How different are rap flows?
Comparative analysis on language and genre.

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Introduction

- Rap is a musical form of vocal delivery, a vocal expression which is usually performed over a backing beat or an instrumental
- Rap is not necessary Hip-Hop
- Rap exists in different languages and sub-genres of Hip-Hop
- 3 main components:
  - Lyrics
  - Flow
  - Delivery
- Focus on Flow

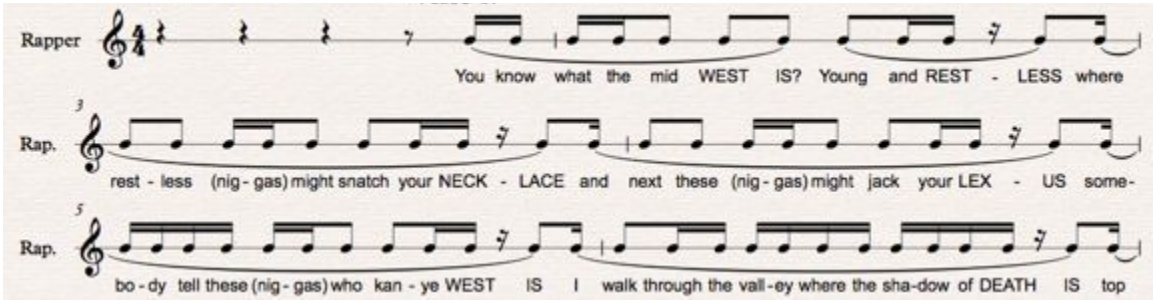
What Is Flow?

- Definition
- “Flow are musical experiences expressed in **rhyme**, **rhythm** and stress, delivered in **sentences** that are in **accordance to the instrumentals**.”
- Interest for investigating different languages
  - Rhyme and phrase structure are language dependent -> Flow from different languages should be different
- Interest for investigating different sub-genres
  - Sub-genres have similarities and differences -> Should be the same for Flow

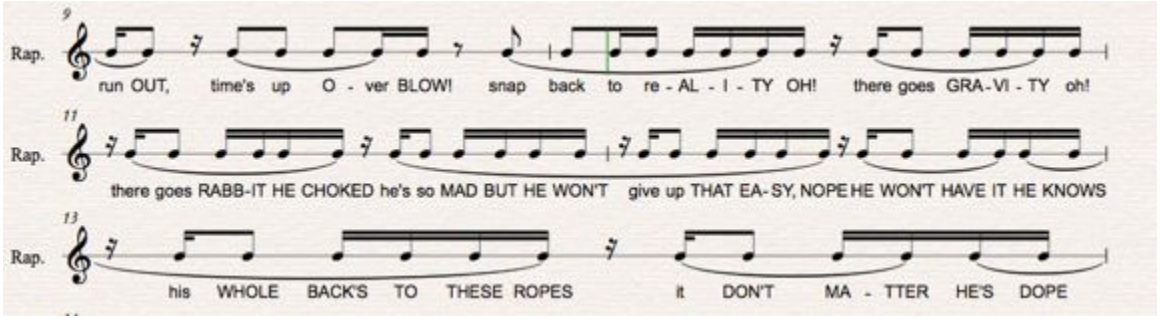
Key Elements of Flow

- How do we separate flow temporally?
- Speed: Tempo of the song and the average speed at which the rapper says each syllable
- Rhyme: Rhyme density and variability of rhyme positions
- Rhythm: Linked to the rhythmic pattern

Flow Diagram



Kanye West: Jesus Walks
Tempo: 87 BPM



Eminem: Lose Yourself
Tempo: 171 BPM

Research Question

- How flow characteristics differ from different languages and genres ?
    - French vs. American
    - Oldschool vs. Newschool

- Past researches on flow: Focus on general descriptors of Flow and on evolution over time

- “MCFlow: A Digital Corpus of Rap Transcriptions”

