



Measuring Musical Sampling Impact Through Network Analysis

by Justin Tran

*IW 09: Information Discovery through
Analysis of Complex Networks*
advised by Prof. Andrea LaPaugh



Motivation

Music sampling is the act of taking a portion of an existing recording and using it in a new recording.

Sampling informs listeners of the artist's level of **influence** on other musicians in the community.



Goal

Explore relationships between influential artists/genres and determine which sample/are sampled the most

Verify popular music sampling claims





Background and Related Work

- [Network Analysis and Rank of Sample-Based Music](#) (Bryan and Wang, 2011) [1]
 - Found relative flow of samples between genres
 - No intra-genre vs. inter-genre analysis
- [Influence Networks in Popular Music](#) (Alban, 2015) [2]
 - Built influence relationships based on harmonic features
 - No temporal analysis



Approach

- **Build** directed graphs from WhoSampled database (categorized by genre and time period) to indicate sample usage
- **Analyze** intra-genre and inter-genre sampling activity over time
- **Unique Edge Property:** Sampled audio elements (new property in dataset)

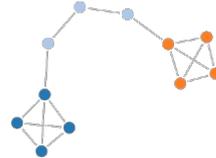


Implementation

Use 30,000
data points
from
WhoSampled



Build directed
graphs with
artists + audio
elements



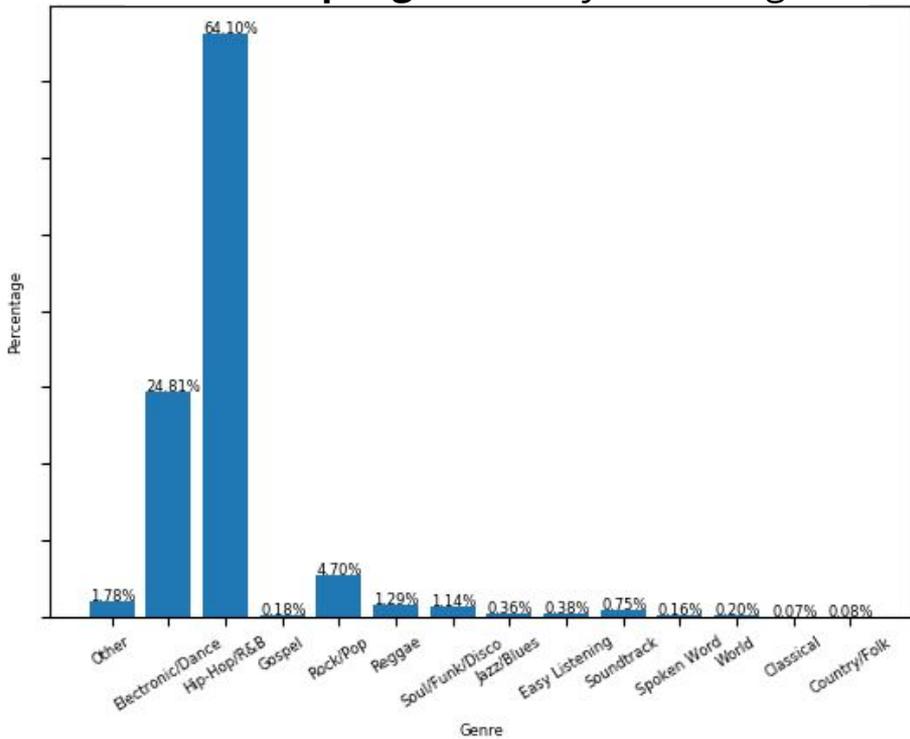
NetworkX



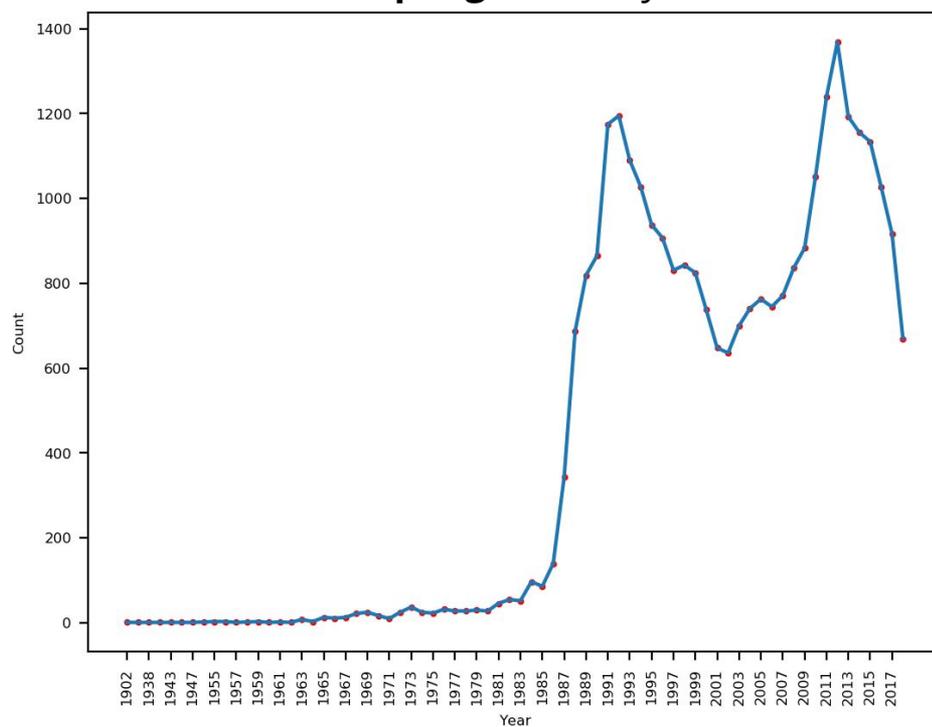
Implementation (Metrics)

- **Statistical Influence:** Compare sampling properties like genres and temporally analyze for patterns
- **Centrality Influence:** Measure artist influence as defined by type of centrality

Most **Sampling** Genres by Percentage



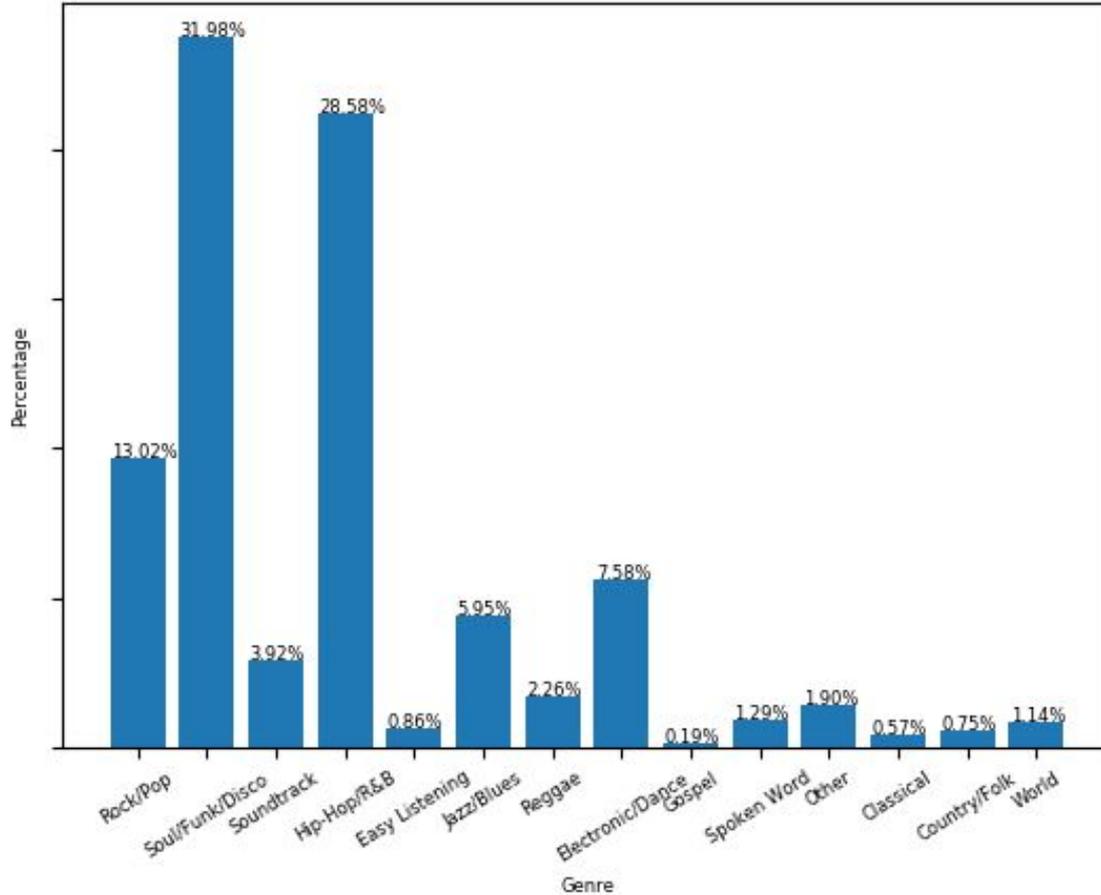
Count of **Sampling** Tracks by Time Period



