Timbre as a rhythmic structuring force in music

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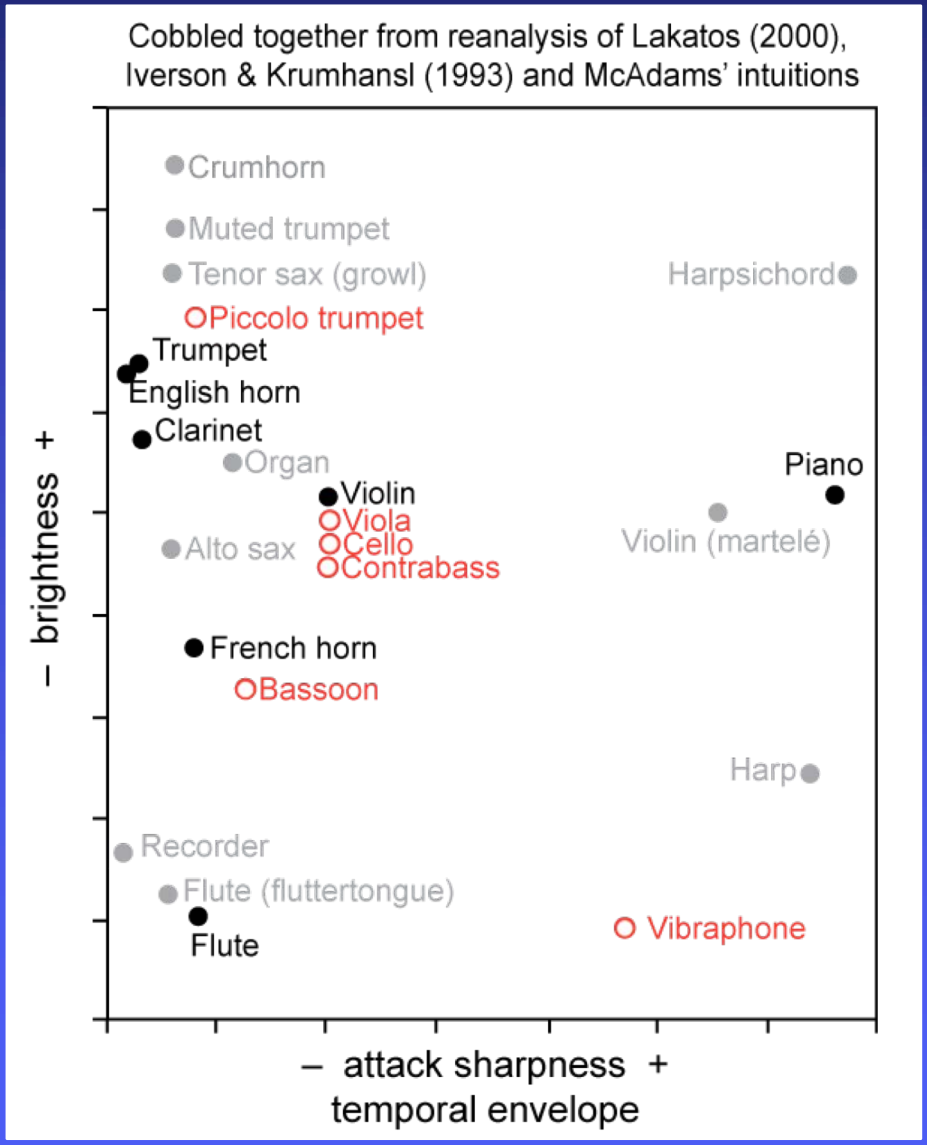
Effects of timbre on rhythm and meter

- Timbre can cause auditory stream segregation (Iverson, 1995; Bey & McAdams, 2003)
  - Stream formation affects rhythm perception (Bregman & Campbell, 1971)
- Timbral contrasts create chunking (Deliège, 1987)
  - Chunking affects perception of rhythm and meter (Povel & Essens, 1985)
- Some timbres are more salient than others (Chon & McAdams, 2012)
  - Salient sounds appear accented and can affect rhythm and meter perception (Fraisse, 1974)
  - N.B. What timbres are perceived as salient in a metric structure may depend on cultural schemas and learned correlations with other sources of meter induction.