Dataset

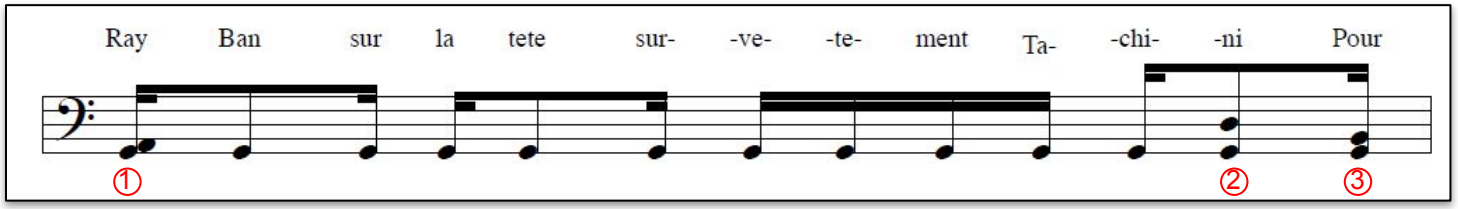
- American: Dataset from the MCFlow corpus: 26 old-school songs and 26 new-school songs

- French: Songs selected from the Top 50 and from the 10 most sold French rap albums

- Song classification: year of release and auditory experience
- All had 4/4 time signature

Transcription

- Logic Pro X : Assign one note to each syllable (+ break, rhyme, rest) → Output in MusicXML File



