A Musicological Approach to the Analysis of Timbre

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▶ Background

Music theory is a field that focuses on developing methodologies for close analysis of specific pieces of music. Traditionally, analysis of this sort is done with a printed musical score; therefore, methodologies have tended to favor musical domains captured in that medium, like rhythm, pitch, and structure. Timbre is only an abstract idea in the musical score, and thus, timbre has historically been neglected in music theory. Yet timbre is one of the most immediate aspects of our musical experience, so many present-day music theorists have become interested in timbre.

In music theory, two distinct approaches to timbre analysis exist, with complementary strengths and limitations. First, music theorists from the 1980s adopt a positivist mindset and look for ways to quantify timbral phenomena, often using spectrograms, avoiding any cultural dimensions of their work (e.g., Cogan 1984). Second, writings of the past five years focus on the cultural aspects of timbre but make no use of spectrograms (e.g., Heidemann 2016).

▶ Methodology

The methodology presented here synthesizes the above approaches by situating spectrogram analysis within a broad cultural context, taking direct account of listener experience, i.e., "perceptualization" (Fales 2002), through the notions of markedness (Hatten 1994). I establish a vocabulary for timbre analysis, which relies on a system of binary oppositions (e.g., percussive/soft, rich/sparse, etc.) that are defined partly via spectrogram analysis.

The binaries are further defined as either marked (+) or unmarked (–). In a linguistic oppositional pair, the terms are semiotically asymmetrical; a marked term carries additional and more specific conceptual information than its unmarked term. The unmarked term within each opposition is normative within a given musical context. The marked term is non-typical. A common example: in the pair *man*/*woman*, the unmarked term is *woman.*

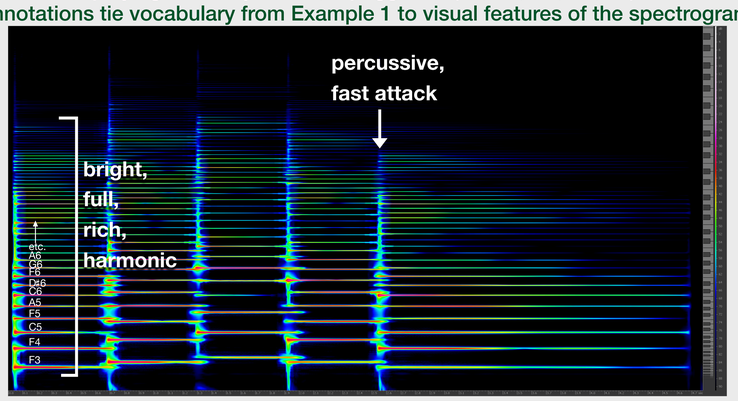
To interpret the data gathered through spectrogram analysis, in Analyses I and II, timbre analysis is connected with textural function, narrative, and ethnography to interpret the acoustic data of spectrograms.

▶ The Yamaha DX7 synthesizer and 1980s popular music

Example 1. An incomplete list of acoustical attributes of timbre observable in spectrograms, in unmarked/marked oppositional pairings.

TERM (–/+)	SPECTROGRAM FEATURE
bright/dark	distance from lowest to highest partial (wide/narrow)
full/hollow	correspondence to overtone series (complete/incomplete)
rich/sparse	number of partials (many/few) or amount of noise present (more/less)
beatless/beating	no pulsing/pulsing in amplitude
harmonic/inharmonic	whole-number/fractional ratios between fundamental and partial
steady/wavering	straight/wavy fundamental line
percussive/soft	attack uses either a diffuse band/compact strand
fast attack/slow attack	length of time to increase from silence to peak loudness

Example 2. Spectrogram of the Yamaha DX7 CLAV 1 sound, playing an F major triad, arpeggiated (F3, A3, C4, A3, F3). Annotations tie vocabulary from Example 1 to visual features of the spectrogram.



I focus on the Yamaha DX7 synthesizer and its factory preset sounds. The DX7 was an immensely popular and revolutionary synthesizer. The DX7 implements frequency modulation (FM) synthesis, a kind of digital synthesis which was still quite new when the DX7 debuted at an expo in Summer 1983. This new method of sound synthesis could create an astounding array of sounds, greatly exceeding the number of possible sounds of older synthesizers. Crucially, however, most listeners, performers, and producers came to know the DX7 through only a small number of the possible sounds: the factory preset sounds programmed into the DX7's memory by Yamaha's programmers. The presets became extremely prevalent in popular music of the 1980s.

▶ Selected Bibliography

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Analysis I
Norms of Instrumentation and Timbre in 1980s Pop

Example 3. Tracks consulted in this study.