Timbre and stream segregation

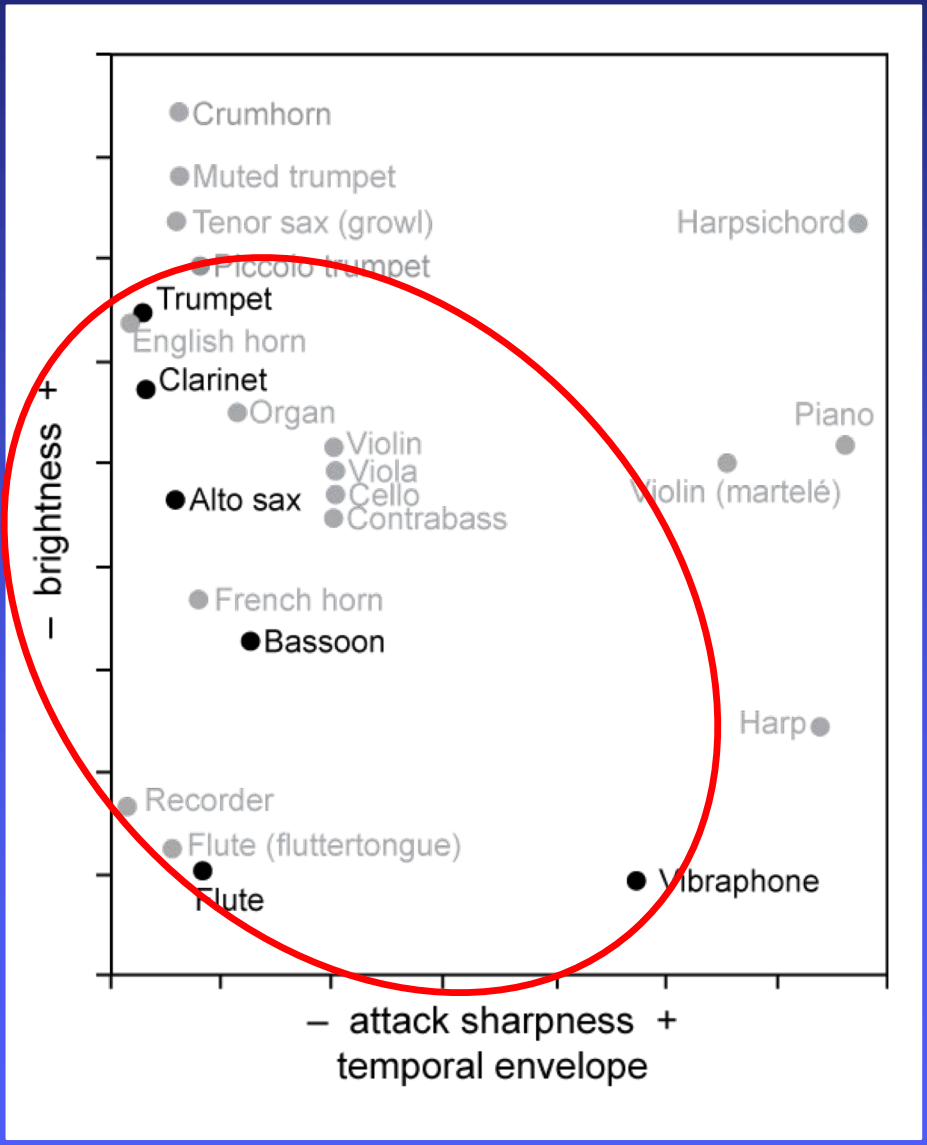
- Sounds coming from the same source tend to be similar in timbre
- Sounds with different timbres tend to come from different sources
- Perceptual organization connects similar sounds into auditory streams
- Rhythm is computed within streams
- Ergo, timbral differentiation that causes stream segregation within sequences will affect rhythm perception