G : Surface

A : Break

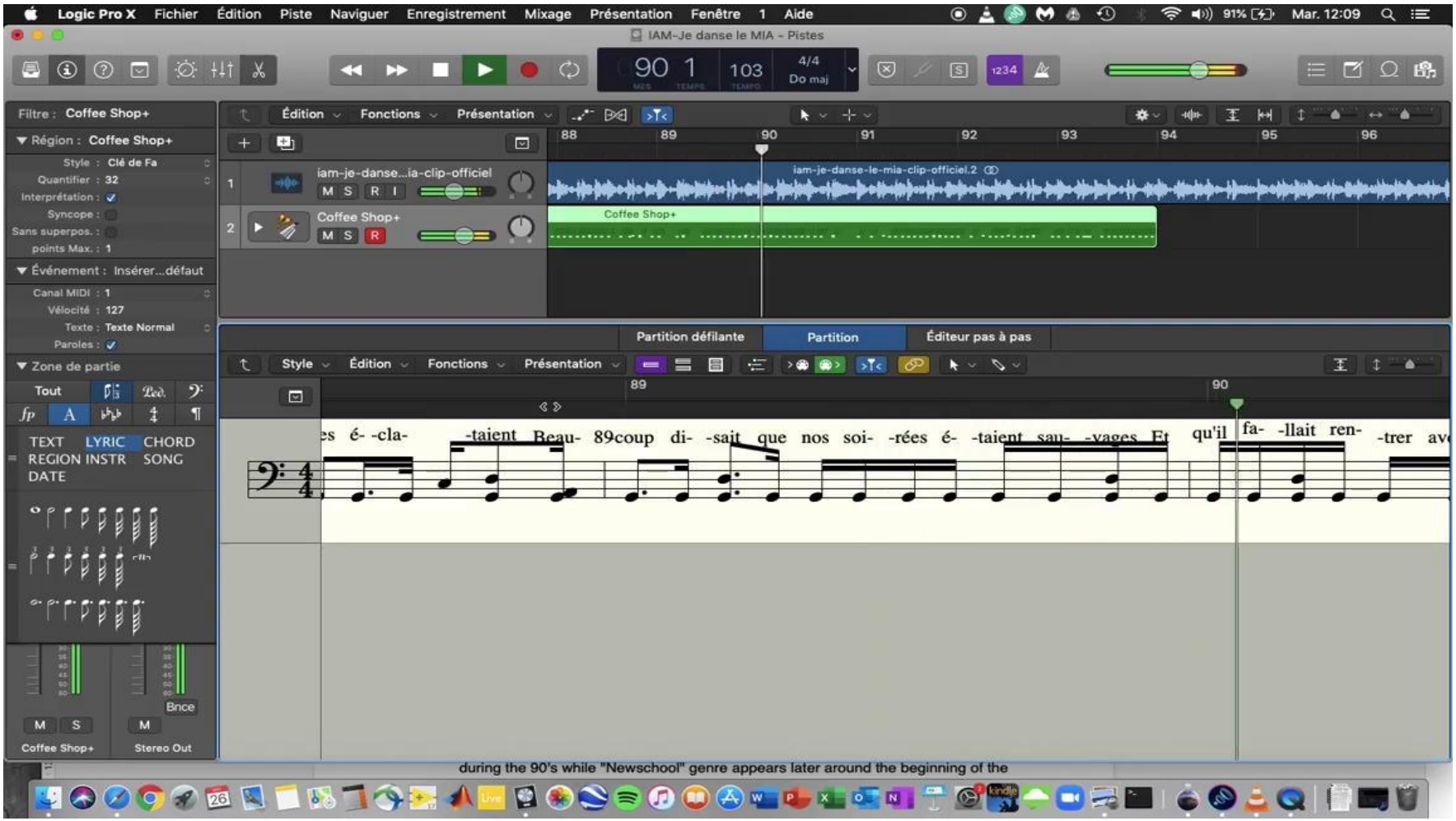
D : Rhyme

B : Small break

	=11	=11	=11	=11
①	16	1	0	Ray
	8	0	0	Ban
	16	0	0	sur
	16	0	0	la
	8	0	0	tete
	16	0	0	sur-
	16	0	0	-ve-
	16	0	0	-te-
	16	0	0	ment
	16	0	0	Ta-
	16	0	0	-chi-
②	8	0	1	-ni
③	16	2	0	Pour

- XML Parser : MusicXML → easy to process format

Transcription Example



Audio Examples

American Old-School

Jay Z: Can't Knock The Hustle

American New-School

Jay Z: Holy Grail

French Old-School

IAM: Je danse le MIA

Hypothesis (1): Speed

- Old-School flow is faster than New-School flow.
- Oldschool flow has narrower range of speed than Newschool flow.
- Figurative description:
  - New-School songs are more “sluggish.”
  - Newschool is to jackhammer, as Oldschool is to wave.

Hypothesis (2): Rhyme

- Rhyme occurs more frequently in American flow than in French flow.

- Rhyme pattern is more diverse in American flow than in French flow

Hypothesis (3): Rhythm

- Genre plays stronger role in differentiating the rhythm of flow, compared to language.
    - Rhythm of American Oldschool flow is more similar to that of French Oldschool, than that of American Newschool.

Defining the Parameters

Speed

- Tempo
  - The speed in which the instrumentals are played.
  - The number of beats per minute.

- Syllabic Density
  - The speed in which the lyrics are delivered.
  - The number of syllable onsets per second.

$$SyllabicDensity = \frac{tempo(BPM)}{60} \cdot \frac{\sum syllables}{\sum beats}$$

  - Obtained for each **phrase.**

Rhyme

- Rhyme Density
  - The frequency of rhyme occurrence.
  - The number of rhymed syllable onsets per measure.

$$RhymeDensity = \frac{\sum rhymed\_syllables}{\sum measures}$$

  - Obtained for each **song**

- Variability of Rhyme Position
  - The distribution of metrical positions of rhymed syllables.
  - The **entropy** of metrical positions of rhymed syllables.
  - Obtained for each **dataset**

Rhythm

- Transition Probabilities between Syllable Durations
  - Markov assumption: one-step transition probability.
  - Transition between 15 most frequent syllable duration of the whole dataset.

  - Transition Matrix *M*

M[i,j] = Pr(i, j)

= The probability that the syllable duration *j* follows the syllable duration *i.*

  - Quantify into a simpler form:

1) Obtain the transition matrix of each **phrase**

2) Get the mean transition matrix of all phrases in each **dataset**

Data Preprocessing

Original Data (humdrum-format)

**recip	**break	**rhyme	**lyrics
=1	=1	=1	=1
8	.	.	.
8	4	.	oh
4	.	[A	no
16	.	.	.
16	3	.	the
8.	.	(B	fight's
8	.	C)]	out
16	.	.	.
=2	=2	=2	=2
16	.	.	.
16	3	.	I'm
16	.	.	bout
16	.	.	to
8	.	.	punch
8	.	[A	yo
8	.	.	.

