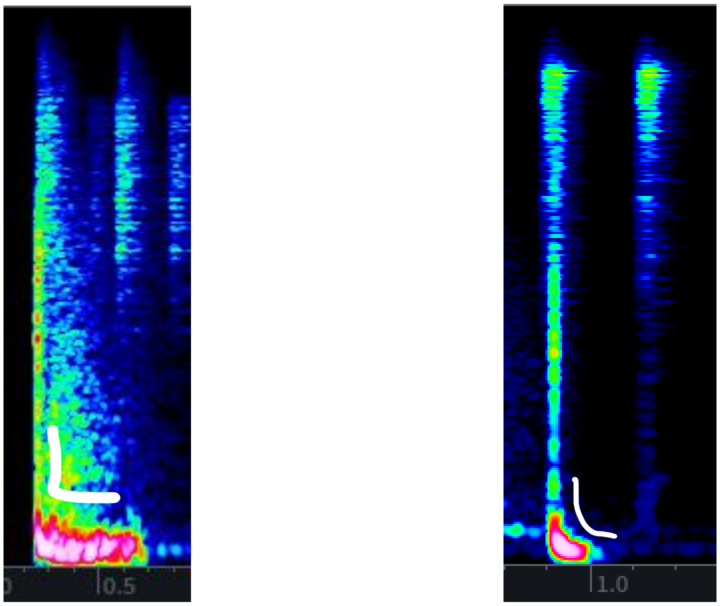


Figure 3.3: Side-by-side kick drums from “Rag Doll” (left) and “Jump (For My Love)” (right)

Figure 3.3 shows a side-by-side comparison of the kick drums from these two songs. The white lines on Figure 3.3 serve to highlight the shape from the attack to the decay portion of the sound. The drum-machine kick drums lose almost all the upper partials after the attack, resulting in a much darker decay profile. The acoustic kick drum has a jagged, thick structure around the fundamental where the drum-machine kick has a smoother line and thins out over time. This thinning and smoothness indicate a much less noisy decay profile on drum-machine kick drums.

The snare drums from drum machines show a curious decay shape after the attack. The acoustic and drum-machine snares are isolated side-by-side in Figure 3.4. A white line highlights the unique decay profile in the synthesized snare. While the upper partials in the acoustic snare adhere to a fairly regular decay pattern, there is an inverted question mark shape to the distribution of partials for the drum-machine snare created by a dip between 500 and 1,000 Hertz.

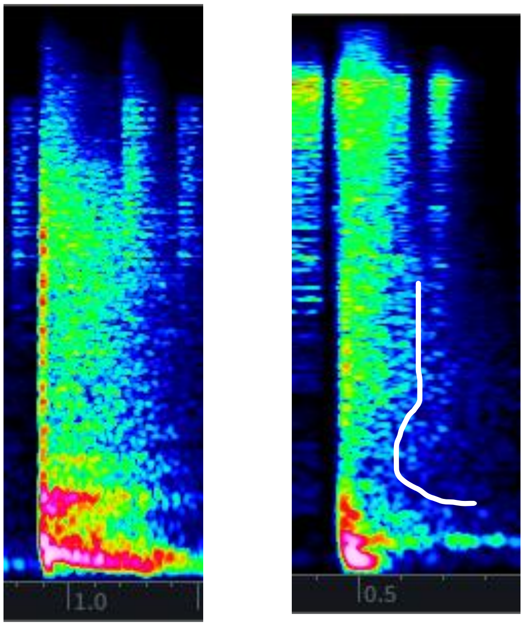


Figure 3.4: Side-by-side spectrograms of snare hits from “Rag Doll” (left) and “Jump (For My Love” (right)

Figure 3.5, a spectrogram of the introductory section of “Little Red Corvette” by Prince, shows a drum-machine kick and snare in a different rhythmic pattern. Solid brackets highlight kick fundamentals and dashed lines outline snares. The texture for this spectrogram is a bit busier than the two preceding figures, which have bare percussion introductions. Still, the clear shapes of the kick and snare drums can be located within the visual representation. The snare drums are triangular in shape, just as they are in both preceding figures. The drum-machine shapes in “Little Red Corvette” have more in common with those of “Jump (For My Love)” than with “Rag Doll,” with the clearest visual comparison coming from the smooth lines on the fundamentals for the decay portion of the drum-machine sounds compared to the acoustic drums.

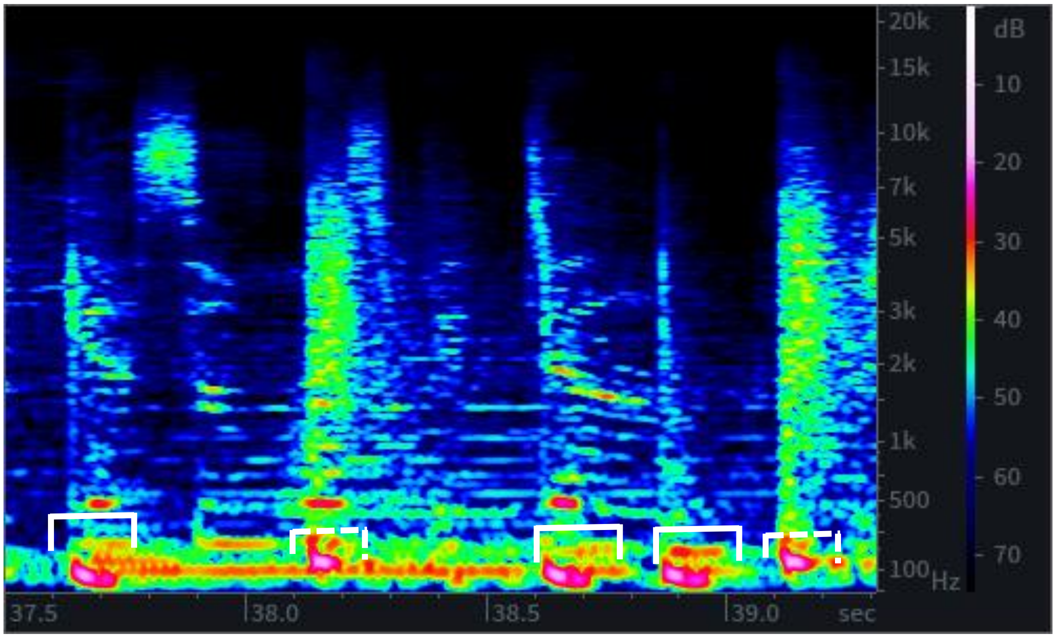


Figure 3.5: Spectrogram of “Little Red Corvette” – Prince, 1983 (0:37.5 -0:39.3) −74.6 dB lower threshold

Table 3.1 summarizes the differences between the timbre characteristics of acoustic drums and drum machines. Since the fast attack is a characteristic feature of typical drum kit sounds, it is no surprise that both drum-machine and acoustic kick and snare drums share similar attack timbres. The decay profile is where differing timbral features occur. Drum-machine kick drums provide the most visible contrast to their acoustic counterparts. The near disappearance of upper partials after the attack gives them a darker, purer sound than the acoustic kick drum, and drum-machine kicks have a more curved shape to their decay than acoustic kicks. The contrast with snare drums is less distinct but acoustic drums are still brighter and noisier. Also, drum-machine snares feature an irregular pattern with a curious dip in upper partial energy between 500 and 1,000 Hz.

Table 3.1: Timbral Binary Oppositions of Acoustic Drums and Drum Machines

	Acoustic Drums	Drum Machine
ATTACK		
Fast/Slow	Fast	Fast
POST-ATTACK	(DECAY)	(DECAY)
Bright/Dark	Bright	Dark
Pure/Noisy	Noisy	Pure
Rich/Sparse	Rich	Sparse
PITCH	N/A	N/A

Table 3.1 generalizes the timbral trends of drum-machine sounds and acoustic drum sounds. The shift toward darker, purer, and sparser sounds in the electronic version of the beat layer stands in opposition to the timbral trends of the synthesized harmonic layer compared to the acoustic. Taken together, these two trends may reflect a timbral counterbalance in the overall soundscape.