Timbre and stream segregation



Timbre and stream segregation

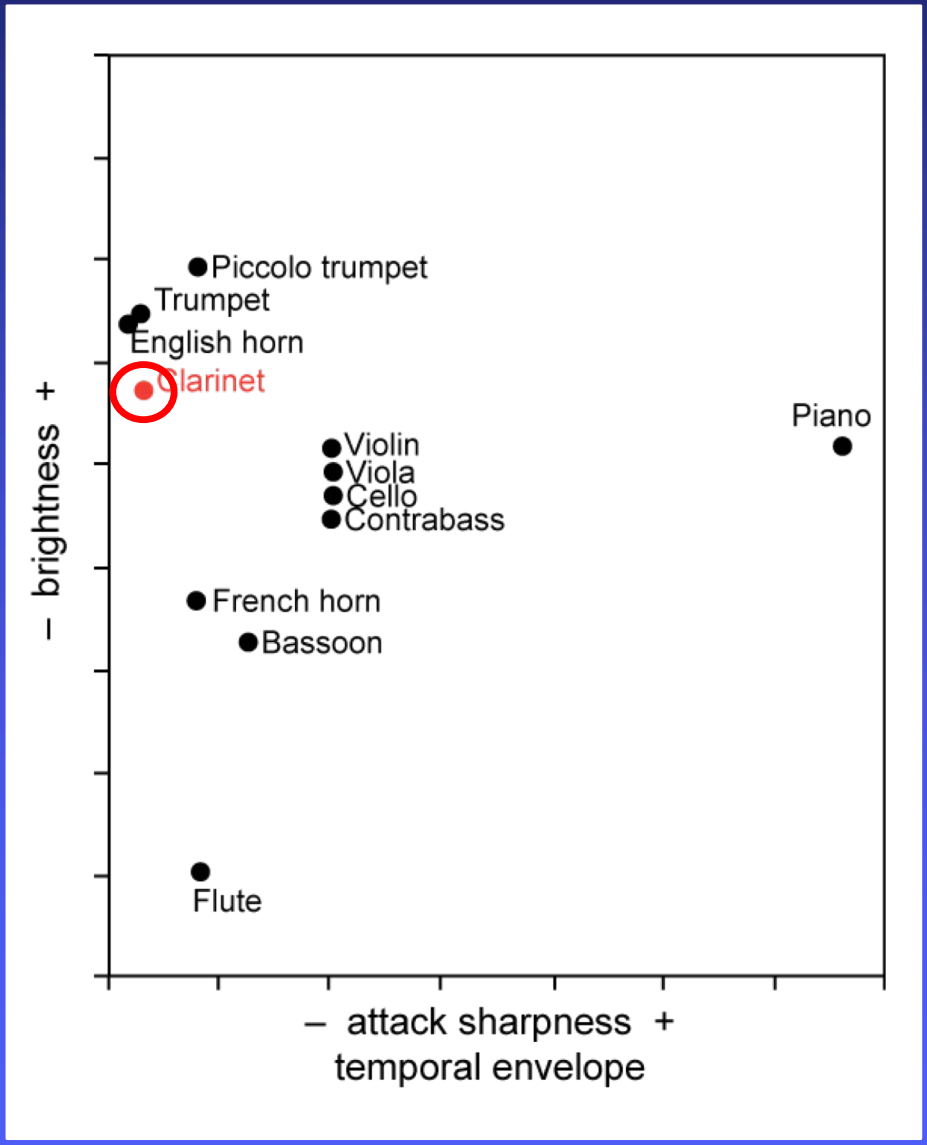
Erickson's original instrumentation



Timbre and stream segregation

McAdams' re-orchstration A:

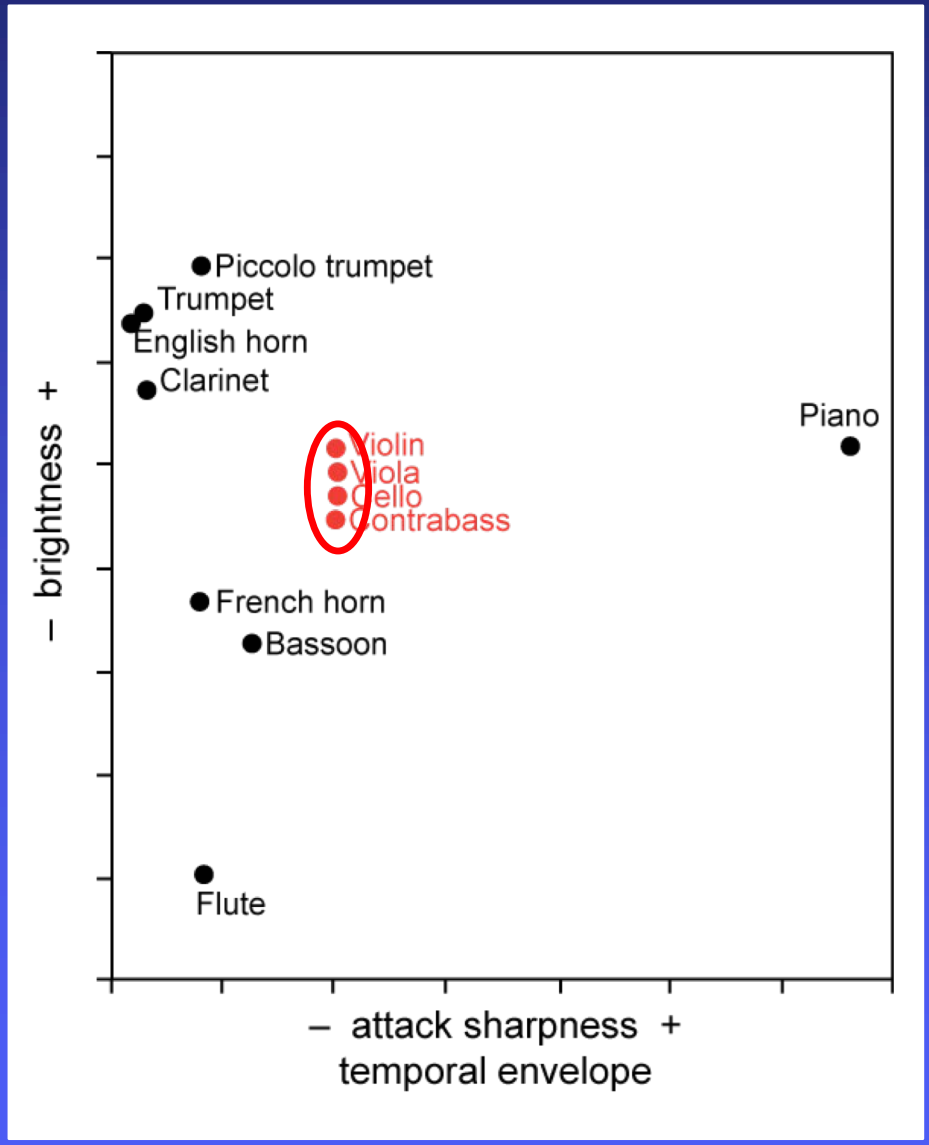
single instrument



Timbre and stream segregation

McAdams' re-orchstration B:

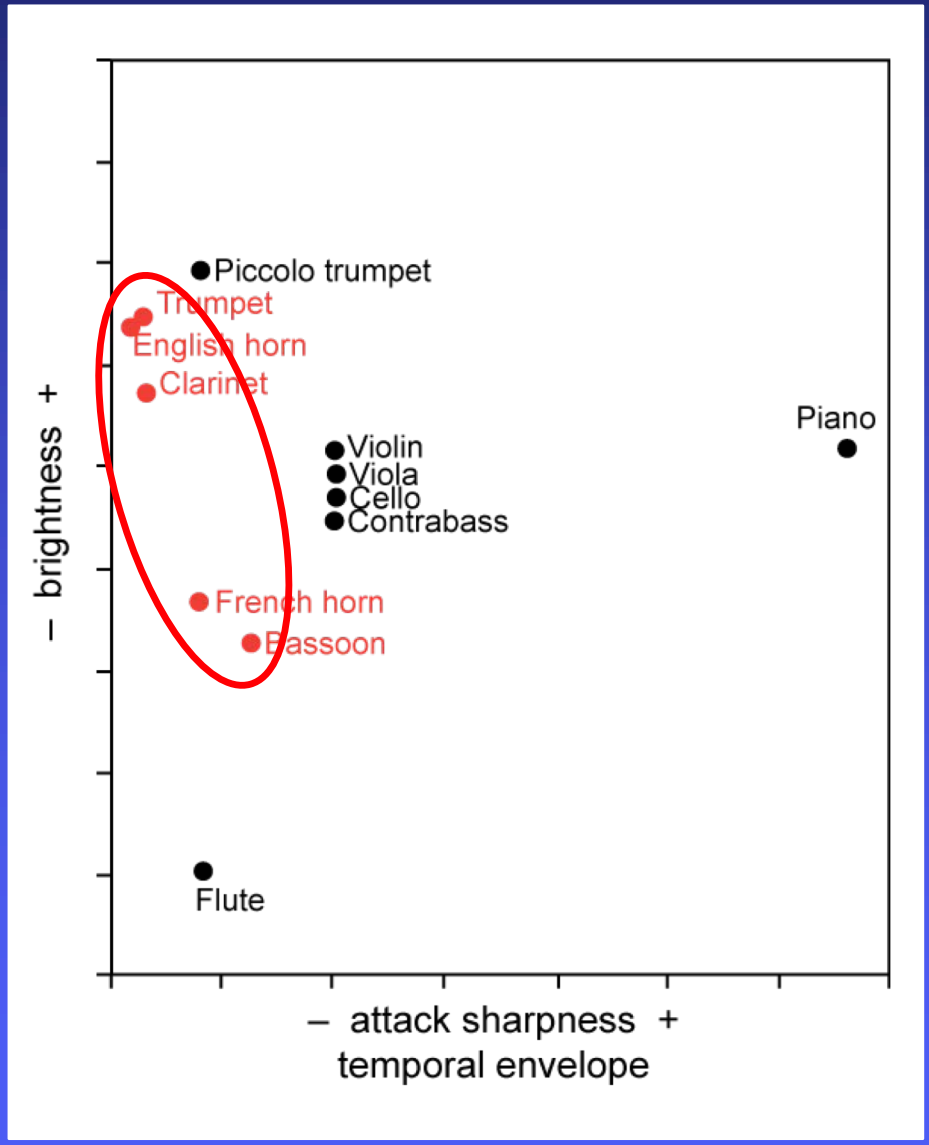
single instrument family (strings)