Data Preprocessing

Original Data (humdrum-format)

**recip	**break	**rhyme	**lyrics
=1	=1	=1	=1
8	.	.	.
1 8	4	.	oh
4	.	[A	no
16	.	.	.
16	3	.	the
8.	.	(B	fight's
8	.	C)]	out
16	.	.	.
=2	=2	=2	=2
16	.	.	.
16	3	.	I'm
16	.	.	bout
16	.	.	to
8	.	.	punch
8	.	[A	yo
8	.	.	.

1. Re-write note durations

After preprocessing

**duration	**break	**rhyme	**lyrics	**duration sum
1 0.5	4	.	oh	1
1.25	.	[A	no	2.25
0.25	3	.	the	2.5
0.75	.	(B	fight's	3.25
1	.	C)]	out	4.25
0.25	3	.	I'm	4.5
0.25	.	.	bout	4.75
0.25	.	.	to	5
0.5	.	.	punch	5.5
1	.	[A	yo	6.5

Data Preprocessing

Original Data (humdrum-format)

**recip	**break	**rhyme	**lyrics
=1	=1	=1	=1
8	.	.	.
1 8	4	.	oh
4	.	[A	no
16	.	.	.
16	3	.	the
8.	.	(B	fight's
8	.	C)]	out
16	.	.	.
=2	=2	=2	=2
16	.	.	.
16	3	.	I'm
16	.	.	bout
16	.	.	to
8	.	.	punch
8	.	[A	yo
8	.	.	.

1. Re-write note durations
2. Get note positions

After preprocessing

**duration 1	**break	**rhyme	**lyrics	**duration sum 2
0.5	4	.	oh	1
1.25	.	[A	no	2.25
0.25	3	.	the	2.5
0.75	.	(B	fight's	3.25
1	.	C)]	out	4.25
0.25	3	.	I'm	4.5
0.25	.	.	bout	4.75
0.25	.	.	to	5
0.5	.	.	punch	5.5
1	.	[A	yo	6.5

Data Preprocessing

Original Data (humdrum-format)

**recip	**break	**rhyme	**lyrics
=1	=1	=1	=1
8	.	.	.
8	4	.	oh
4	.	[A	no
16	.	.	.
16	3	.	the
8.	.	(B	fight's
8	.	C)]	out
16	.	.	.
=2	=2	=2	=2
16	.	.	.
16	3	.	I'm
16	.	.	bout
16	.	.	to
8	.	.	punch
8	.	[A	yo
8	.	.	.

1. Re-write note durations
2. Get note positions
3. Merge rest durations to the preceding syllables

After preprocessing

**duration	**break	**rhyme	**lyrics	**duration sum
0.5	4	.	oh	1
1.25	.	[A	no	2.25
0.25	3	.	the	2.5
0.75	.	(B	fight's	3.25
1	.	C)]	out	4.25
0.25	3	.	I'm	4.5
0.25	.	.	bout	4.75
0.25	.	.	to	5
0.5	.	.	punch	5.5
1	.	[A	yo	6.5

Data Preprocessing

1. Re-write note durations
2. Get note positions
3. Merge rest durations to the preceding syllables

After preprocessing

**duration	**break	**rhyme	**lyrics	**duration sum
0.5	4	.	oh	1
1.25	.	[A	no	2.25
0.25	3	.	the	2.5
0.75	.	(B	fight's	3.25
1	.	C)]	out	4.25
0.25	3	.	I'm	4.5
0.25	.	.	bout	4.75
0.25	.	.	to	5
0.5	.	.	punch	5.5
1	.	[A	yo	6.5

Data Preprocessing

1. Re-write note durations
2. Get note positions
3. Merge rest durations to the preceding syllables
4. Get the rhythmic sequence of each phrase.