ARTIST	TITLE	PEAK CHART POSITION (BILLBOARD HOT 100 / UK OFFICIAL CHARTS CO.)
Tina Turner	"What's Love Got to Do with It?"	#1, Sept 1984 / #3, June 1984
Howard Jones	"What Is Love?"	#33, June 1984 / #2, Nov 1983
Level 42	"Running in the Family"	#83, Aug 1987 / #6, Feb 1987
Janet Jackson	"When I Think of You"	#1, Oct 1986 / #10, Aug 1986
Madonna	"Live to Tell"	#1, June 1986 / #2, Apr 1986
Gloria Estefan	"Rhythm is Gonna Get You"	#1, Mar 1988 / #15, Dec 1988
Band Aid	"Do They Know It's Christmas?"	#13, Dec 1984 / #1, Dec 1984
Beastie Boys	"Girls"	n/a (from *License to Ill*, 1986)

After analyzing instrumentation across several hit 1980s singles, I categorize sounds used in a given track into three groups, or **instrumentational categories:**

▶ **core sounds**, which articulate structural aspects of pitch and rhythm of the song;
▶ **melody sounds**, which are the voice and any instrument replacing the voice;
▶ **novelty sounds**, used primarily for coloristic effects.

The results of this process suggest that within mainstream 1980s pop, certain Yamaha DX7 presets were consistently paired with a specific instrumentational category (Example 4). Furthermore, **a correlation arises between the timbral characteristics of these presets and their instrumentational category**: the core and melody DX7 presets share mainly unmarked timbral properties, weaving into the groove's fabric, rather than demanding attention. Novelty timbres are intrinsically difficult to generalize, but tend to feature marked timbral characteristics more.

Example 4a. Opposition table for core sounds.

- / + OPPOSITION	E. PIANO 1	BASS 1
Spectral components - sustain		
bright / dark	–	–
pure / noisy	–	–
full / hollow	+	–
rich / sparse	+	–
beatless / beating	+	–
steady / wavering	–	–
harmonic / inharmonic	–	–
Spectral components - attack		
percussive / soft	–	–
bright / dark	–	–
Pitch components		
low / high	∅	–
steady / wavering	–	–

Example 4b. Opposition table for melody sounds.

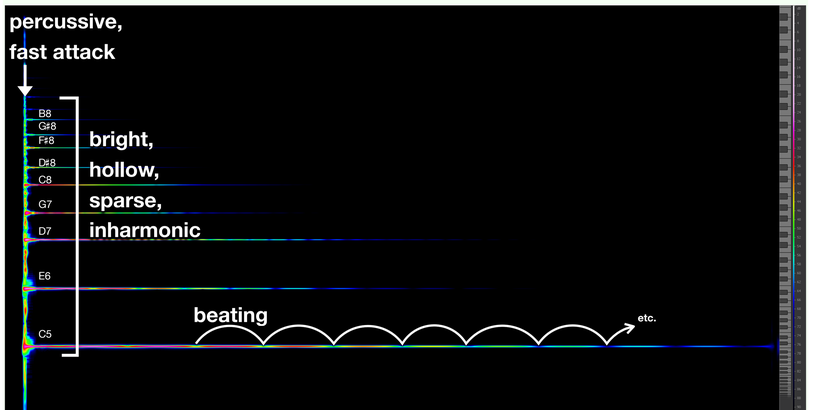
VOICE	BRASS 2	HARMONICA	CLAV 1
+	–	+	–
–	–	–	–
–	–	+	–
±	–	–	–
–	–	–	–
+	+	+	–
–	–	–	–
+	+	+	–
∅	+	∅	–
+	∅	∅	∅
+	+	–	–

Example 4c. Opposition table for novelty sounds.

- / + OPPOSITION	TUB BELLS	FLUTE 1	CALLIOPE	VIBES	MARIMBA	COWBELL
Spectral components - sustain						
bright / dark	–	+	+	–	–	+
pure / noisy	–	+	+	–	–	–
full / hollow	+	–	+	+	+	+
rich / sparse	+	+	+	+	+	+
beatless / beating	+	–	–	–	–	–
steady / wavering	–	–	–	–	+	–
harmonic / inharmonic	+	+	+	–	+	+
Spectral components - attack						
percussive / soft	–	+	+	–	–	–
bright / dark	–	∅	∅	+	+	–
Pitch components						
low / high	∅	∅	∅	+	∅	∅
steady / wavering	–	–	–	–	±	–

Instances of **subversion of timbral norms** enables the analyst to locate musical meaning created through the manipulation of timbres. An example of this may be found in the closing cumulative chorus of "Do They Know It's Christmas?" by Band Aid (1984), wherein the novelty sound TUB[ULAR] BELLS becomes a melody sound. Though TUB BELLS is typically too marked to function as a melody sound, this chorus's communal mantra works especially well with a synthesis of two opposed textural functions.

