Berkeley
UNIVERSITY OF CALIFORNIA

CNMAT

CARMINE-EMANUELE CELLA

A GUIDE TO MUSICAL TIMBRE

MUSIC 159

INSTRUMENTAL TIMBRE

WHAT IS TIMBRE?

- Sound “colour” / quality (Wessel 1979)
- A set of acoustic attributes
  - Static and dynamic
- Multidimensional
  - bright/dark,
  - fast/slow
  - etc.
- Vehicle for sound identification & source tracking (McAdams 1993)
- Serves as a sequential grouping cue

David Wessel created CNMAT!

SPECTRUM: A TOOL TO REPRESENT TIMBRE

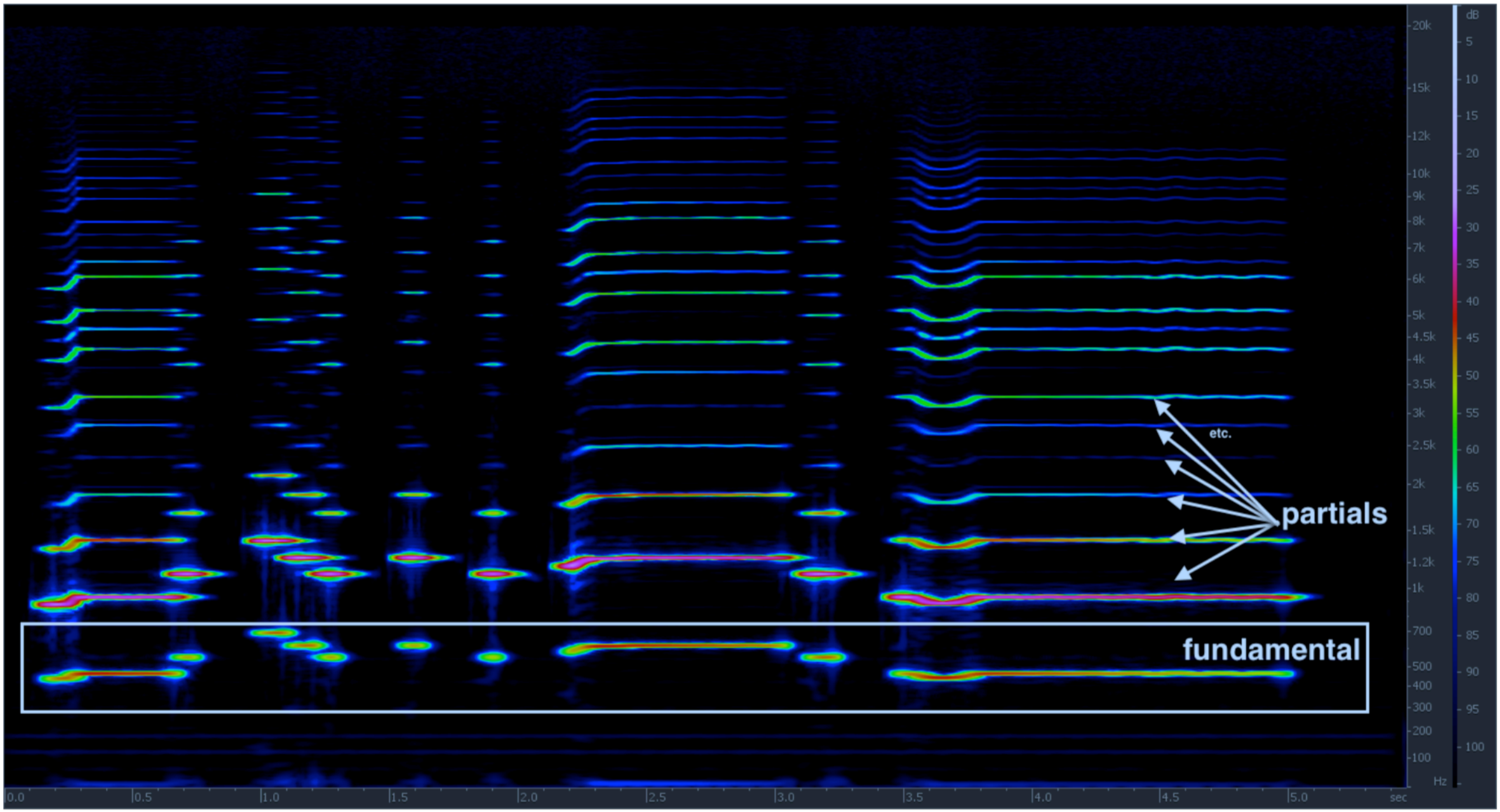


Image by Megan L. Lavengood

BRIGHT VS DARK

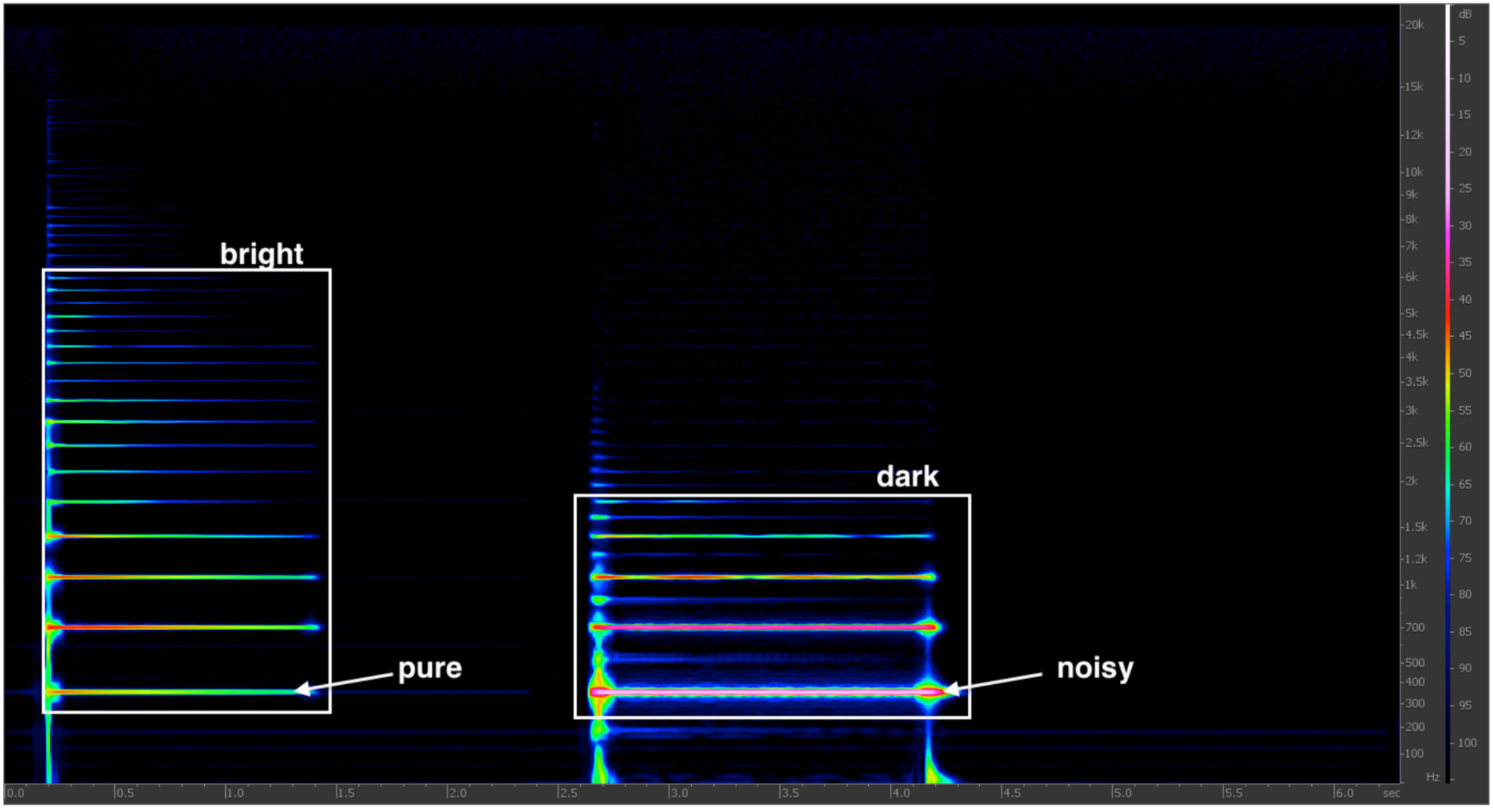


Image by Megan L. Lavengood

HARMONIC VS INHARMONIC

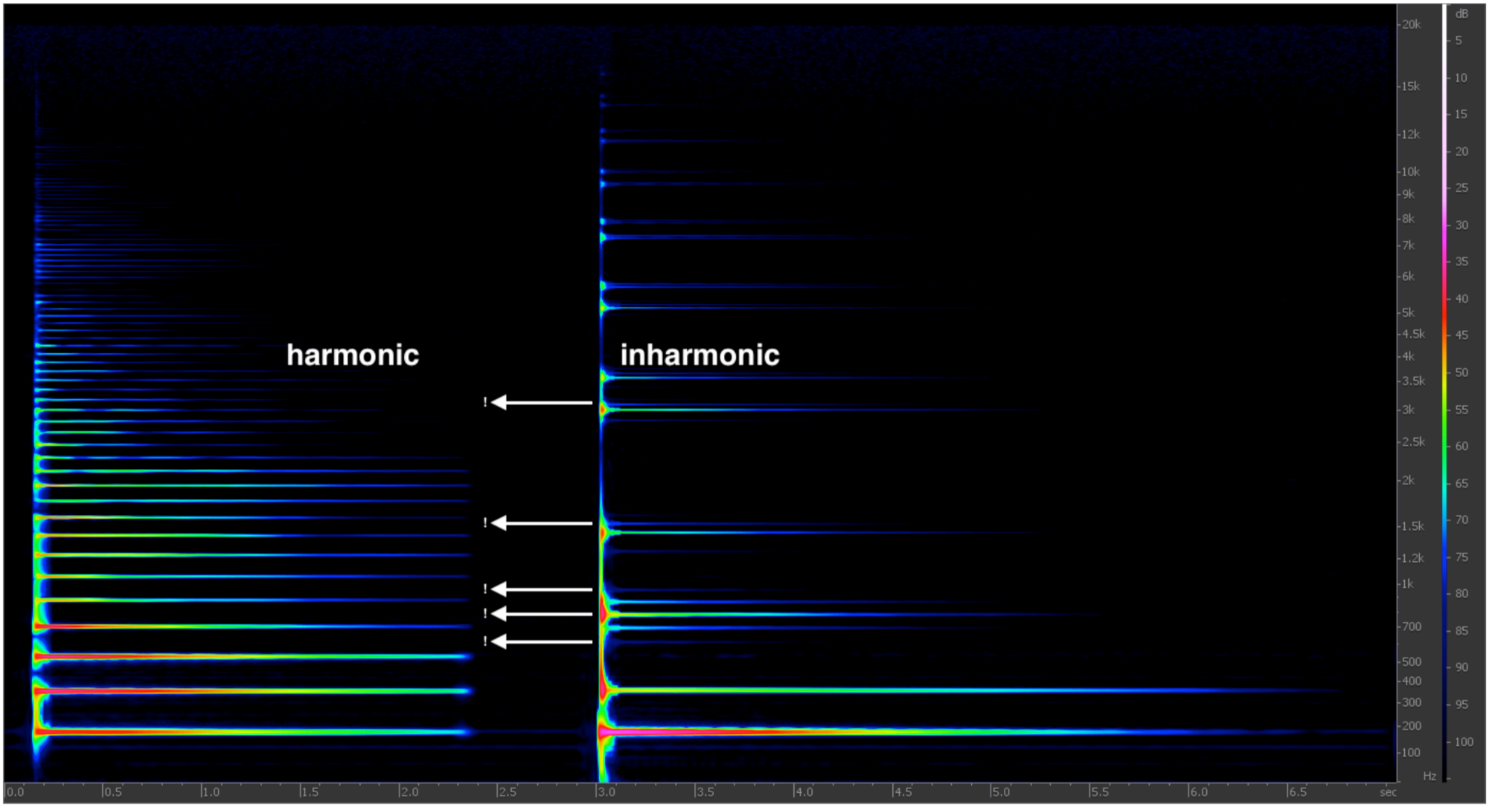
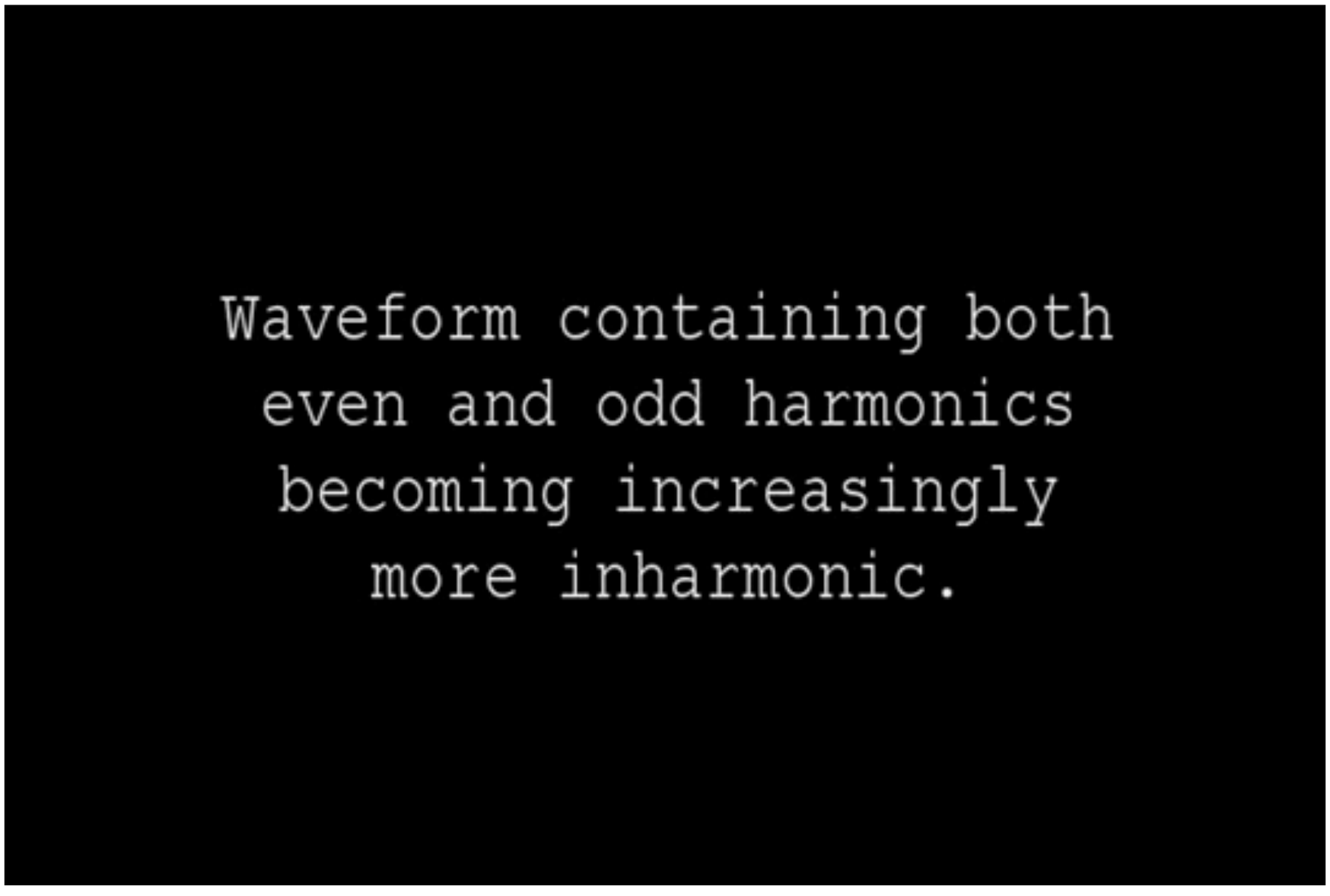