Timbre and stream segregation

McAdams' re-orchstration C:

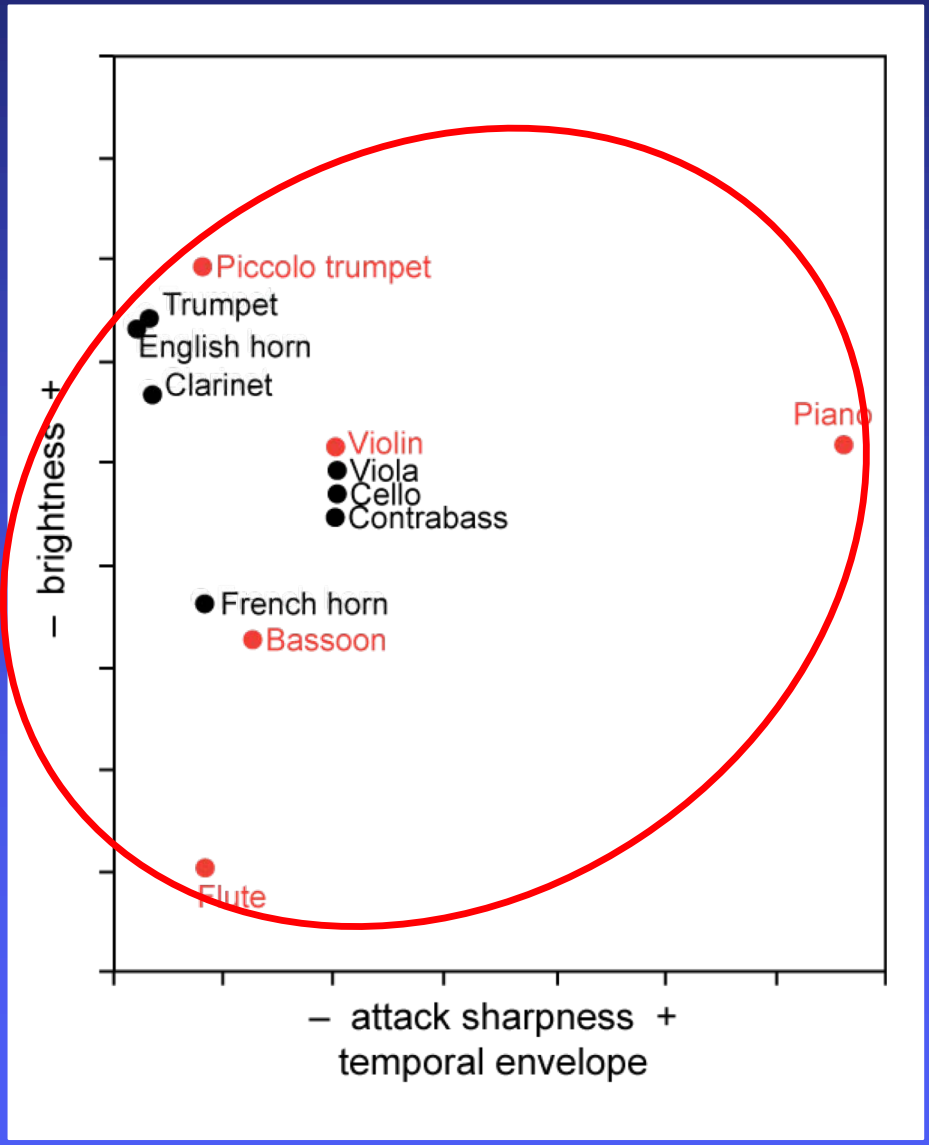
woodwind and brass instruments



Timbre and stream segregation

McAdams' re-orchstration D:

Woodwinds, brasses and bowed and struck strings



Timbre and stream segregation

New Loops for Instruments (Robert Erickson, 1972-3; reorchestrations by Stephen McAdams)

A

1 2 3 1 2 3 . . .

a. Bb Clarinet
b. Violins / Violas / Violoncelli
c. Bassoon / Trumpet / Bb Clarinet
d. Violin / Piccolo Trumpet / Bassoon