Rhythm for each song (split in phrases)

[0.5, 1.25]	oh no
[0.25, 0.75, 1.0]	the fight's out
[0.25, 0.25, 0.25, 0.5, 1.0, 0.75, 1.25]	I'm bout to punch yo lights out

After preprocessing

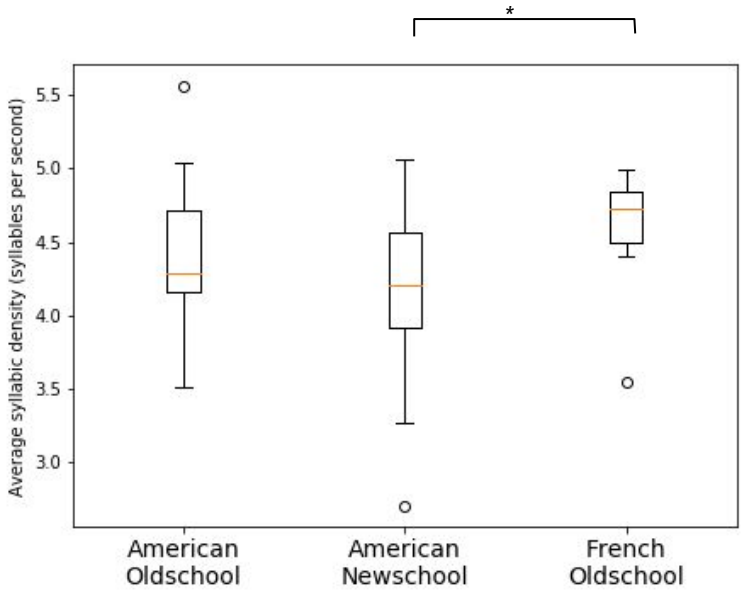
	**duration	**break	**rhyme	**lyrics	**duration sum
4	0.5	4	.	oh	1
	1.25	.	[A	no	2.25
	0.25	3	.	the	2.5
	0.75	.	(B	fight's	3.25
	1	.	C)]	out	4.25
	0.25	3	.	I'm	4.5
	0.25	.	.	bout	4.75
	0.25	.	.	to	5
	0.5	.	.	punch	5.5
	1	.	[A	yo	6.5

Results

DatapoInts

- Songs
  - 26 American Oldschool songs.
  - 26 American Newschool songs.
  - 10 French Oldschool songs
- Phrases
  - 1699 American Oldschool phrases
  - 1647 American Newschool phrases
  - 494 French Oldschool phrases

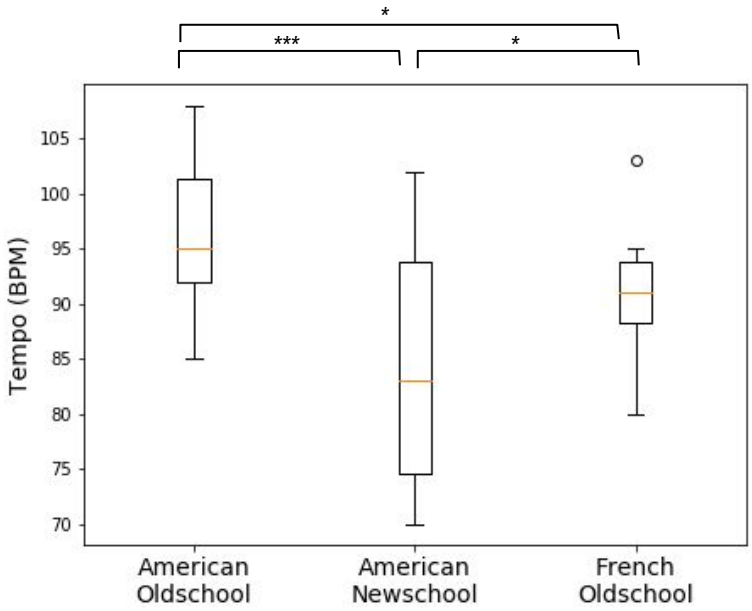
Syllabic Density



French Oldschool > American Oldschool > American Newschool

(Permutation test for pairwise mean comparison)