Image by Megan L. Lavengood

HARMONIC VS INHARMONIC – TRANSFORMATION



Video by Nick Oakman

RICH VS SPARSE

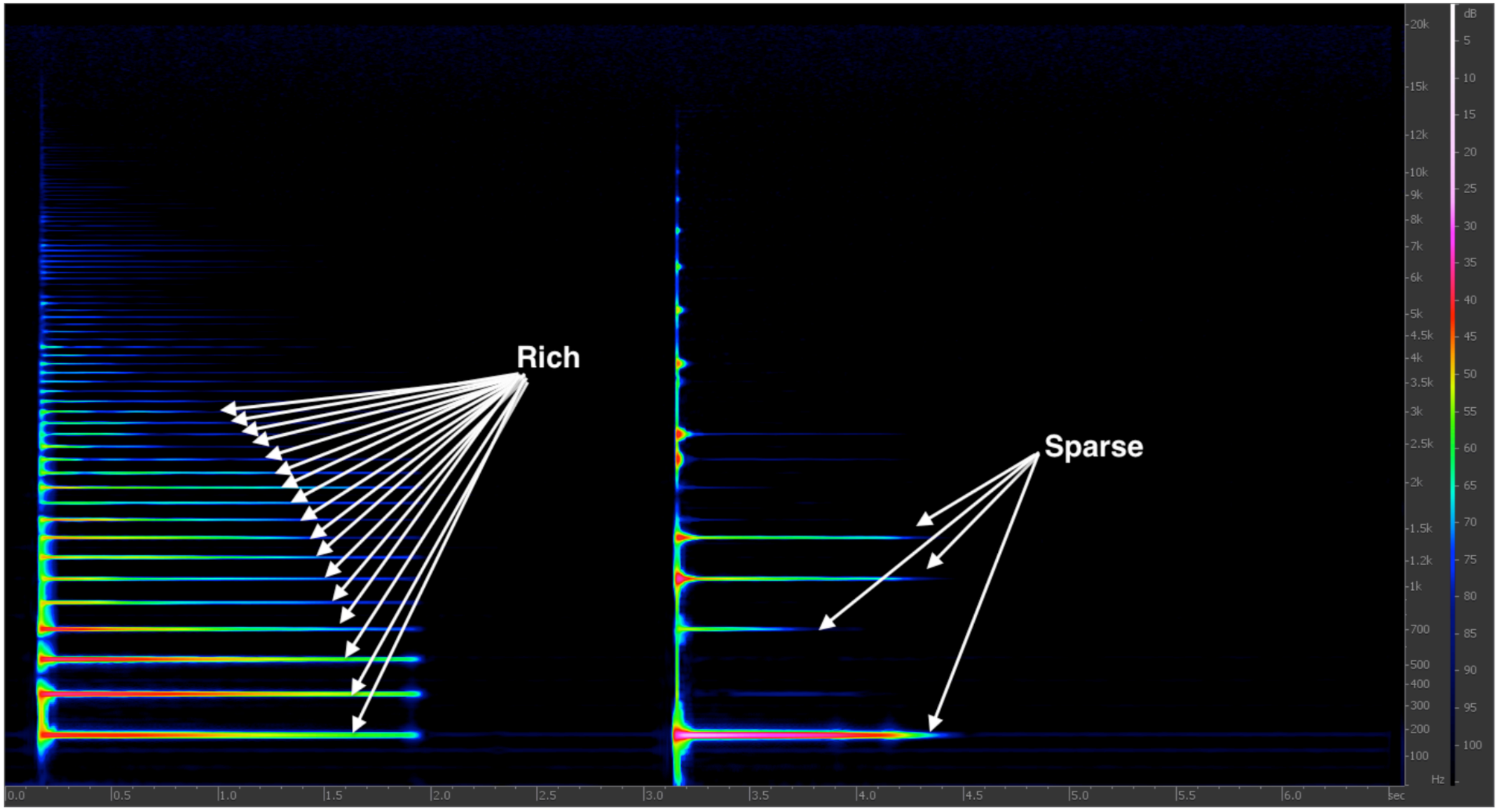


Image by Megan L. Lavengood

TRANSIENTS

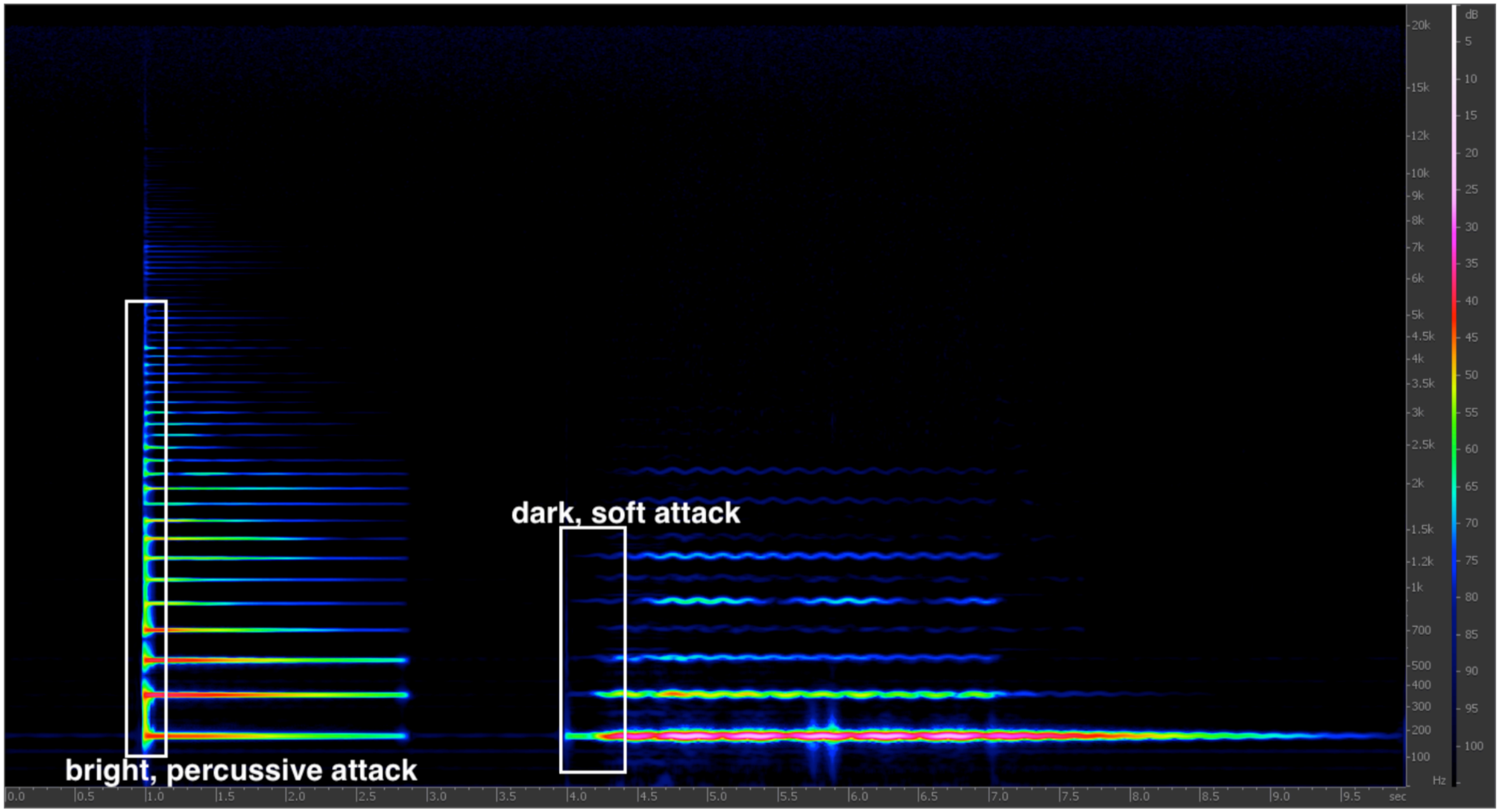
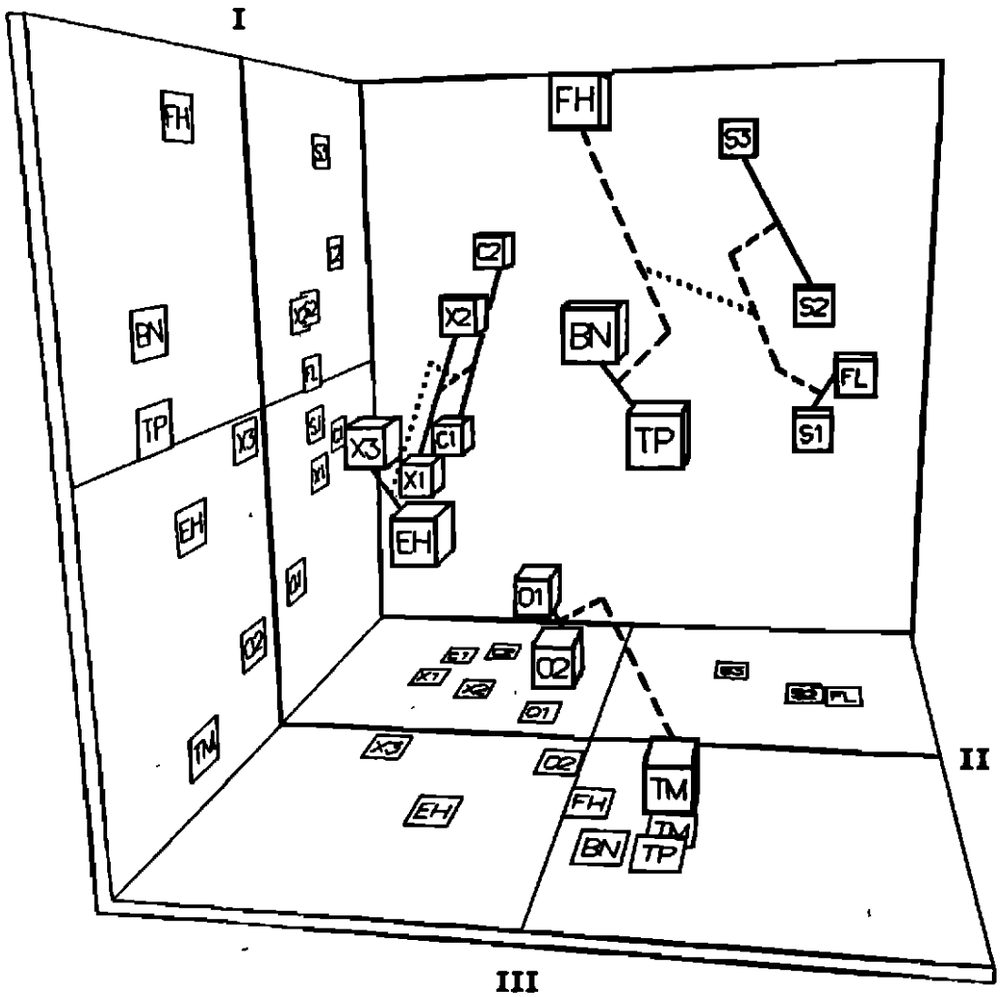
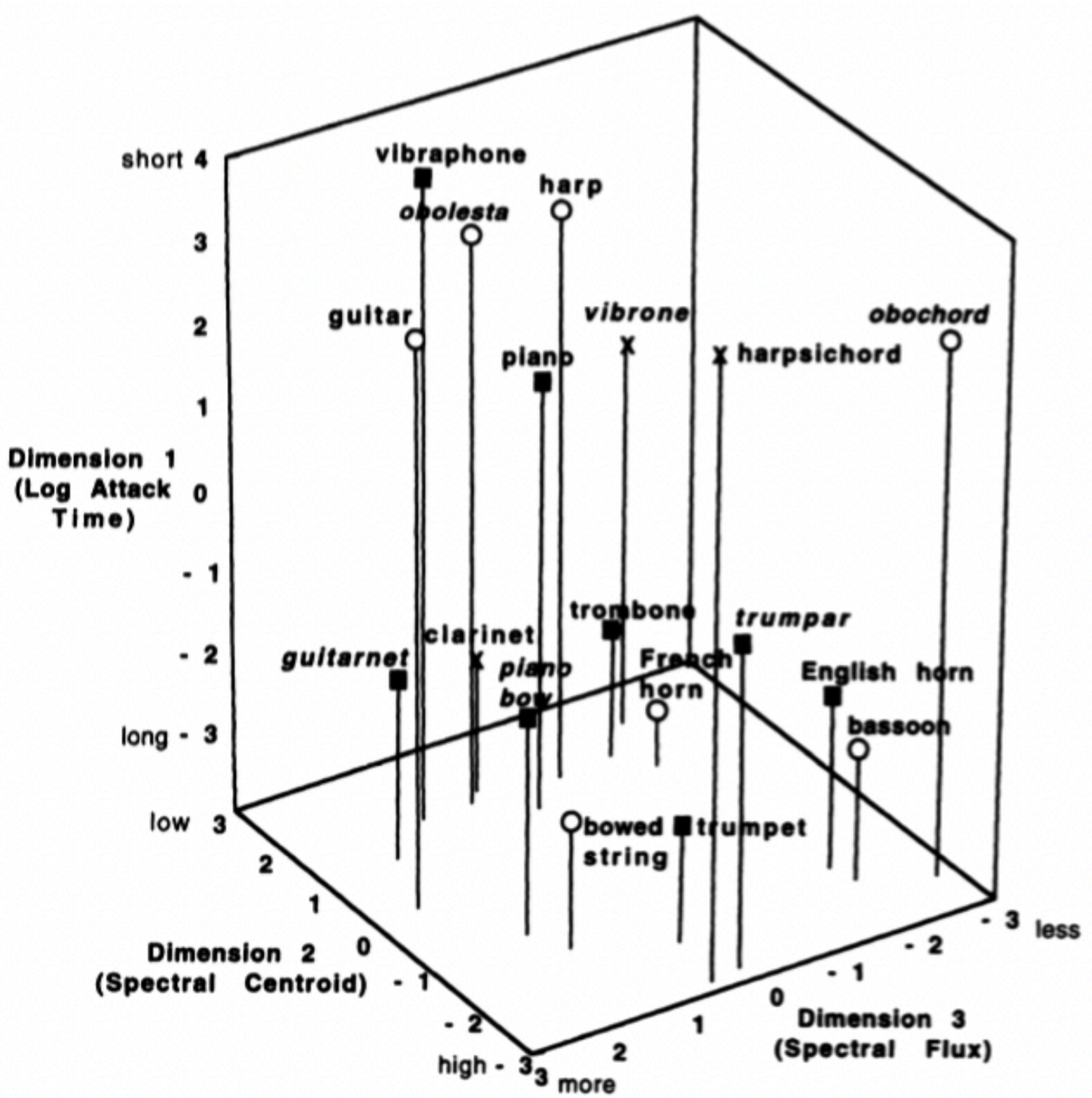