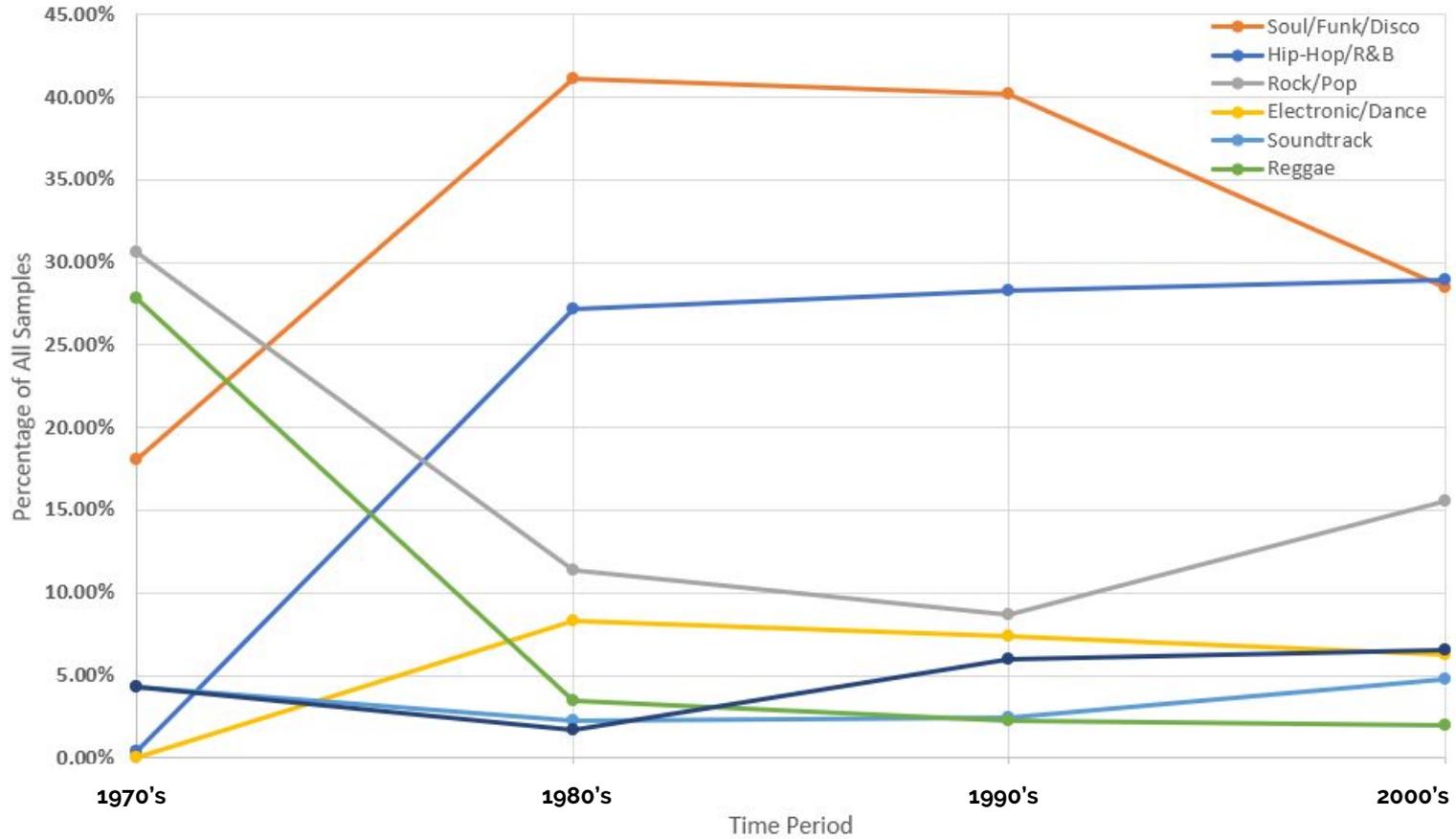


**What are the
most influential
genres?**