CHAPTER IV: WAILING GUITAR

The electric guitar is incredibly versatile in terms of the timbres it can produce. It also frequently serves in multiple textural functions in music, often within the same track. While the electric guitar itself is certainly not a new timbre in the 1980s, there is a certain characteristic sound within the range of electric guitar timbres that achieved such popularity in the 1980s that it warrants discussion here. I will refer to this timbre as the wailing guitar.

The term "wailing guitar" has been attributed to a wide range of styles and eras. From Jimi Hendrix's signature style in the 1960s to metal groups like Metallica and Megadeth who emerged in the 80s and remained popular into the 90s, there have been sounds that people have termed "wailing." While the word "wailing" is often used to describe a variety of soloistic guitar techniques, my use of the term is meant to characterize the resultant sound. The wailing guitar in this chapter is a specific 1980s pop and rock sound often employed by groups such as Journey, Van Halen, and Styx. I define this wailing guitar sound as melodic fragments or full melodies in the electric guitar's mid-to-upper range. The signal for this style of wailing guitar is not heavily processed; it most often has slight-to-moderate reverb added and is less distorted than the typical sound product of the 1960s guitar or the guitar used in metal. Another element of the wailing electric guitar that contributes to the characteristic sound is the inclusion of pitch bends and vibrato. While these are certainly gestural and stylistic considerations, they have a significant effect on the resulting timbre.

Some bands, such as Journey, Van Halen, Styx, and Bon Jovi, adopt the wailing guitar as one of the core elements of their sound identity. Sometimes a guitar wail will interject a simple background figure, especially at points when it is not needed to fill out the core texture, such as introductions, bridges, or verses. REO Speedwagon and Chicago use the wailing guitar in this fashion. When the electric guitar shifts out of the core textural function to take on a melodic or novelty textural role, one of the first things that one notices is the change in attack. Rather than a fast attack that provides a reinforcement of rhythmic structure, the guitarist performs in such a way that the sound onset is softer and darker than rhythm guitar sounds. The onset is not distinct from the profile of the resultant decay. An example of this technique is present in the guitar solo from "Wheel in the Sky" by Journey, shown in Figure 4.1.

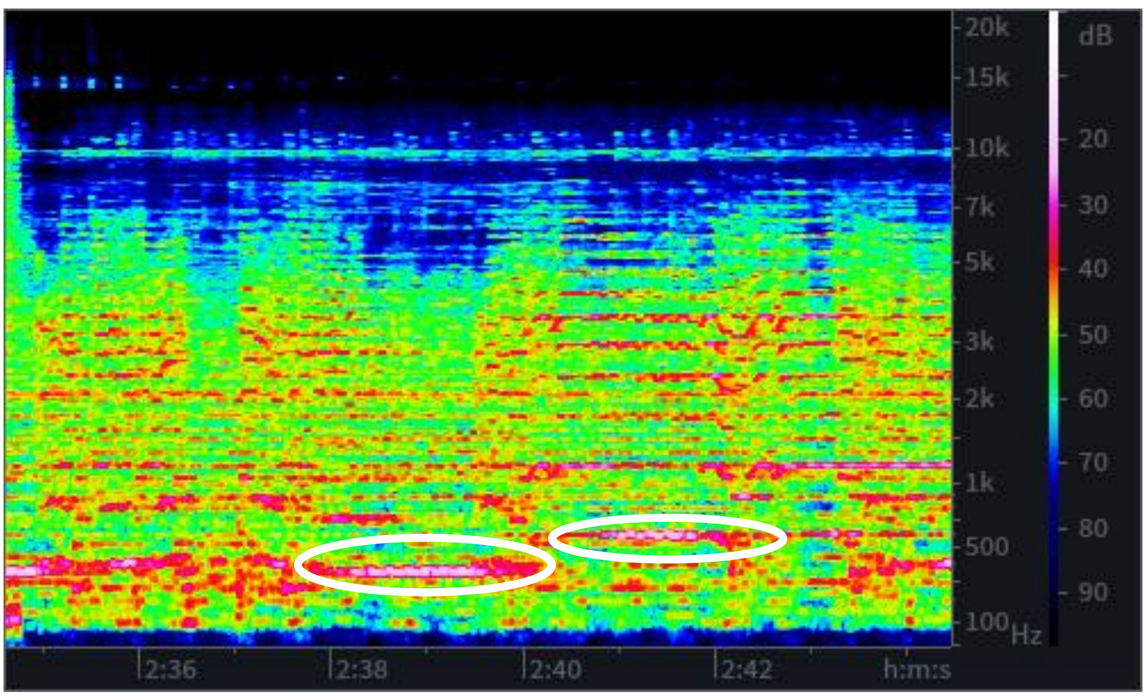


Figure 4.1: Spectrogram of "Wheel In The Sky" – Journey, 1978 (02:34-02:44.5) −98.2 dB lower threshold

The circles in this spectrogram highlight the fundamental of two long melodic notes. It is clear from both the thinness of the bands and the consistency in loudness indicated by the color of the fundamental that the sound's energy does not vary much over time. Though an acoustic decay is present, it happens too slowly to be visible in the spectrogram of these events. Timbrally, we would describe this profile as a pure sound with a soft attack.

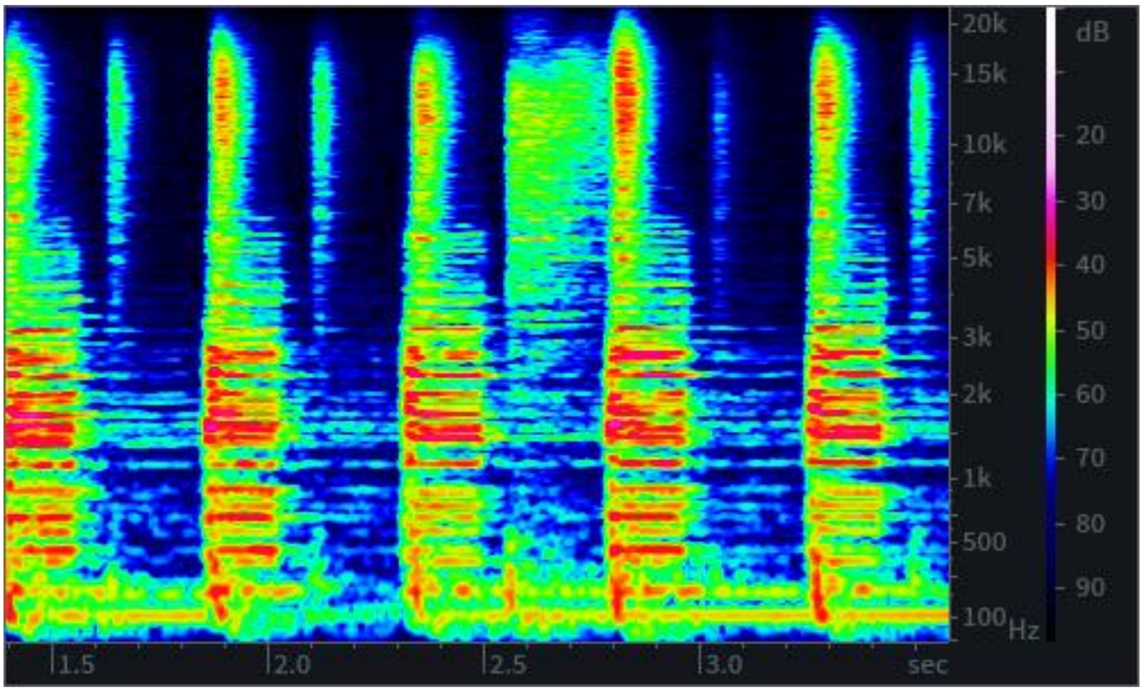


Figure 4.2: Spectrogram of "Roxanne" – The Police, 1978 (0:01.4-0:03.6) −98.6 dB lower threshold