Image by Megan L. Lavengood

FEATURES AS DESCRIPTION OF TIMBRE



Grey, 1977



McAdams, 1999

FEATURES TODAY

tSNE dimensionality reduction on MFCC for the SOL database

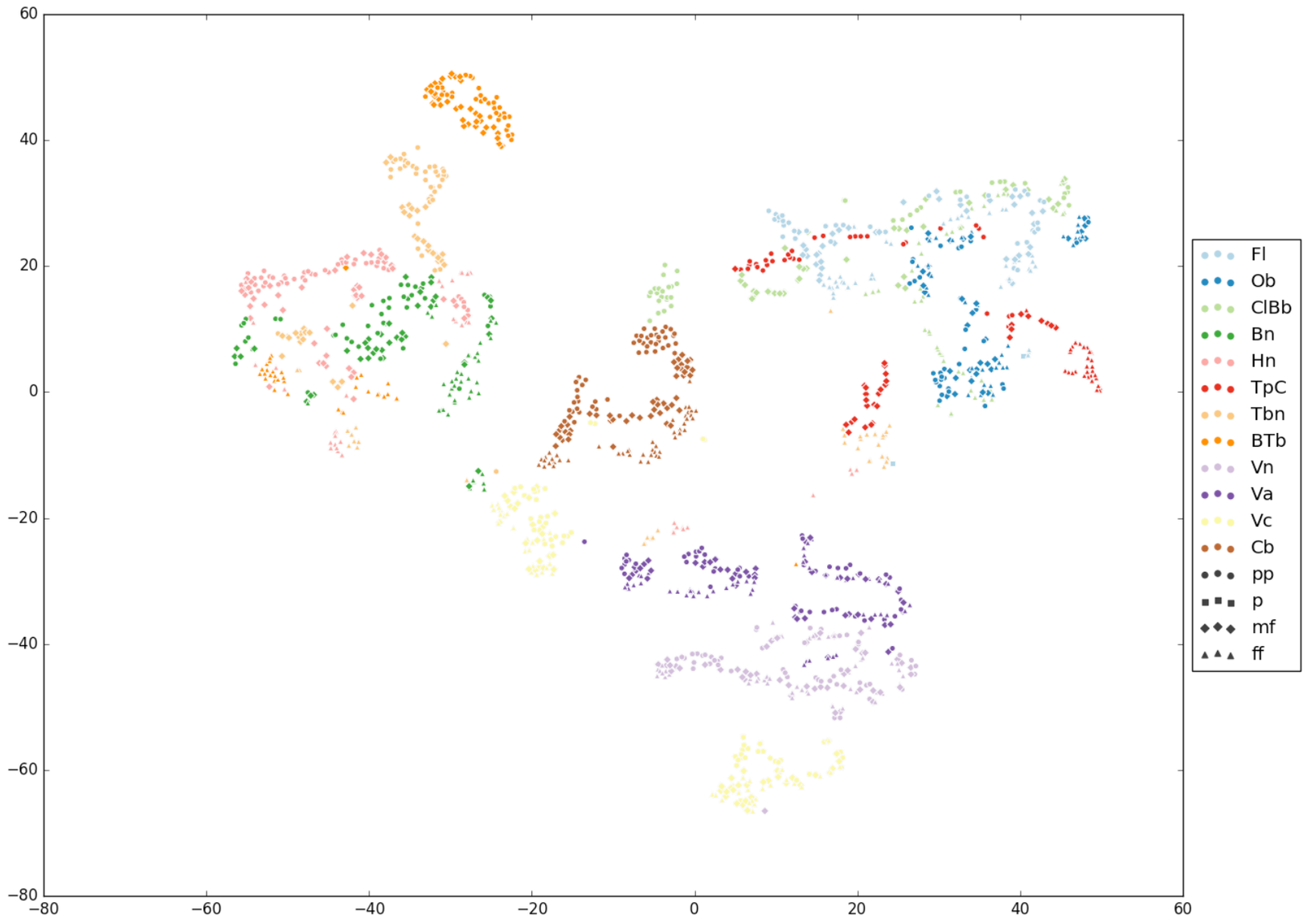
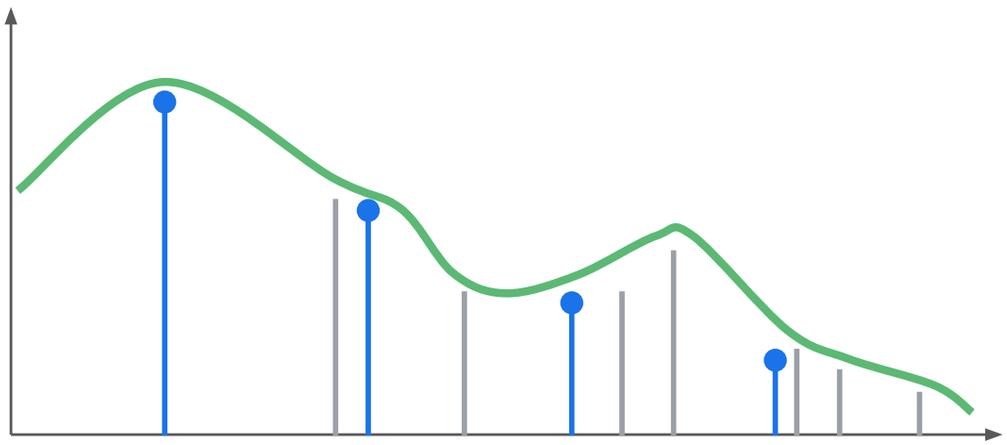