Tempo

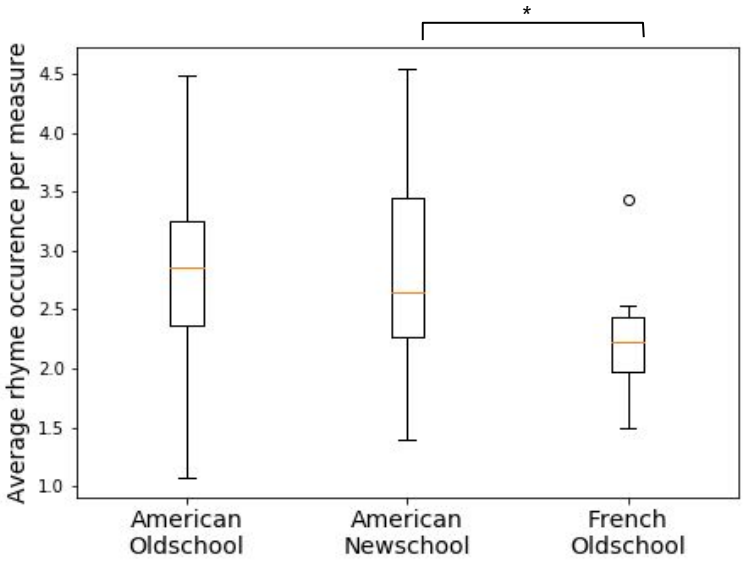


American Oldschool > French Oldschool > American Newschool

Variance is significantly higher in American Newschool.

(Permuation test for pairwise mean comparison, and Levene test for pairwise variance comparison)

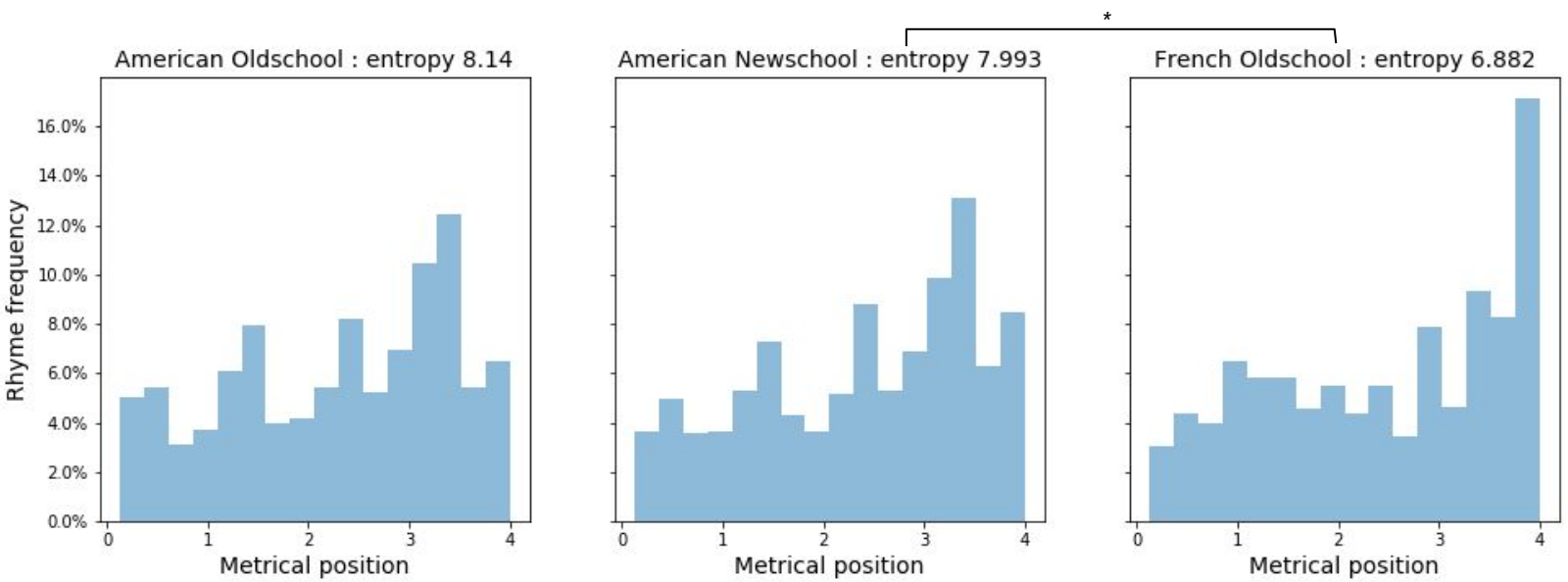
Rhyme Density



American Oldschool ≈ American Newschool > French Oldschool

(Permutation test for pairwise mean comparison)