Figure 4.2 provides a spectrogram of the opening rhythm guitar from "Roxanne" by The Police. Compare this sound profile to the wailing guitar in Figure 4.1. These two profiles are markedly different, despite being produced by the same instrument. The versatility of the electric guitar allows it to function in both the core and melodic textures. Note how the rhythm guitar exhibits timbral qualities more closely related to chording synthesizers than to the wailing guitar. The rhythm guitar has a faster attack than the wailing guitar. In the post-attack portion of the sound, the rhythm guitar is slightly brighter, with distinctly shaped partials extending to nearly 7,000 Hz compared to the 5,000 Hz of the wailing guitar. Single notes from the wailing guitar have thinner bands than the partials from the rhythm guitar. The band width can be obscured by the wavering nature of the sound if the spectrogram is not zoomed in with enough detail to see the wave shape. Notice how spaced out the upper partials in the wailing guitar are compared to the rhythm guitar. The nature of the single note at a time of the wailing guitar compared to the multiple simultaneous notes in a rhythm guitar chord result in a sparser tone in the post-attack portion of the wailing guitar's profile. There is a notable difference in the pitch category of timbral comparison between these two spectrograms. The wavy lines of the wailing guitar give a clear example of a wavering pitch component. Compare these waves to the steady lines in the partials of the rhythm guitar. These comparisons are summarized in Table 4.1.

Table 4.1: Timbral Binary Comparison of Wailing Guitar and Rhythm Guitar

	Rhythm Guitar	Wailing Guitar
ATTACK		
Fast/Slow	Fast	Slow
POST-ATTACK	(DECAY)	(DECAY)
Bright/Dark	Bright	Dark
Pure/Noisy	Noisy	Pure
Rich/Sparse	Rich	Sparse
PITCH	Steady	Wavering

The pitch bends and vibrato associated with the wailing guitar stand out in a spectrogram, even in the context of thicker textures with a lot of other sound activity. In

Figure 4.1, the waviness of the lines contained within the circles are indicative of vibrato. "Wheels Are Turnin'" by REO Speedwagon, excerpted in Figure 4.3, features both pitch bends and vibrato, which contribute to the wavering pitch timbral feature.

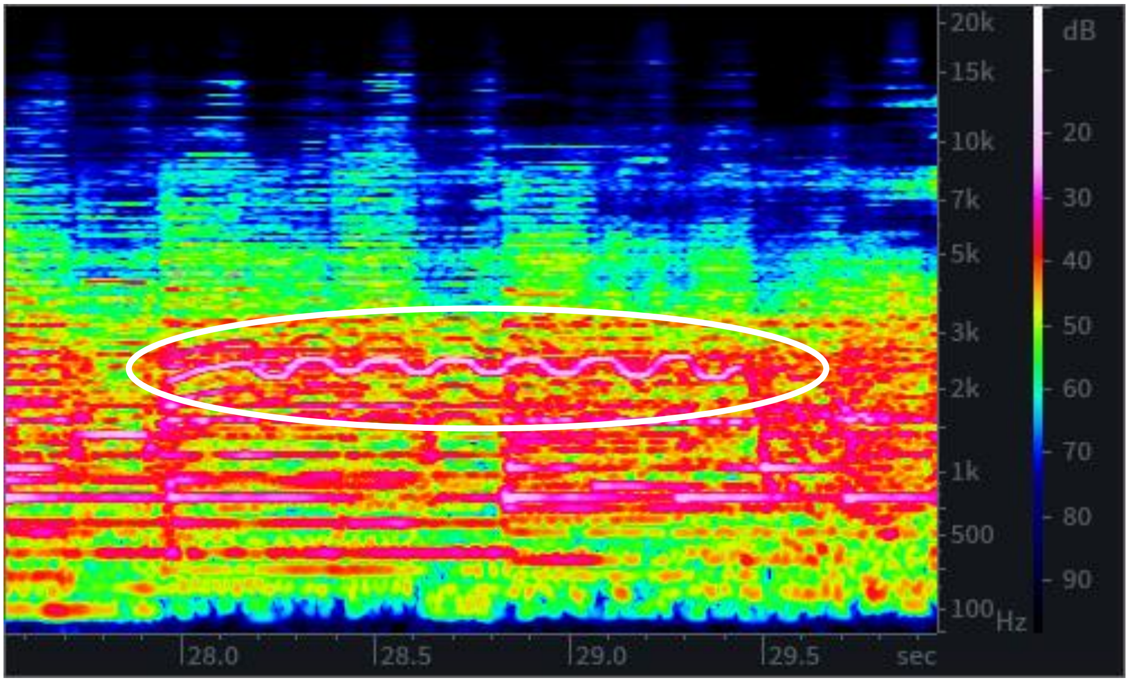


Figure 4.3: Spectrogram of "Wheels Are Turnin'" – REO Speedwagon, 1984 (0:27.5-0:30) −98.2 dB lower threshold

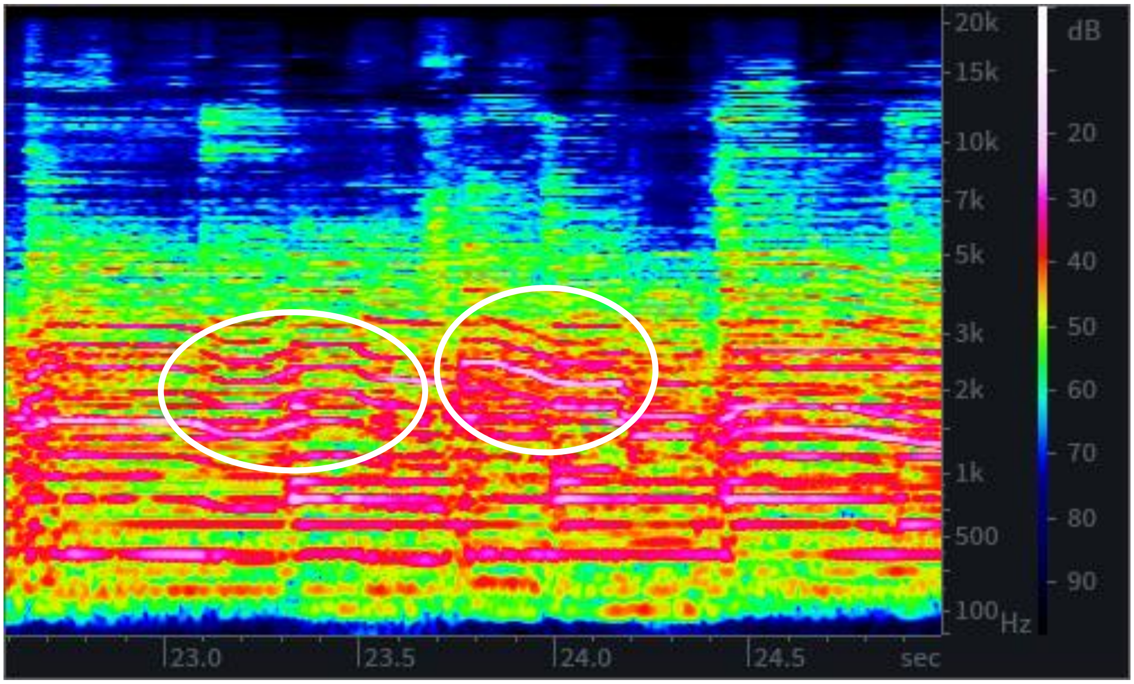


Figure 4.4: Spectrogram of "Wheels Are Turnin'" – REO Speedwagon, 1984 (0:22.5-0:25) −98.2 dB lower threshold

Figure 4.3 shows a wider vibrato in a different register of the guitar. Figure 4.4, taken from a few seconds prior, includes clear presentations of pitch bends. The wailing guitar weaves seamlessly between the vibrato and pitch bends of wavering pitch components and the steady pitch component that characterizes straight tones. This alternation often mimics the vocal technique featured in these songs. Figure 4.5 shows the vocal line from "Wheels Are Turnin." Notice the similarity between the pitch bend of the second circle in Figure 4.4 and the circles in Figure 4.5.