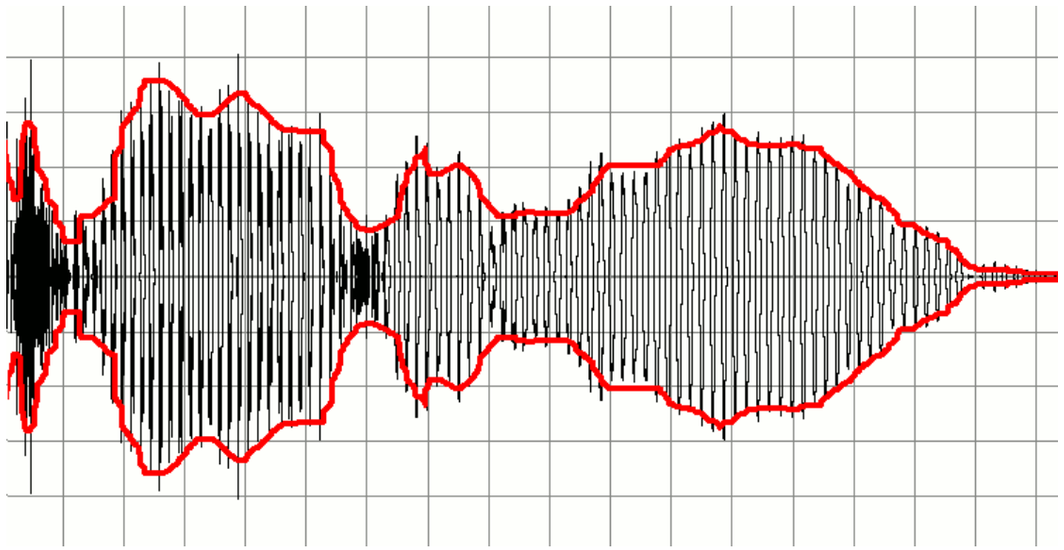
Image by Daniele Ghisi

ENVELOPE: ANOTHER IMPORTANT CUE FOR TIMBRE

Spectral envelope



Amplitude envelope

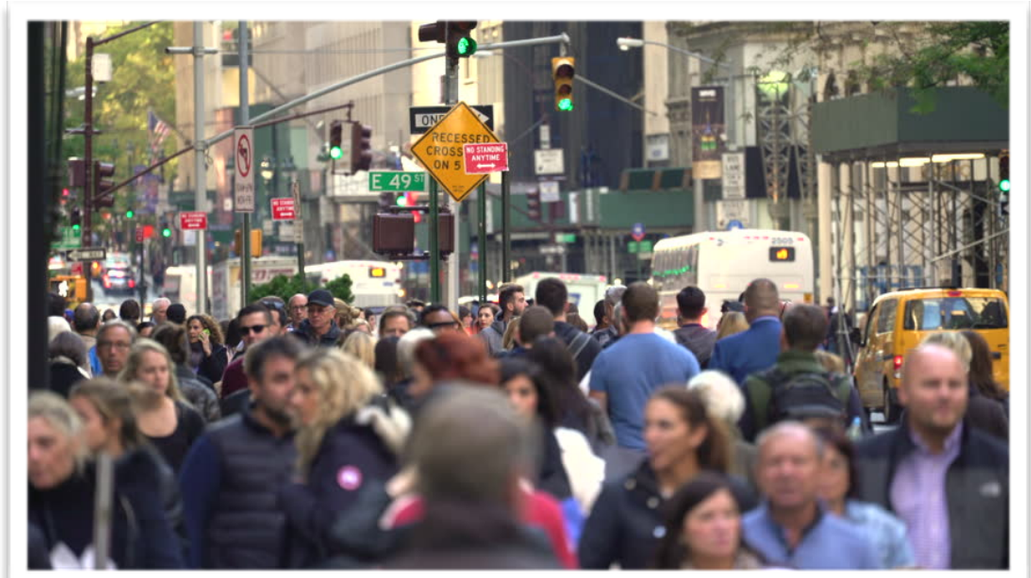


AUDITORY SCENE ANALYSIS

(Albert Bregman 1994)

The process by which the auditory system extracts meaning from the acoustic environment

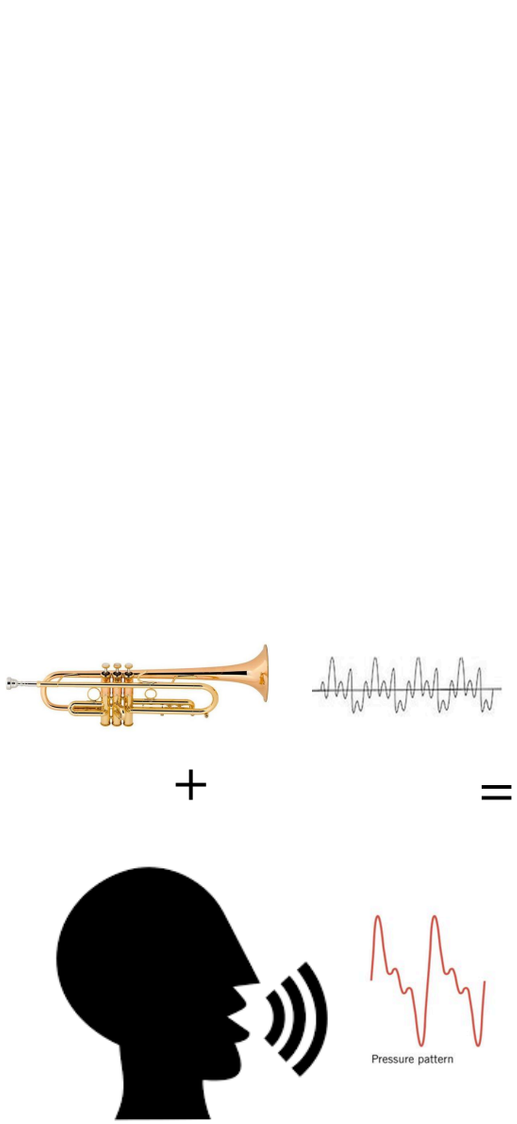
Organizes the incoming sound mixture into separate ‘streams’

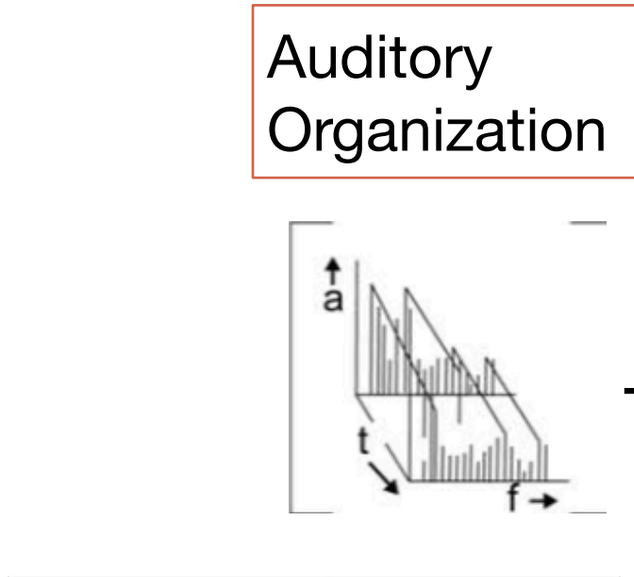


Credits: M. Fischer, K. Soden, M. Goodchild, S. McAdams

AUDITORY STREAM ANALYSIS

Grouping occurs before perception





Auditory Organization

→ Mental representation

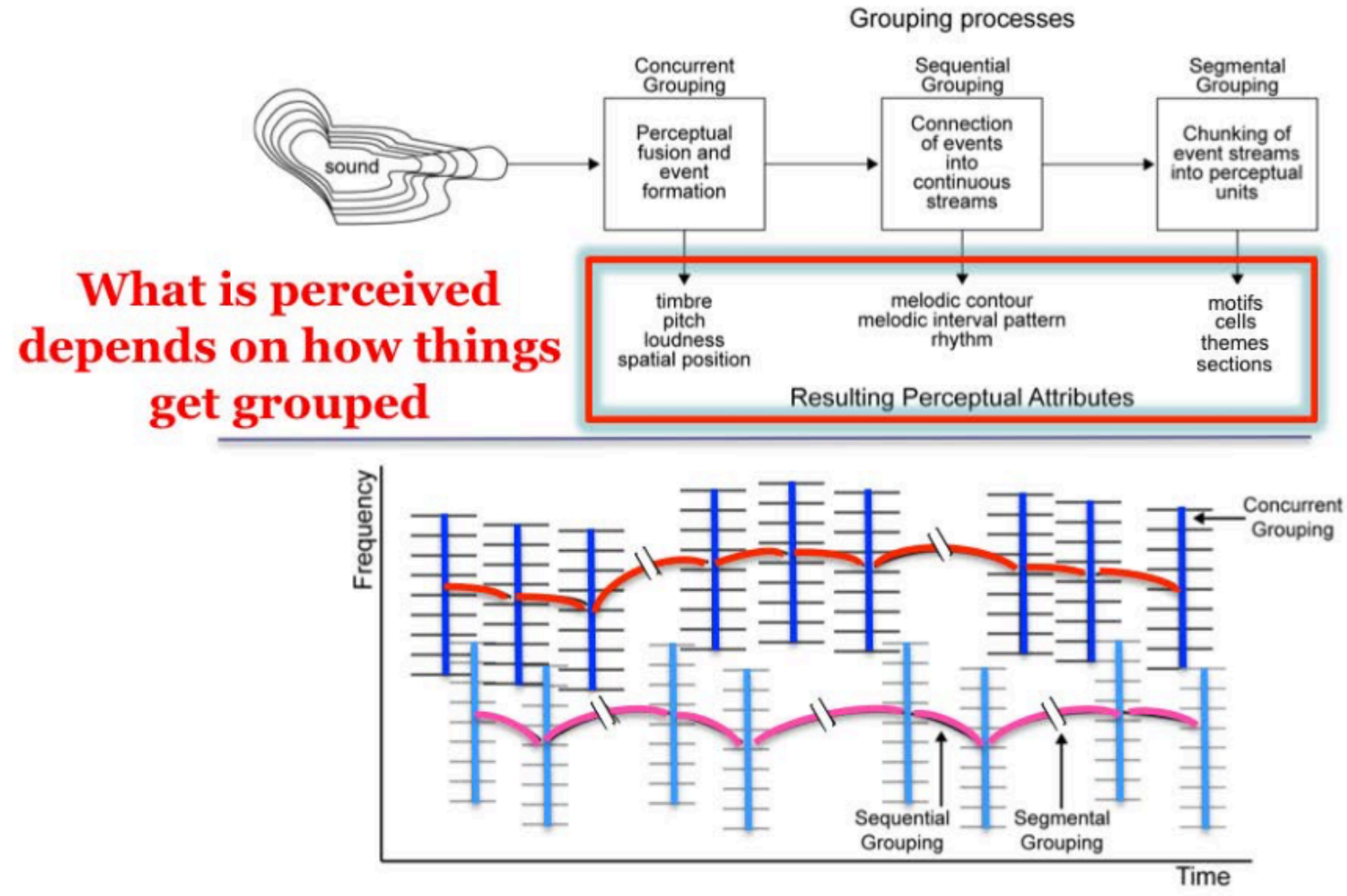
Perception

Credits: M. Fischer, K. Soden, M. Goodchild, S. McAdams

AUDITORY ORGANISATION

Three types of auditory organization:

- Concurrent
- **Sequential***
- Segmental



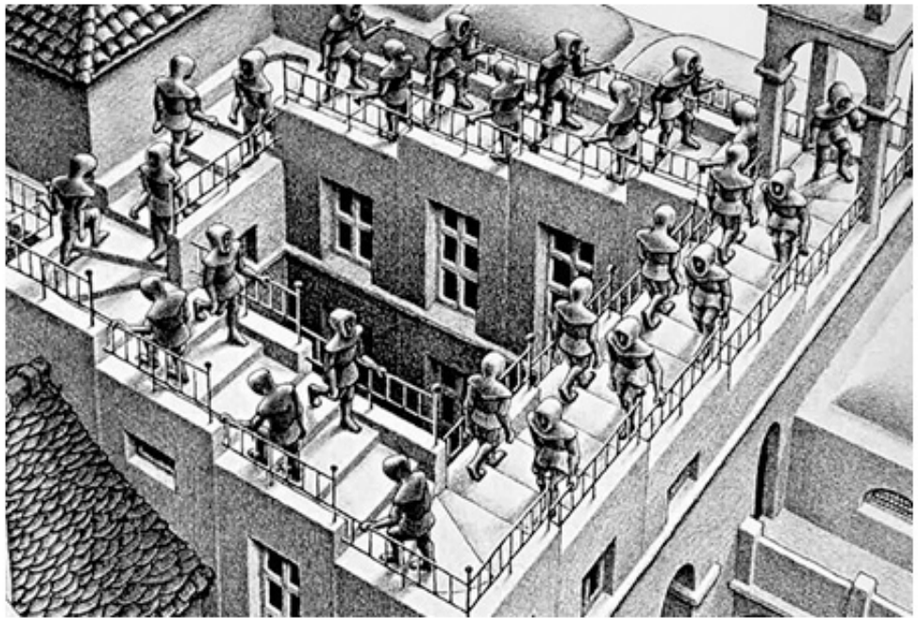
Credits: M. Fischer, K. Soden, M. Goodchild, S. McAdams

SEQUENTIAL GROUPING

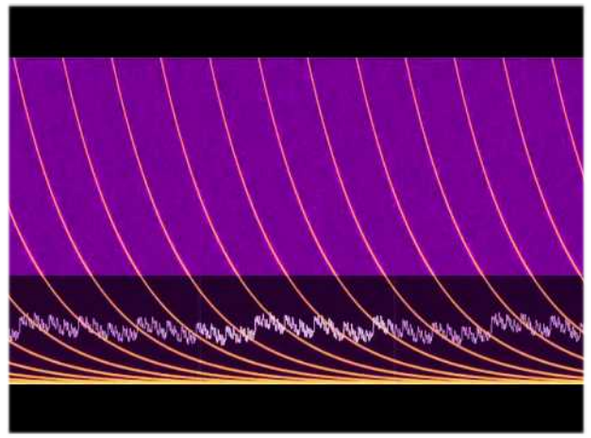
- 1. **Spectral continuity (pitch and *timbre*)**
  - Frequency content
- 2. Intensity continuity (envelopes)
- 3. Spatial continuity