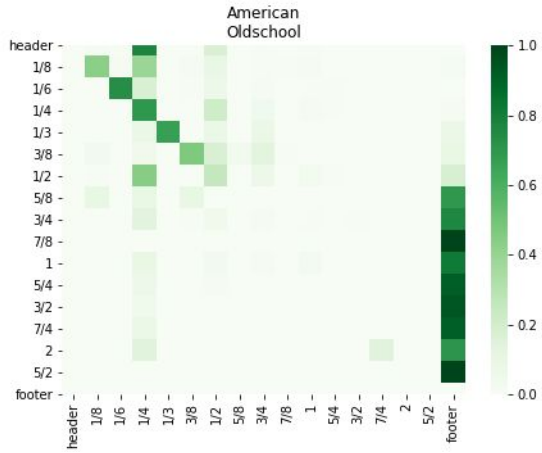
Variability of Rhyme Position

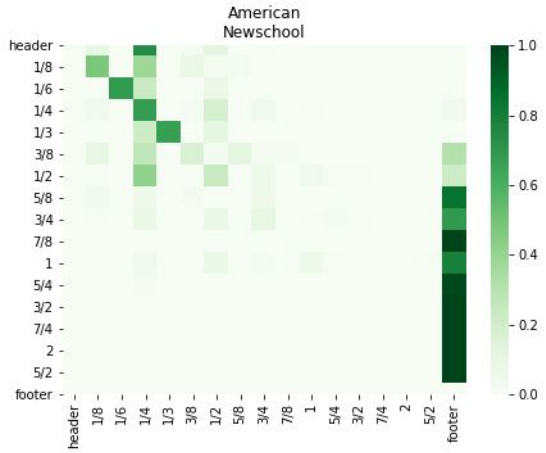


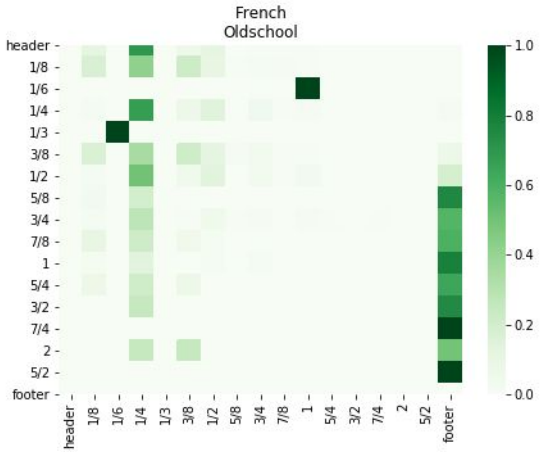
American Oldschool > American Newschool > French Oldschool

Entropy is significantly higher in American Newschool that in French Oldschool ($p < .05$)

Rhythm







Diagonal Line : American Oldschool ≈ American Newschool > French Oldschool

Vertical Line : French Oldschool > American Oldschool > American Newschool

Conclusions & Future Works

Revisiting our hypothesis

1. Oldschool flows are faster than Newschool flows?
   → Tempo: Oldschool > Newschool
   → Syllabic density: French (Oldschool) > American (Newschool)

2. Rhyme is more frequent and diverse in American flows?
   → Rhyme density: American (Newschool) > (French Oldschool)
   → Variability of rhyme position: American (Newschool) > French (Oldschool)

3. American Oldschool rhythm is more similar to the French Oldschool rhythm, rather than American Newschool rhythm?
   → Inter-lingual difference > inter-genre difference.

→ Musical characteristics of rap flows

are more influenced by the language than by the genre distinction.

Possible Improvements

- **Dataset**
  - Compare with the French Newschool dataset.
  - Increase the size of the French Oldschool dataset.
  - Add more genres to compare.
  - Add more languages.

- **Methodology**
  - Perform different testing.

- **Interdisciplinary approach**
  - What makes rhyme practice differ between languages? How does it differ?

Thank you for your attention!