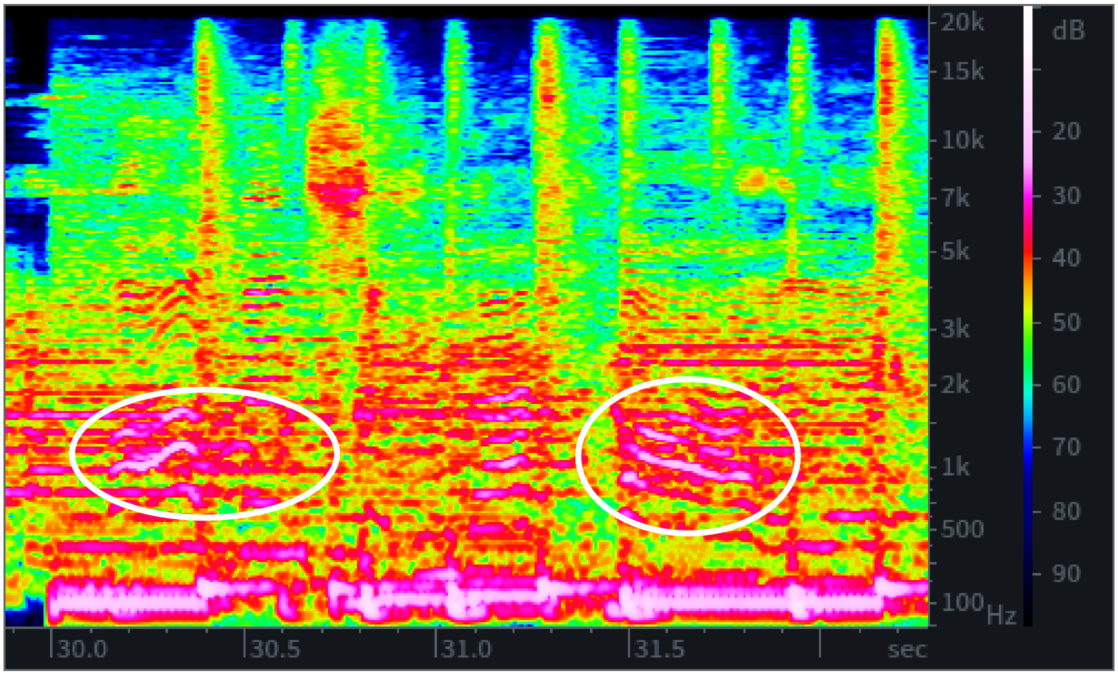
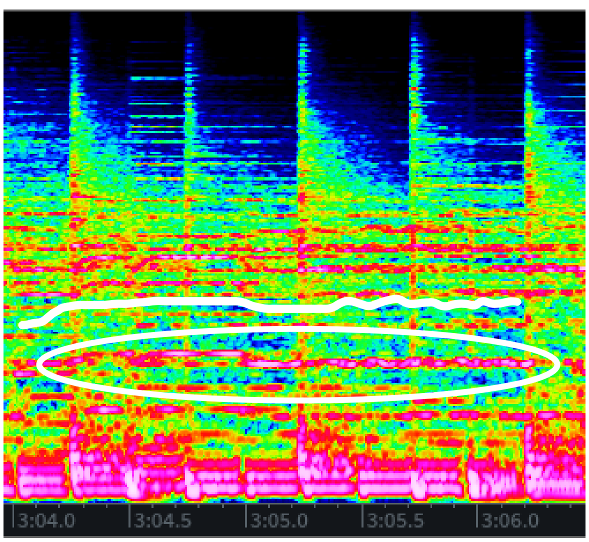


Figure 4.5: Spectrogram of "Wheels Are Turnin'" – REO Speedwagon, 1984 (0:29.9-0:32.3) −98.2 dB lower threshold



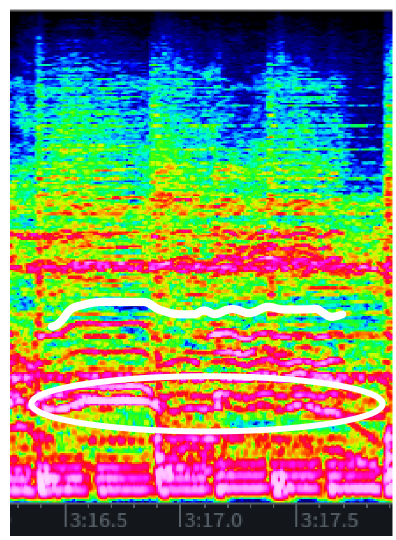


Figure 4.6: Spectrogram of "Livin' On A Prayer" – Bon Jovi, 1986 (3:04-3:06.5) guitar left, (3:16.3-3:17.8) vocals of lyrics "hold on" right

To further explore the amount of similarity between the wailing electric guitar and vocals, look at the elements of pitch bend and vibrato in both the voice and guitar shown in Figure 4.6 from Bon Jovi's "Livin' On A Prayer." The solid circles in these figures indicate the respective fundamentals. I have drawn a generalization of the overall shape above the fundamentals in white. Notice how the guitar on the left exhibits a very similar shape to the voice during the lyrics "hold on," performed about ten seconds later. Both iterations have a bend upward, followed by a hold, then a bend downward with added vibrato at the end of the gesture.

The change in timbral characteristics on the electric guitar signals a shift from a core textural function to a melodic one, often mimicking or foreshadowing the vocal techniques used within the same track. The shift in playing technique clearly marks the electric guitar's change in function by avoiding those components that characterize the other core function instrument timbres. Instead of matching with the noisy percussion and synthesizers, performers change technique to provide a timbre that closely resembles and therefore aligns itself with other melodic instruments; namely, the voice. Compared to the core rhythm guitar, the wailing guitar has a darker, softer attack; a dark, pure, and sparse decay profile; and an especially noticeable wavering in pitch. The attack components and wavering pitch are especially similar to the voice.

CHAPTER V: NOSTALGIA

Synthesis and sampling technologies have grown and developed immensely since breaking into the mainstream of popular music in the 1980s. Modern sound studios can create digital sounds that are indistinguishable from acoustic instruments, as well as completely novel synthesized sounds. Furthermore, the technology is becoming increasingly affordable for, and accessible to, a wider group of people. Virtually anyone with the right software and a laptop can produce a wide array of sounds. Even with the realm of possibilities infinitely expanding, some writers and producers have elected to include the timbres that had their start in 80s popular music. By doing so, these modern tracks can produce a sense of nostalgia for the sounds of the 80s. This chapter will examine tracks by Bruno Mars, The Weeknd, and Beyonce, all released after 2010, and compare their spectrograms to those discussed in Chapters 2, 3, and 4. The timbral trends in these tracks can show one way the songs evoke a sense of the 80s.

Several tracks in Bruno Mars's 2016 album *24K Magic* feature synthesizers and/or drum-machine sounds that directly reference timbres from previous decades. "Calling All My Lovelies," "Versace on the Floor," "Too Good to Say Goodbye," "Chunky," and "24K Magic" all prominently feature at least one 80s timbre. Note the chording synthesizer from "24K Magic" shown in Figure 5.1 compared to that of Figure 2.2 (reproduced).