Credits: M. Fischer, K. Soden, M. Goodchild, S. McAdams

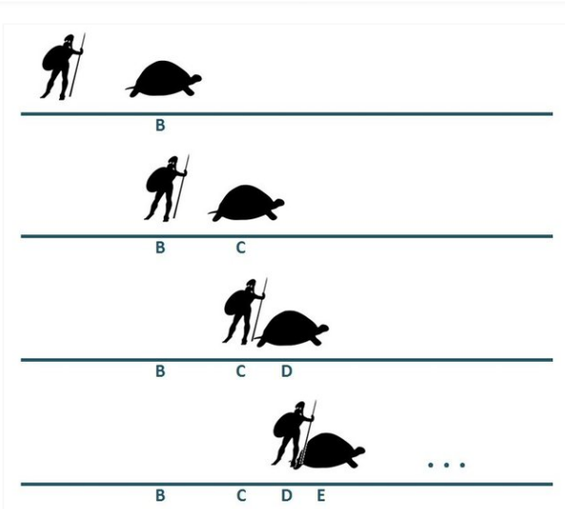
ACOUSTIC PARADOXES



Shepard-Risset
infinite glissando



Impossible rhythm

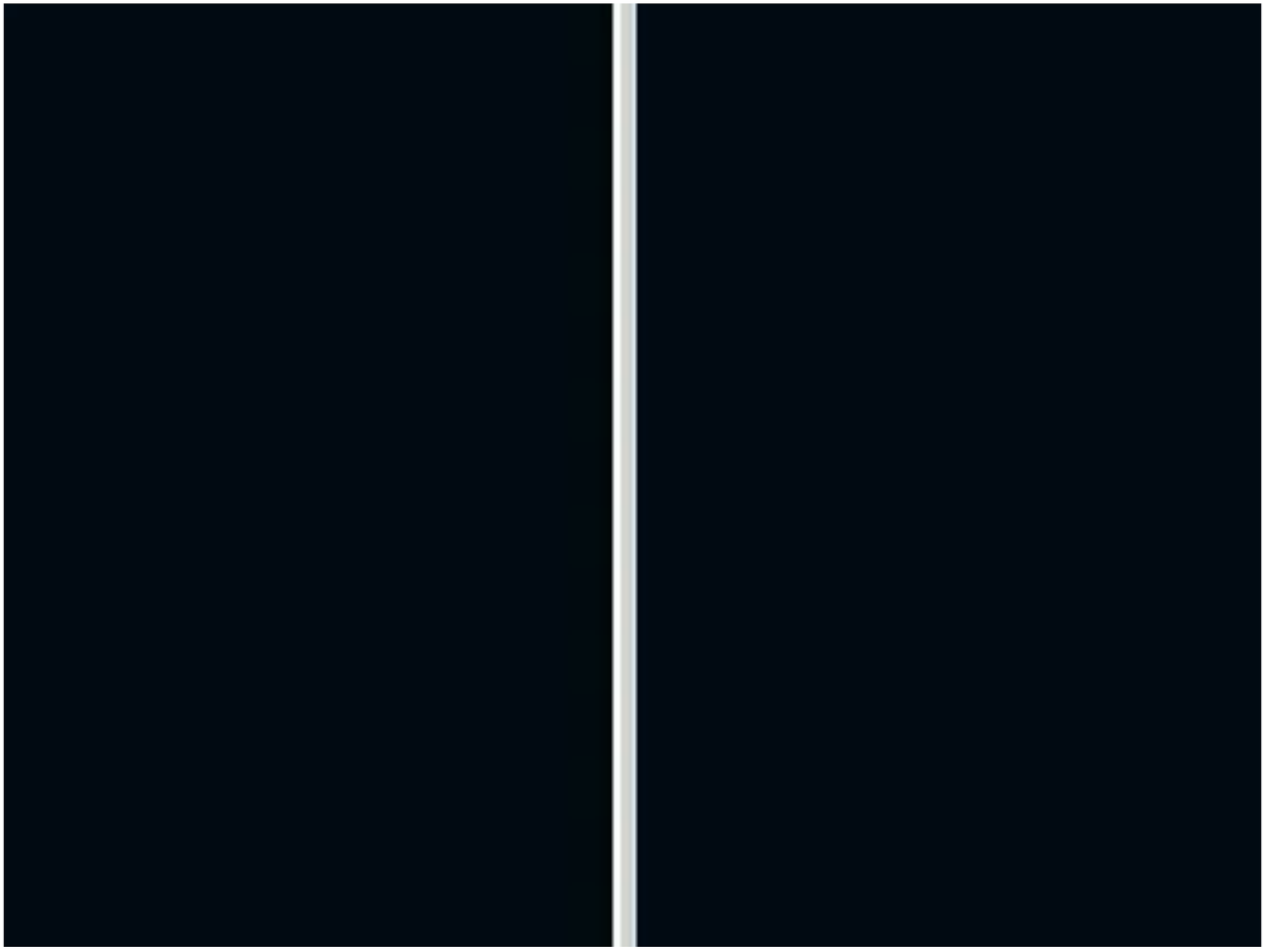


ORCHESTRAL COLORS

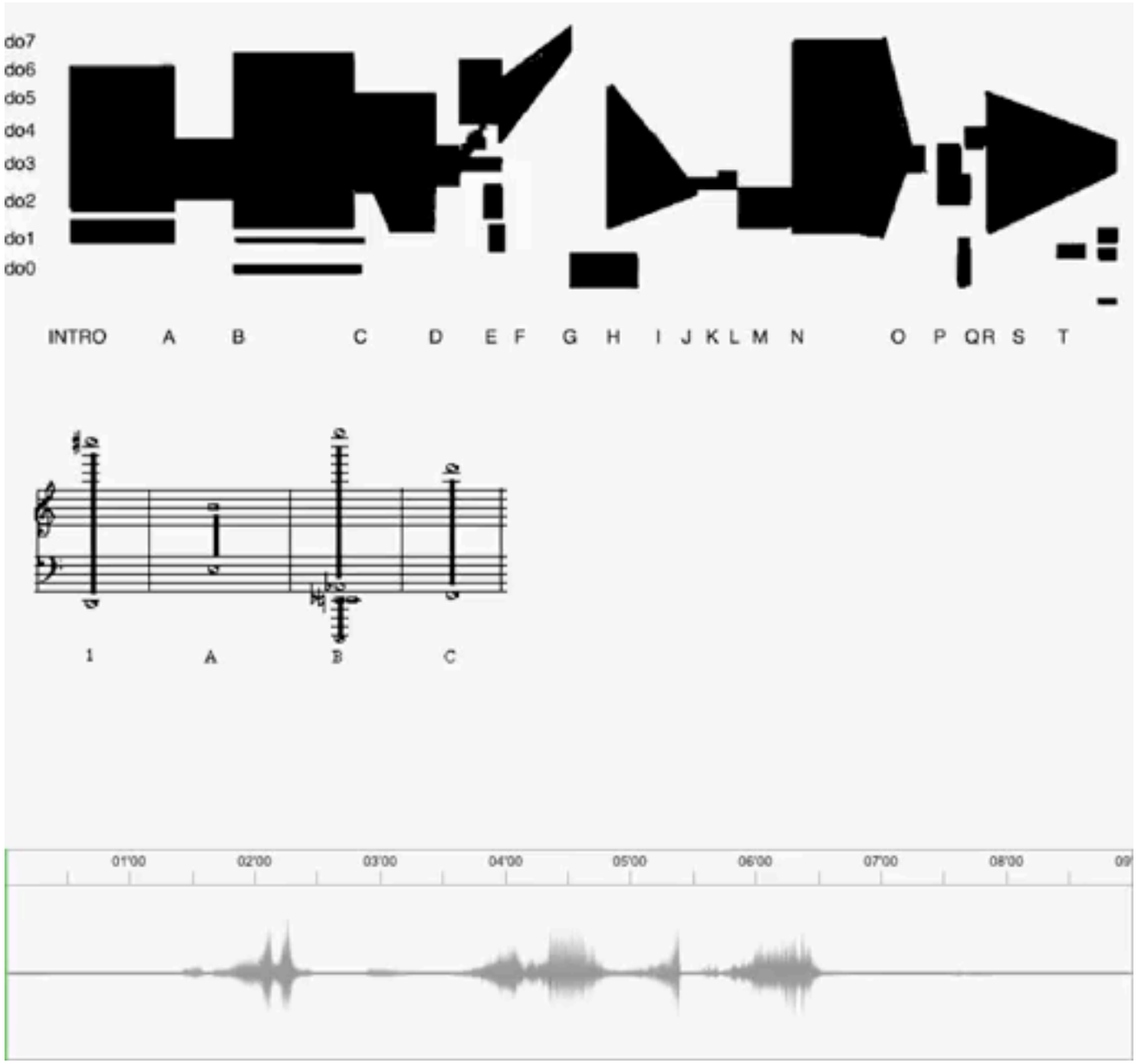
- Book ***Sound color*** (1985) by Wayne Slawson
- Schoenberg's "**Klangfarbenmelodie**" (from *Harmonielehre,* 1911)
- **Choice of semantic categories to describe timbre**
  e.g: "bright", "dark", "sound color"
- ***Color*** (2001) by Marc-André Dalbavie (IRCAM)