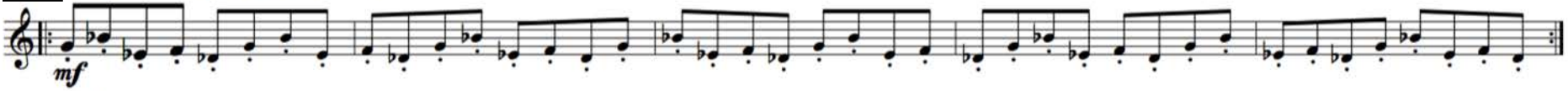
B

1 2 3 5 1 2 3 5 . . .

a. Bb Clarinet
b. Violins / Violas / Violoncelli / Contrabasses
c. Bassoon / Trumpet / Bb Clarinet / English horn
d. Violin / Piccolo Trumpet / Bassoon / Flute

C

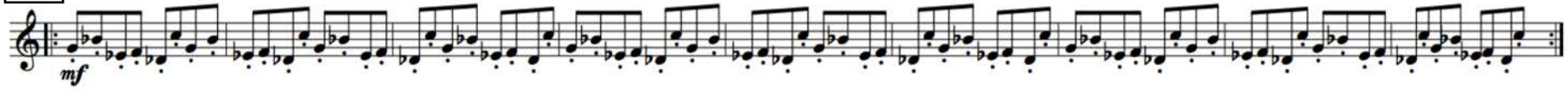
1 2 3 4 5 2 1 2 3 4 5 3 . . .



a. Bb Clarinet
b. 1st Violins / 2nd Violins / Violas / Violoncelli / Contrabasses
c. Bassoon / Trumpet / French horn / English horn / Bb Clarinet
d. Violin / Piccolo Trumpet / Piano / Bassoon / Flute

D

1 2 3 4 5 1 2 3 4 5 . . .



a. Bb Clarinet
b. 1st Violins / 2nd Violins / Violas / Violoncelli / Contrabasses
c. Bassoon / Trumpet / French horn / English horn / Bb Clarinet
d. Violin / Piccolo Trumpet / Piano / Bassoon / Flute

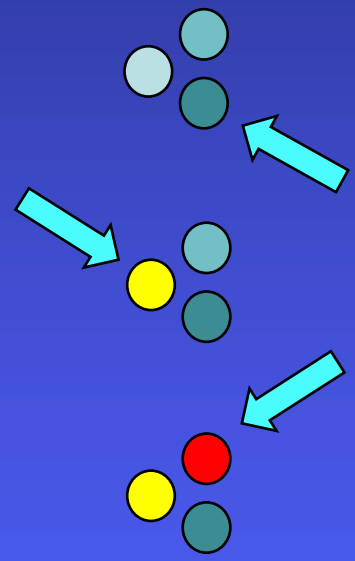
Realized with the McGill Digital Orchestra SIMulator (DOSIM)

Rhythmic structure from repeating timbre patterns

- Repeating patterns create segmentation
- Regular segmentation creates a grouping structure which can establish a level of metric structure
  - No structure
  - Subtle binary alternation
  - Ternary pattern
  - Timbral polyrhythm by combining binary and ternary patterns
  - Quintuplet pattern