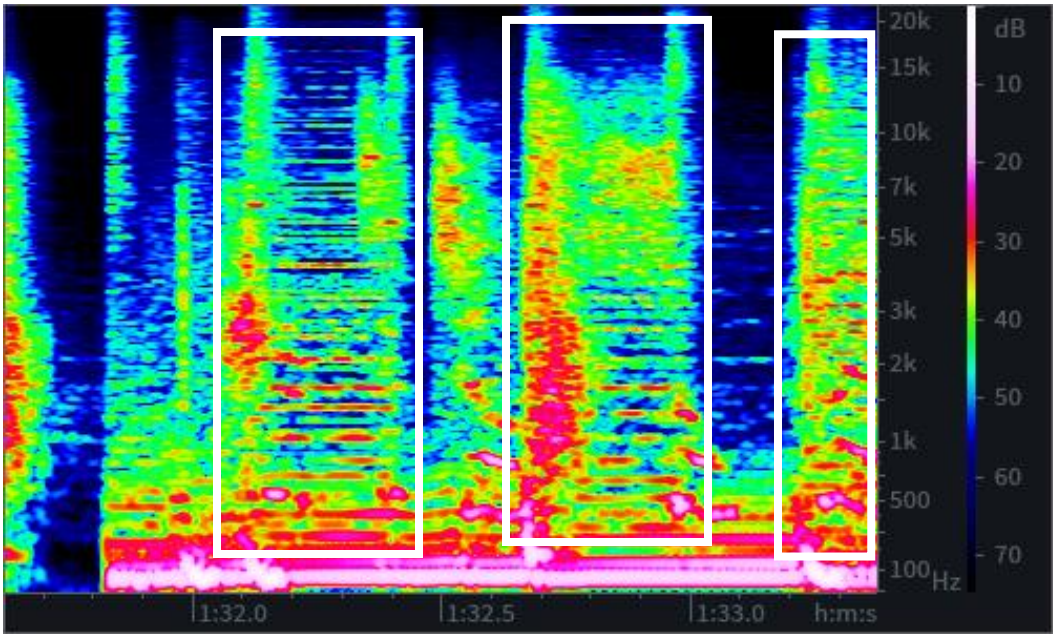


Figure 5.1: Spectrogram of "24K Magic" – Bruno Mars, 2016 (1:31.5-1:33.5) −74.6 dB lower threshold

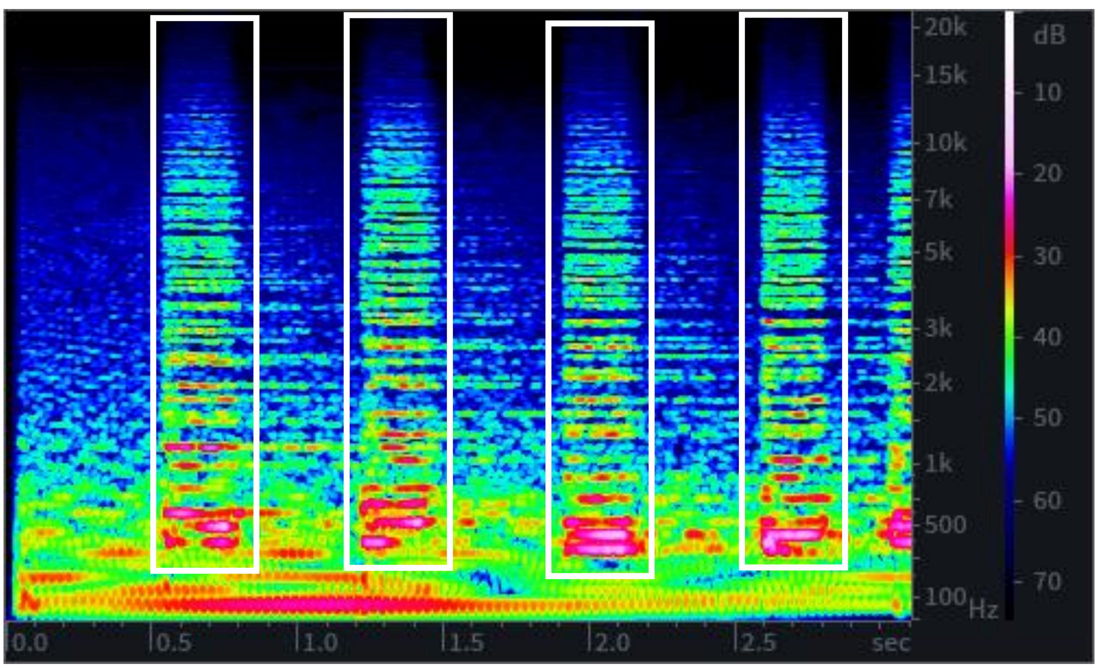


Figure 2.2: Spectrogram of "Jump" -Van Halen, 1983, (0:00-0:03); −74.6 dB lower threshold

Both spectrograms show thick, noisy bands; bright, rich, and noisy partials; and an even sustain across all partials without the curved shape created by the long decay of the acoustic piano. The drums in "24K Magic" are also of an 80s style. Notice how the kick drum, bracketed with a solid line in Figure 5.2, features the gradual decay found in drum-machine sounds. The resulting shapes contained in the spectrogram is similar to the shapes of the drum machines from the 1980s examined in chapter 3.

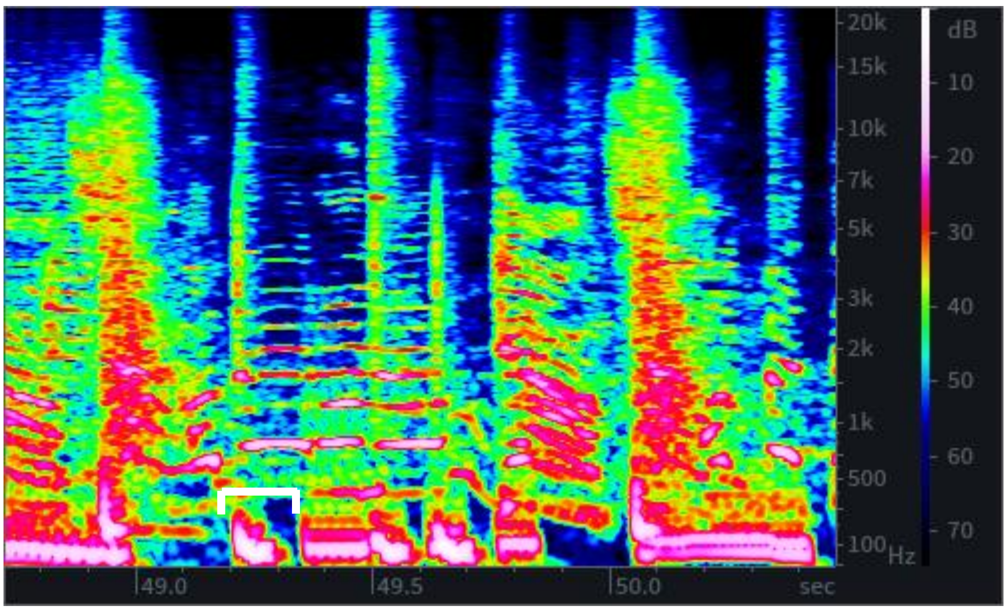


Figure 5.2: Spectrogram of "24K Magic" – Bruno Mars, 2016 (0:48.7-0:50.5) −74.6 dB lower threshold

"Blinding Lights" by The Weeknd was released in 2020 on the album *After Hours*, but the song's soundscape recalls popular music of about 35 years prior. This track is extremely effective in evoking the 1980s. Evidence of widespread recognition of this nostalgia is easy to find. For example, when one types this track's title into Google, the top question listed under the "People also ask" section of the search page reads, "Is

Blinding Lights a remake of an 80s song?"[24] Also, in a podcast episode of *Switched on Pop*, hosts Charlie Harding and Nate Sloan specify the "classic 80's elements" such as "the pulsing drums, the screaming synthesizers…"[25] Harding goes so far as to identify specific tracks of the 80s that he hears as reference, including "Maniac" by Michael Sembello (1983) for the beat and "Take on Me" by A-ha (1985) for the synthesizers. Harding and Sloan further identify this simple beat pattern as a common framework of the decade.