- **Spectral music:** Grisey, Murail, Dufourt, Levinas…
  - Study of acoustic features of sound.
  - "Sound treated phenomenologically as a dynamic presence to be encountered in listening."
  - Timbral representation of sound.

Credits: P. Gianferrara, K. Soden, M. Goodchild, S. McAdams

I. XENAKIS, METASTASEIS (1953–4) – ORCHESTRA

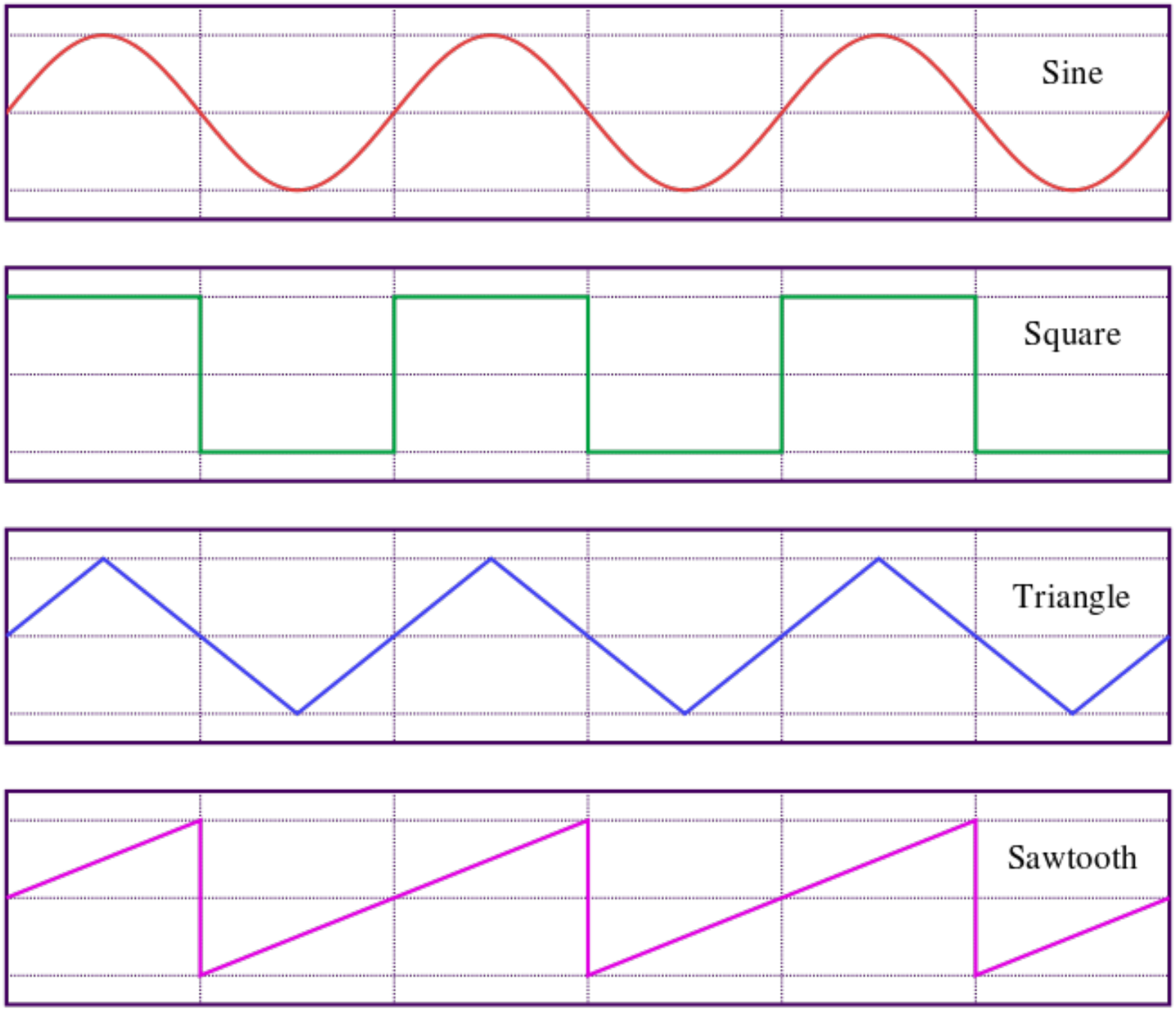


G. LIGETI, ATMOSPHÉRES (1961) – ORCHESTRA



ELECTRONIC TIMBRE

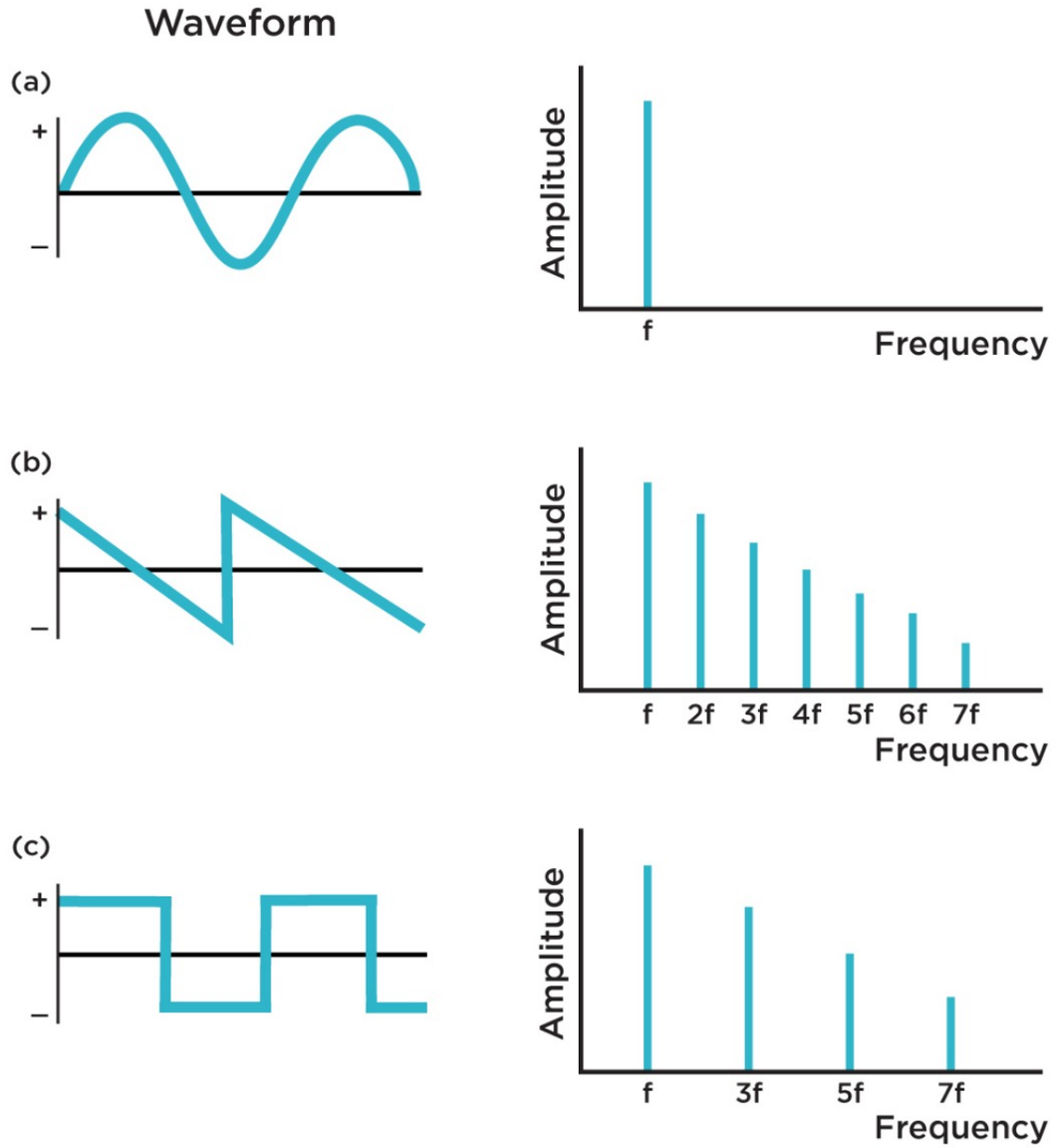
CLASSICAL DIGITAL WAVEFORMS . . .