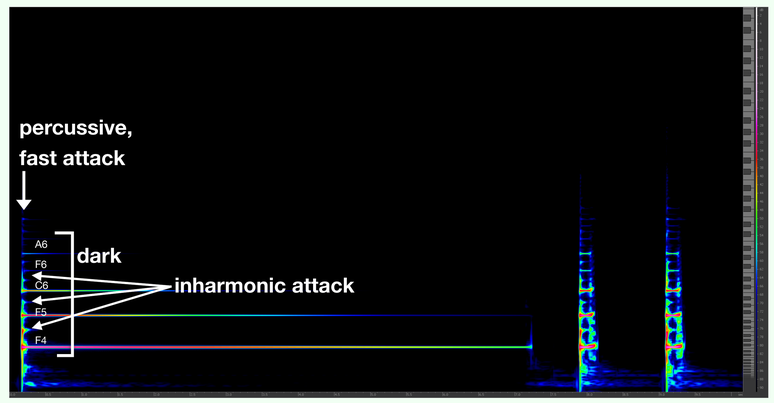
Example 5. Spectrogram of the Yamaha DX7 TUB BELLS sound playing a C5.



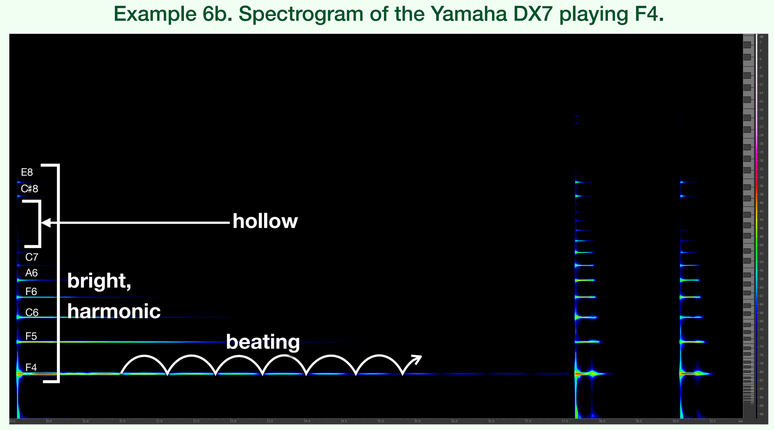
Analysis II
"What Makes it Sound '80s?": E. PIANO 1

Popular music of the 1980s is remembered today as having a 'sound' that is somehow unified and generalizable. **The '80s sound is tied to the electric piano preset of the Yamaha DX7 synthesizer.** Not only was this preset (E. PIANO 1) astonishingly prevalent—heard in up to 61% of #1 hits on the pop, country, and R&B Billboard charts in 1986—but the timbre of E. PIANO 1 also encapsulates two crucial aspects of a distinctly '80s sound in microcosm: one, technological associations with digital FM synthesis and the Yamaha DX7 as a groundbreaking '80s synthesizer; and two, cultural positioning in a greater lineage of popular music history. Ultimately, I argue that this web of connections created by the use and re-use of DX7 presets like E. PIANO 1 among hundreds or maybe thousands of different tracks, across genres, is what allows modern listeners to abstract a unified notion of the ''80s sound' from a diverse and eclectic repertoire of songs produced in the 1980s.

Example 6a. Spectrogram of the Fender Rhodes playing F4.



Example 6b. Spectrogram of the Yamaha DX7 playing F4.



In terms of acoustics, E. PIANO 1 is distinct from older electric pianos like the Fender Rhodes through the timbral characteristics of hollowness and a wider range of partials. These two characteristics add a new, '80s sheen to the E. PIANO 1 sound, which might be described colloquially as "bright." The brightness of E. PIANO 1, and the DX7 more generally, sets both of these things apart from synthesizers and electric instruments of the '60s and '70s, whose defining timbral characteristic, by comparison, is warmth. Timbrally, the characteristics of brightness and clarity are the signature of a digital sound.

This is further supported by statements made by musicians, in the 1980s and today, that describe the E. PIANO 1 sound and the DX7 in general. Consider the following quotations, collected from contemporary rock criticism magazines.

▶ **Pervasiveness of E. PIANO 1**

- "Anyone remember … the amazing expressiveness of the Rhodes patch that was subsequently so overused that today it makes us cringe?" —*Keyboard* editors, July 2003
- "No [I never use a real Rhodes sound], I just go direct into the board with a Rhodes synth sound. With all the companies having Rhodes patches, it's easier to use the variations." —Timmy "Jimmy Jam" Harris, May 1987

▶ **Brightness and clarity as characteristic of the DX7 or FM in general**

- "When FM synths came on the scene in the mid '80s, their bright, digital sound stood in stark contrast to their analog ancestors. Analog recording still reigned, and the DX7's clarity was a fine complement to the warmth of analog tape." —Craig Anderton, July 2003
- "Anyone remember feeling goosebumps at the startling clarity of the sleek little DX7's factory vibe patch?" —*Keyboard* editors, July 2003
- "That instrument gave the music a harder, more 'digital' feel and that, combined with the final mixdown to digital master, produced a harsh-sounding record. It's not unpleasant to listen to, it just has a bright and hard quality." —Ian Boddy, December 1986
- "[The DX7] has a number of very clear and very good digital sounds." —Nick Rhodes, February 1986
- "Clear, chiming sounds are most typical of the FM synth…" —Tony Mills, April 1985