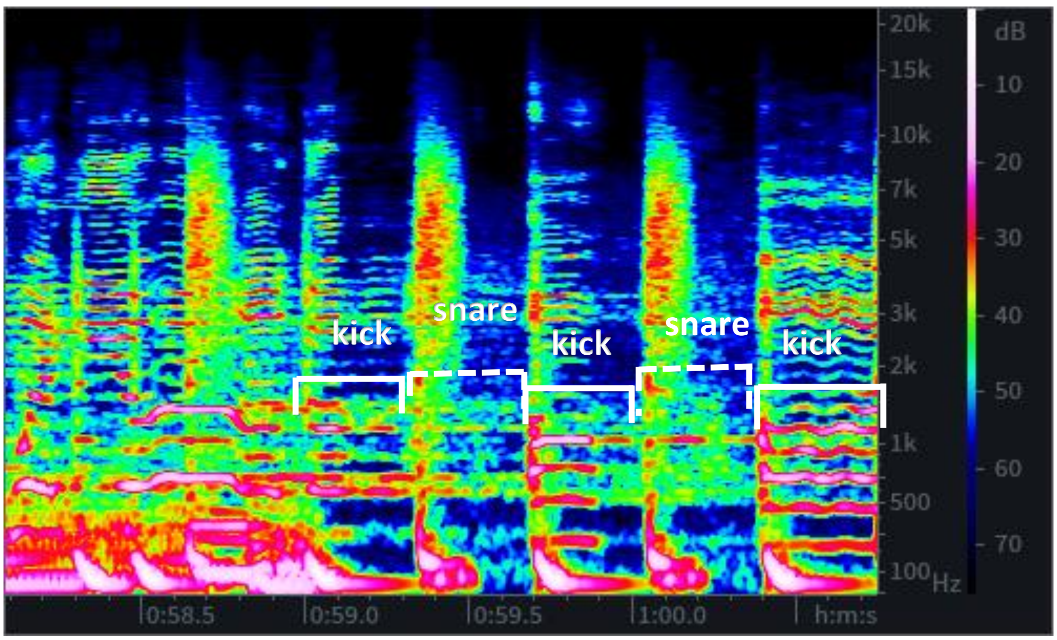


Figure 5.3: Spectrogram of "Blinding Lights" – The Weeknd, 2020, (0:58.0-1:00.5) −76.4 dB lower threshold

24. "Blinding Lights – Google Search," Google, accessed September 26, 2021.

25. Harding, Charlie, and Nate Sloan, "How 'Blinding Lights' used Retro Sounds and Modern Bass to Break Records," *Switched on Pop*, Podcast, February 7, 2021.

Analyzing spectrograms of “Blinding Lights” confirms and brings specificity to Harding and Sloan’s observations through timbral comparison. In Figure 5.3, the kick drums are bracketed with solid lines and the snares are bracketed with dashed lines. Notice the shape of the kick drum after the attack: it has a gradual curve that ends near a point. This is the common drum-machine kick shape that appears in “Jump (For My Love)” reproduced on the left side of Figure 5.4. Another similarity between the drums in “Blinding Lights” and “Jump (For My Love)” can be seen in the snare sounds. As shown in Figure 5.5, the snare hits in both songs feature a similar dip between 500 and 1000 Hz with more energy in the higher partials.

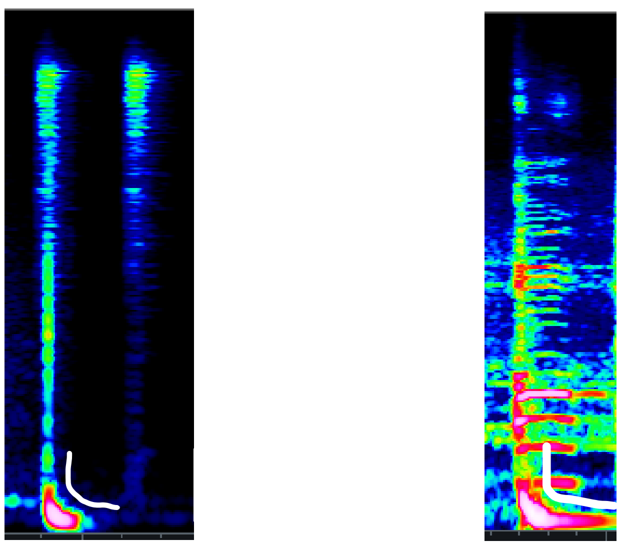


Figure 5.4: Spectrograms of “Jump (For My Love)” and “Blinding Lights” Kick Drums

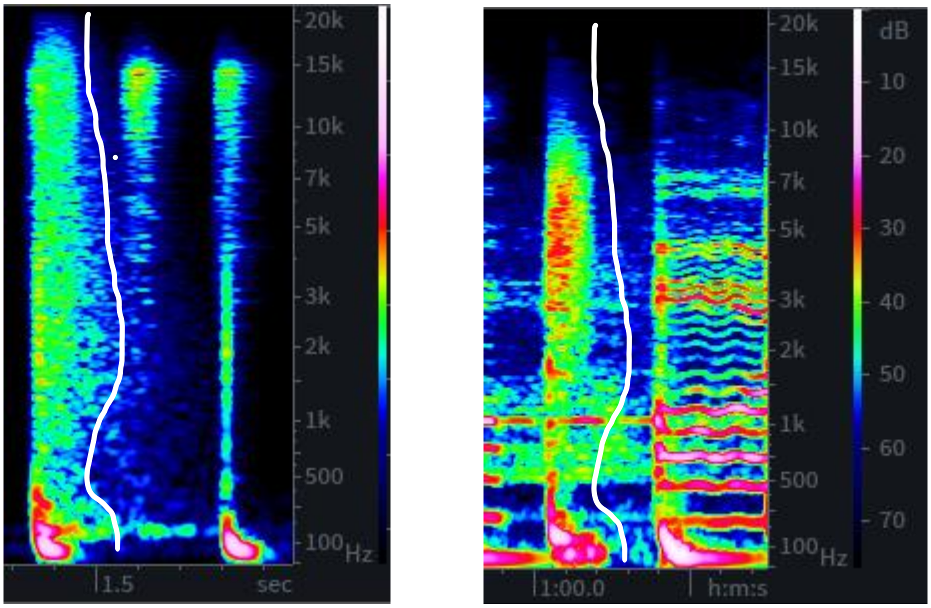


Figure 5.5: Spectrogram of "Jump (For My Love)" and "Blinding Lights" Snare Drums