https://en.wikipedia.org/wiki/Waveform

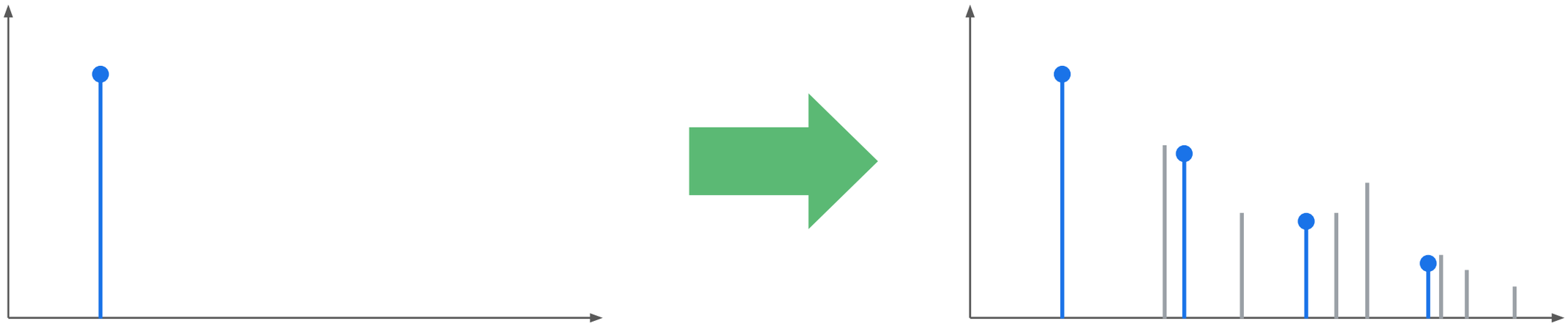
CLASSICAL DIGITAL WAVEFORMS . . .

. . .AND RELATIVE SPECTRA



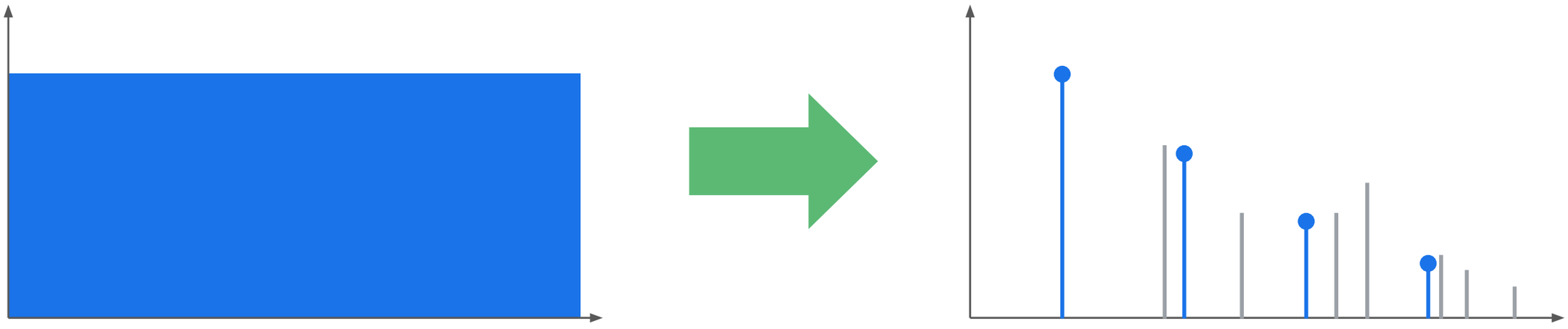
https://www.perfectcircuit.com/signal/learning-synthesis-filters

Additive Synthesis



We will implement
this soon!

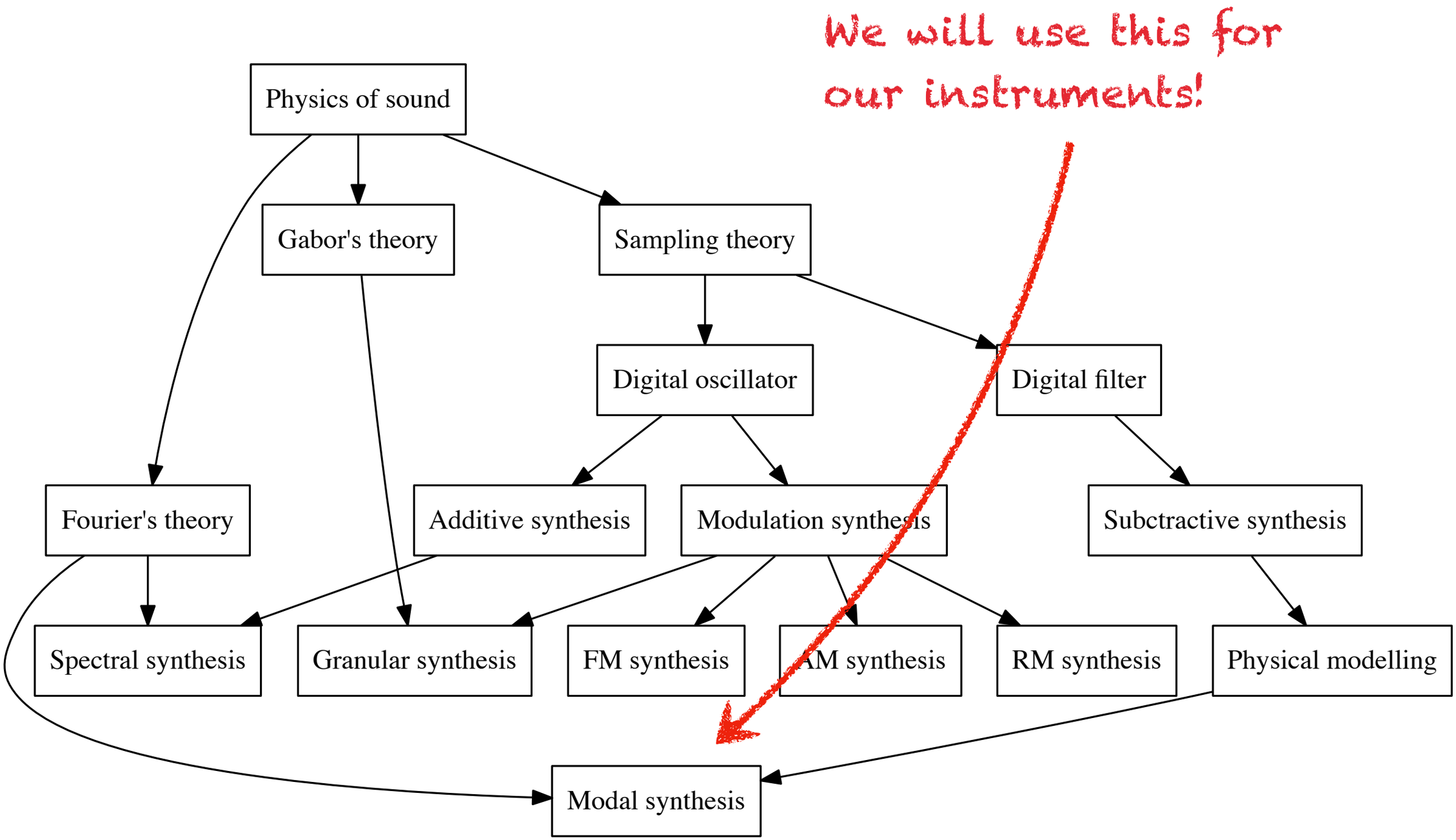
Subtractive Synthesis



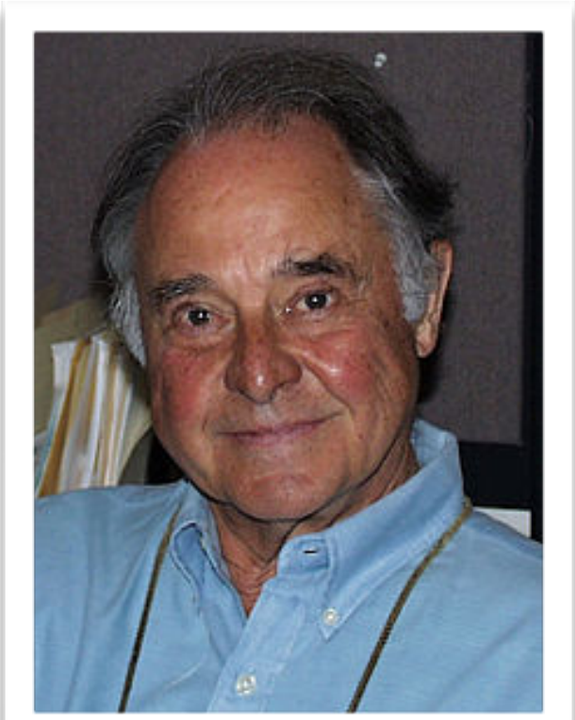
Question:

Which is the main difference between the two sounds generated by additive synthesis and subtractive synthesis respectively?

A TAXONOMY OF SOUND SYNTHESIS



A MORE COMPLEX EXAMPLE



J. Chowning, Stria, for FM synthesis (composed in Stanford)

THANK YOU!

Suggested exercise: check the Max/MSP tutorials on sound synthesis!