Timbral differentiation and saliency

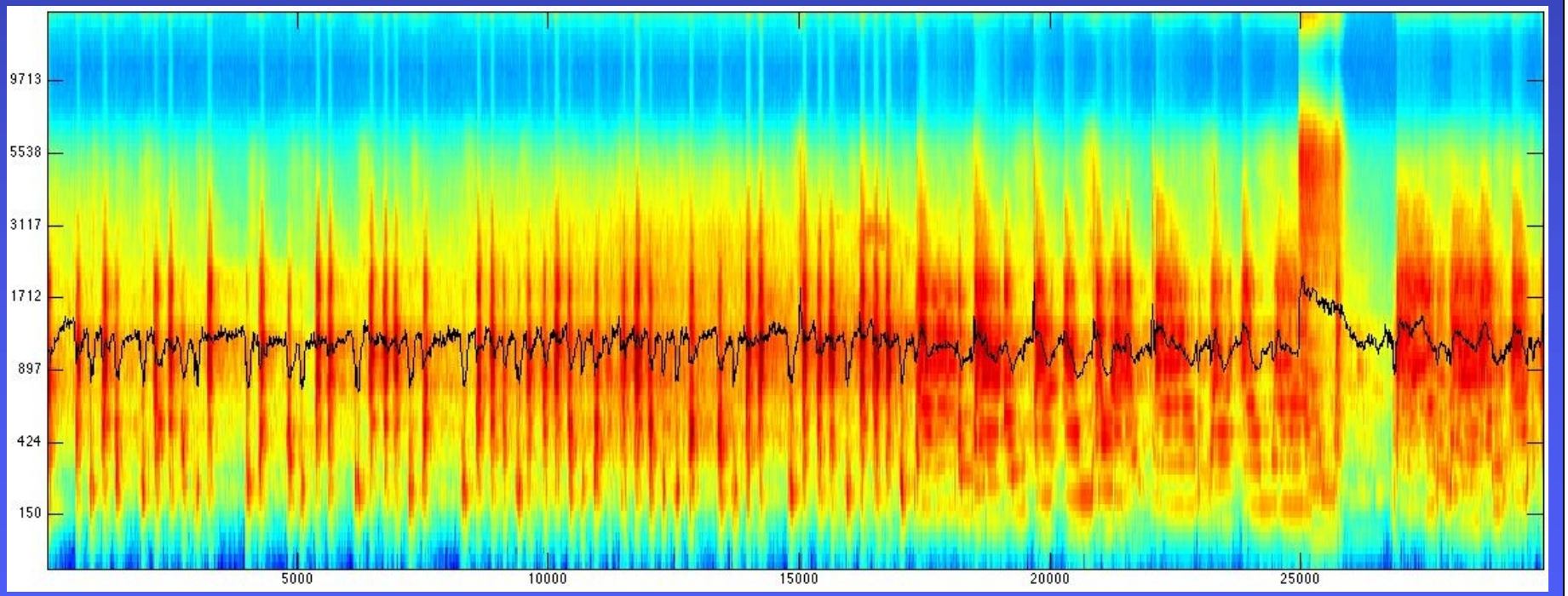
- Timbres that are different may be heard as accented
  - 3 similar timbres (Eb, Bb and bass clarinets) but most different one heard as accented (bass)
  - Replace Eb clarinet with English horn which is now more different
  - Replace Bb clarinet with trumpet which is now more different



Timbral differentiation and saliency

- Rhythmic use of wah wah pedal on electric guitar in rock and wah wah mute on brass in jazz

Jimi Hendrix *Voodoo Child (Slight Return)* [live]



Timbral patterns in culturally defined rhythmico-metric structures

- Classical Indian tabla (in North Indian Khyal)
  - Taals – rhythmic cycles of fixed length (avartan) and subgroupings (vibhag) with stronger and weaker subgroups (tali/khali or claps/waves), e.g. Teentaal – 16 beats = 4+4+4+4, clap-clap-wave-clap
  - Theka – standardized realization of a taal with bols (timbre pattern)
    - Bols involving bass tabla (Bhayan) present in clap groups and absent in wave groups (only treble Dayan)

Timbral patterns in culturally defined rhythmico-metric structures

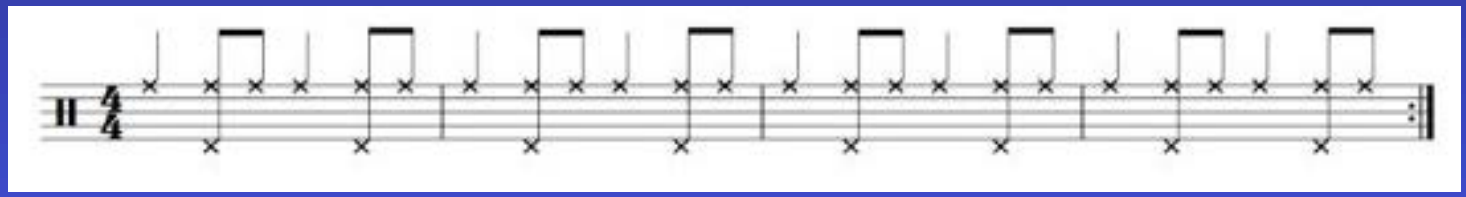
- Theka for teentaal
  - [clap] Dha Dhin Dhin Dha
  - [clap] Dha Dhin Dhin Dha
  - [wave] Dha Tin Tin Na
  - [clap] Na Dhin Dhin Dha


- These patterns allow for (enculturated) listeners to situate themselves within the metric cycle
  - Situating right hand pattern on the Dayan (Na Tin Tin Na)
  - N.B. One must know the theka to pick up on clap/wave pattern