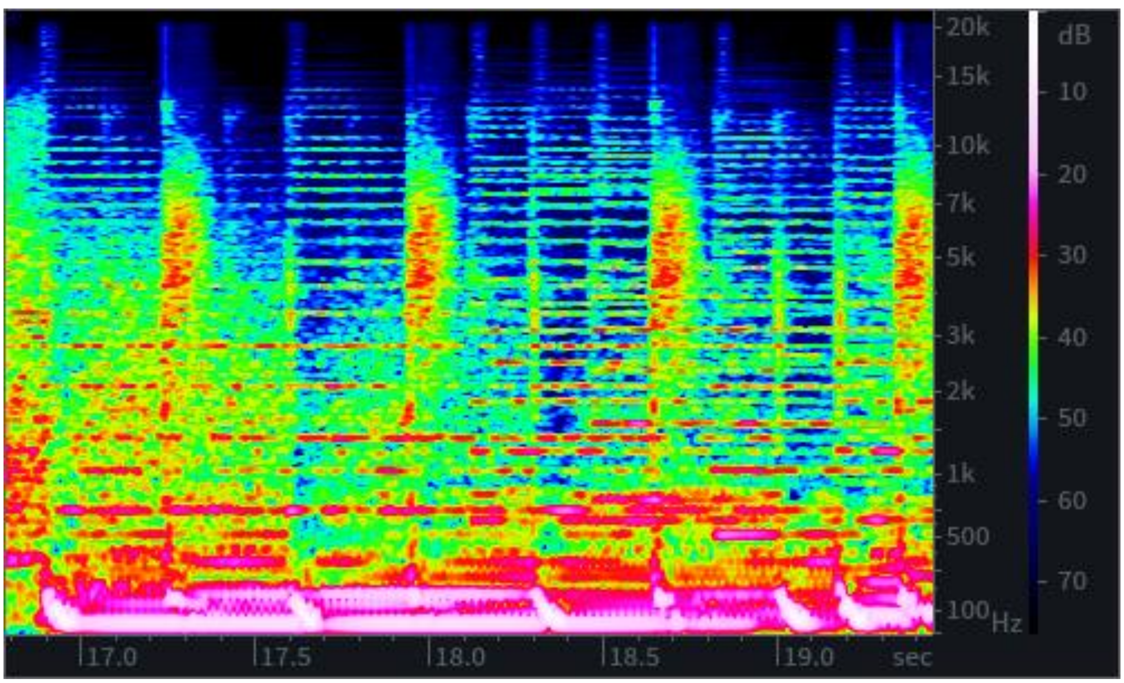


Figure 5.6: Spectrogram of "Blinding Lights" – The Weeknd, 2020, (0:16.8-0:20) −76.4 dB lower threshold

Likewise, the synthesizers that Harding and Sloan identify as 80s in character from the 2020 track are timbrally similar to those previously examined from 1980s tracks. Consider Figure 5.6, which excerpts the opening gesture from the synthesizer in the song's introduction. There are several sound sources in this excerpt, including a chording synthesizer, a lead melodic synthesizer playing single notes rather than chords, and a tremolo bass synthesizer which is reminiscent of the bass from "Jump." While this moment in the track includes the drums and bass along with chording and lead melodic synthesizers, the evidence of the influence of chording synth timbres is still visually perceptible. Note the amount of energy in the partials all the way up into the 10 kHz range, as shown by the amount of green color, especially at the onset of the thicker combined texture around 0:17. There is also the characteristic sustain, creating an extremely short decay in the synthesizer sound, evidenced by the shape of the bands showing the partials. These shapes are linear and consistent in shape throughout the sound event.

Instead of acoustic piano, several artists in the past decade have opted for the brighter, noisier sound of the synthesizer as a core texture sound. Note the spectral similarities of the opening synthesizer from Beyonce's song, "Schoolin' Life," Figure 5.7, to that of "Jump" (Figure 2.2 reproduced previously). The chording synthesizers are marked with white rectangles. The number of upper partials present in both Figures 5.7 and 2.2 extend into the upper limit of 15 to 20 kHz. Many of the upper partials are fairly loud and present in the sound, as shown by the green and yellow tones indicating decibel level. In addition, the steady sustain that is a synthesizer specialty is also present in "Schoolin' Life." The presentation of the chording synthesizer and following percussion fill in isolation are also formally similar to the introductory sections of "Jump," "I Wanna

Dance With Somebody," and "Jump (For My Love)." The sparse introductory textures allow the listener to experience the timbres of various layers in isolation before combining forces for higher energy portions of the songs.

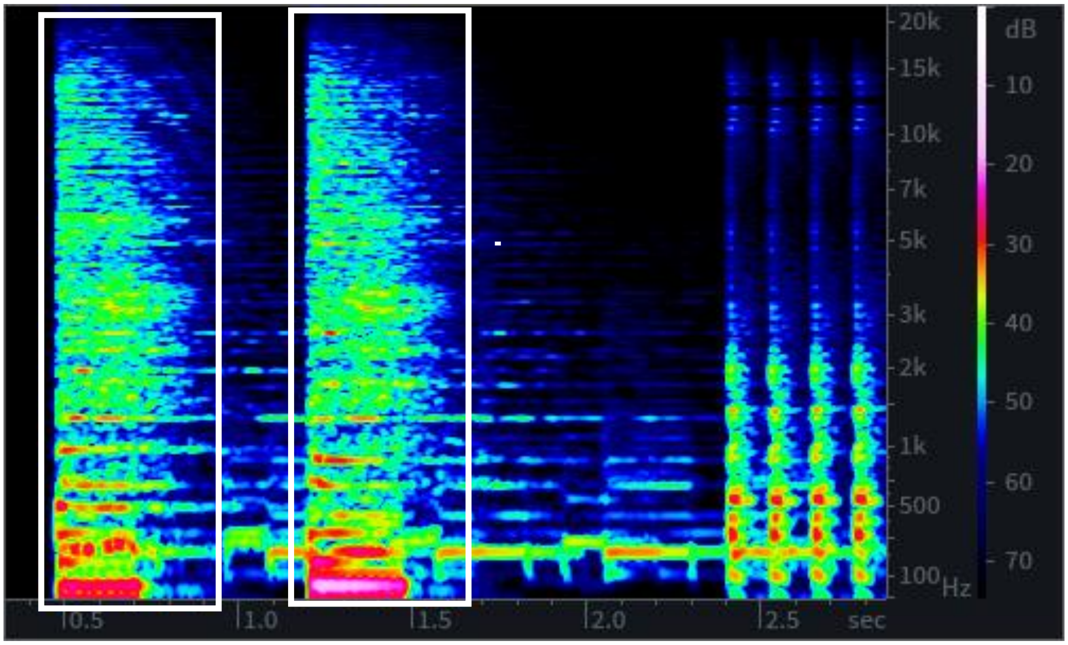


Figure 5.7: Spectrogram of "Schoolin' Life" – Beyonce, 2011, (0:00.3-0:02.8) −74.6 dB lower threshold

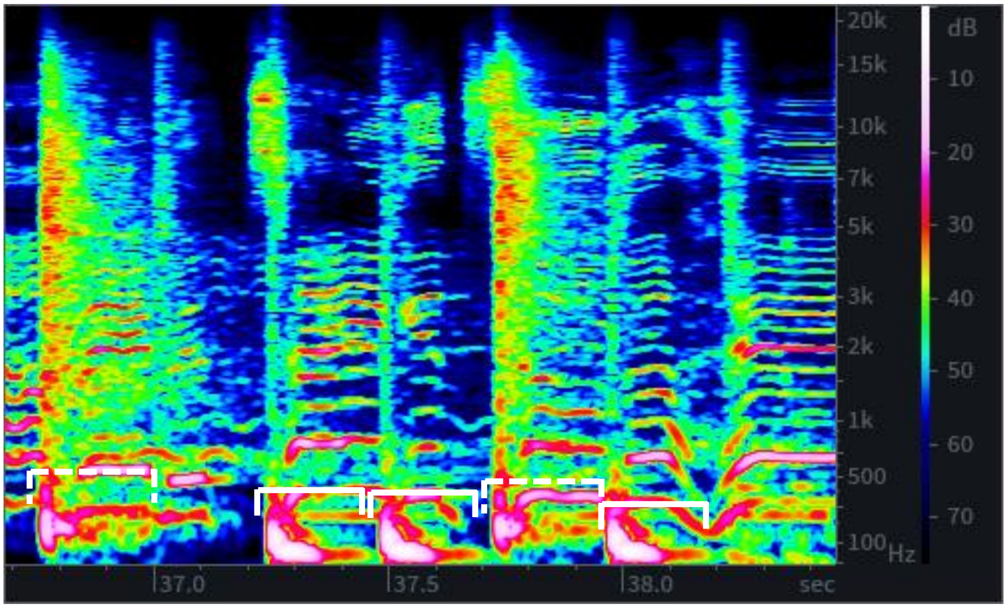


Figure 5.8: Spectrogram of “Schoolin’ Life” – Beyonce, 2011, (0:36.7-0:38.5), −76.4 dB lower threshold

Similar to “Blinding Lights,” “Schoolin’ Life” combines 1980s synth and drum-machine timbres. Looking closer at the drum spectrogram, the same pattern emerges again. Figure 5.8, excerpted from the end of the first verse, shows the regular percussion pattern of kick and snare established in the verse. The lowest kick-drum partials are bracketed with solid lines, and the lowest snare partials are bracketed with dashed lines. Again, the snare exhibits more energy in the upper partials past the 1000 Hz range, and the kick drums have a curved, gradual decay that comes near to a point once it is past the attack.

Beyonce’s “Schoolin’ Life” adds a very subtle third element that completes the trifecta of 1980s timbres highlighted in this thesis. Though it is a background element, there is a simple but effective synthesized guitar wail that accompanies Beyonce’s non-verbal vocals. A clear, separate partial from the guitar synthesizer is circled in Figure 5.9.

Though this pitch bend is subtle, it still cuts through the track texture as an aural event and nods to the wailing guitar of the 80s.

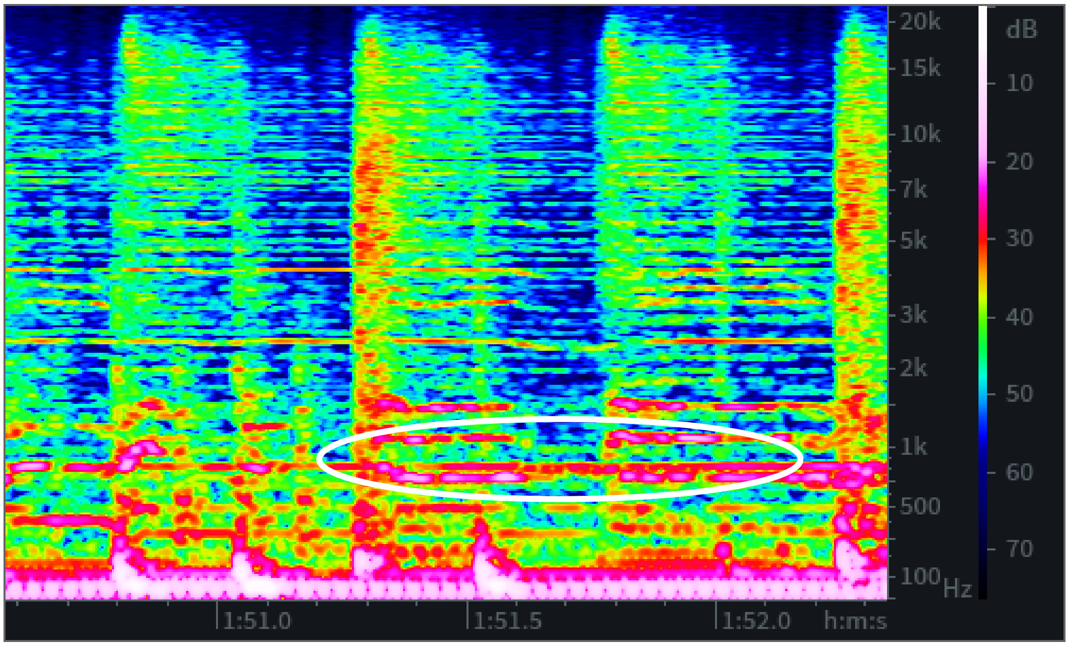


Figure 5.9: Spectrogram of "Schoolin' Life" – Beyonce, 2011, (1:50.5-1:52.5) −76.4 dB lower threshold

Complementing the nostalgic timbral palate of this track, the lyrics hint towards a reason for nostalgia. In the first verse, Beyonce addresses various age groups. Dedicating the song to "them 20-somethings," "30-somethings," "40-somethings," and "50-somethings," in the first verse, she calls on generations whose music is not that of 2011 but of the last 6 to 45 years prior.[26] Therefore, including the nostalgic 80s timbres reinforces the thought that this song is really for those age groups, the 20-somethings to 50-somethings, who identify more with music of the past than that of the present.

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26. Beyoncé. "Schoolin' Life." *4.* Recorded 2010-11. Parkwood/Columbia, 2011, compact disc.

Conclusion

Throughout the course of this thesis, timbral trends have emerged for sounds in specific textural functions. Chording synthesizers in the core texture exhibit trends in the dimension of the spectral centroid. Namely, they are brighter, noisier, and richer than their acoustic analogues. In addition, they do not exhibit the decay of struck strings. Drum machines, also a member of the core texture, are darker and less noisy than their acoustic counterparts and feature unique decay profiles. Drum-machine kick drums have a very curved shape to their decay. Drum-machine snare drums exhibit an irregular dip in their partials. The wailing guitar is a versatile timbre that fits well as a melodic texture. It is a defining feature for some tracks and a part of some bands' overall sonic identity. For others, it is a background element or a feature that adds a little bit of polish to less texturally full areas. Each of these trends have reemerged in recently released tracks. Bruno Mars, The Weeknd, and Beyonce have all released tracks with soundscapes that are remarkably 80s. While elements such as harmony and form may play a role, I submit that the use of sounds with timbral trends from the 80s in their respective textural functions represents the most significant component of the nostalgic effect in these tracks.

This thesis has focused on 1980s popular music, but analysts could apply this methodology to identify timbral trends and create timbre profiles for other decades and genres. For example, Electronic Dance Music producers often develop a signature sound identity, and this process could help analysts understand what timbres play a role in a given artist's sound identity. Future research may also examine a wider range of synthesizers and include sampling techniques to develop a more complete picture of timbre profiles across decades. Behavioral studies could further explore the role of timbre in decade and genre identification and categorical versus specific memory for timbre in song identification. The timbral binaries examined here could also be implemented as descriptors to aid in analysis and discussion in classroom settings. Indeed, these binaries could facilitate a comparative timbral discussion in the aural skills classroom. There may also be a way to assign more definitive values to these timbral descriptors so they could be utilized in contexts beyond binary comparisons. Perhaps future research can develop a more complete picture of the spectrum of timbral possibilities via corpus data. This data may allow us to develop definitive values for the timbral descriptors used in this analysis and free analysts from the confines of comparative analysis.

While spectrograms have proven invaluable in the analyses for this thesis, they are not without their challenges. As previously stated, spectrograms may visually represent information that the ear does not perceive. There is an aural component that is invaluable in interpreting the visual information contained in spectrograms. Spectrograms also tend to capture big-picture information but are not the best way to gather specific details like pitch information and chord voicings. Spectrograms are also not as common as other forms of notation or transcription in music theory but, much like timbres of the 1980s, are experiencing a recent resurgence. Because they are less common, we do not have dissimilarity ratings for how spectrograms of other genres or decades compare to each other yet. Gathering the timbral trends from additional groupings such as decades or genres is another path for future research.

This thesis began as an entirely selfish endeavor; I set out on this research path purely to feed my own curiosity. Nevertheless, I hope it contributes more than a possible answer to my own questions. The methodology I have employed is fairly accessible. It does not require access to more than a laptop, uncompressed audio files, and a computer program to generate spectrograms. Even analysts who do not follow the technical methodology presented here can use these models to inform aural analysis and incorporate close timbral reading in their musical analyses. In addition to the results reported in this document, my hope is that this methodology may at least serve as a launching point for more timbral analysis. Timbre is a fascinating and under-studied dimension of music. The fact that it is challenging should not deter anyone from attempts to describe or analyze it.

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