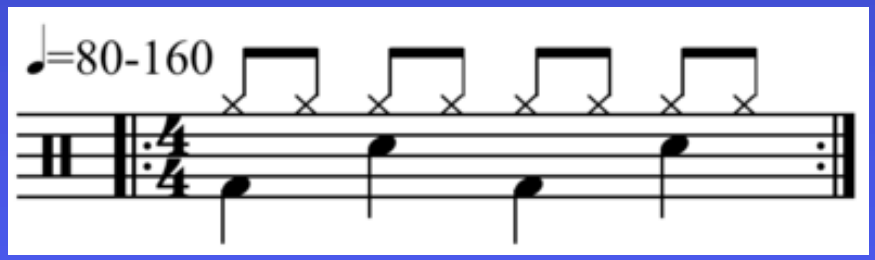
Timbral patterns in culturally defined rhythmico-metric structures

- Jazz and rock drum beats

ride
hi-hat



ride
snare
bass



Backbeat and clapping conventions (NA and EU)

Timbral patterns in culturally defined rhythmico-metric structures

- Thai classical music
  - Role of damped (+) and undamped (o) ching and reinforcement of damped ching by a lower pitched gong (O) in establishing a metric framework

Slow tempo

Medium tempo

Fast tempo

from Morton (1976)

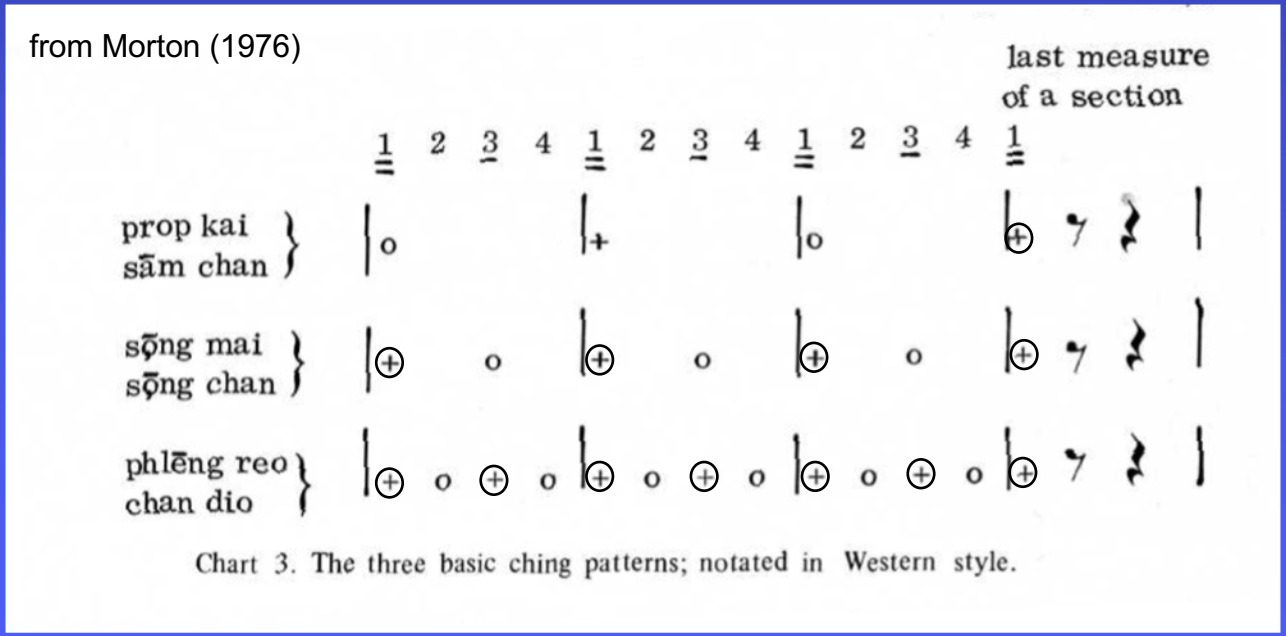


Chart 3. The three basic ching patterns; notated in Western style.

Timbre's role in rhythm & meter

- Timbre space as predictive model of timbral relations
  - Stream segregation
  - Contextual saliency (relative differentiation)
- Timbre-based stream segregation
- Rhythms computed on auditory streams
- Segmentation by repeating timbral patterns
- Intrinsic and contextual timbral saliency => accents
- Culturally determined roles of timbral properties in meter induction (intrinsic saliency or cultural learning?)

Many thanks to collaborators and funders

- Shawn Mativetsky, tabla professor at McGill
- Félix Baril, composition graduate student at McGill, co-designer of DOSIM
- Aiyun Huang, percussion professor at McGill
- The Mandeville Special Collections at the University of California, San Diego for the Erickson score