Most **Sampled** Genres by Percentage



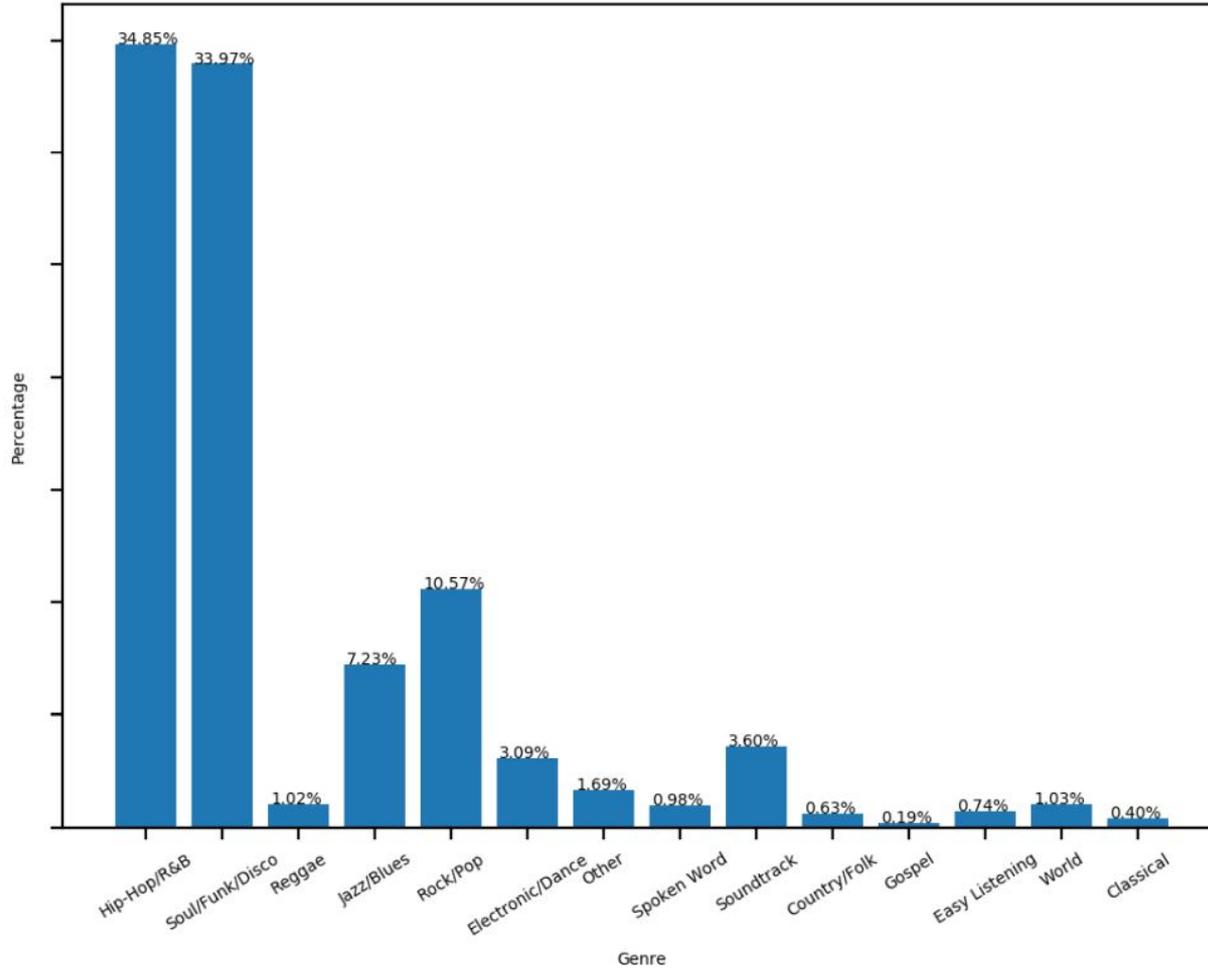
Most Sampled Genres Over Time



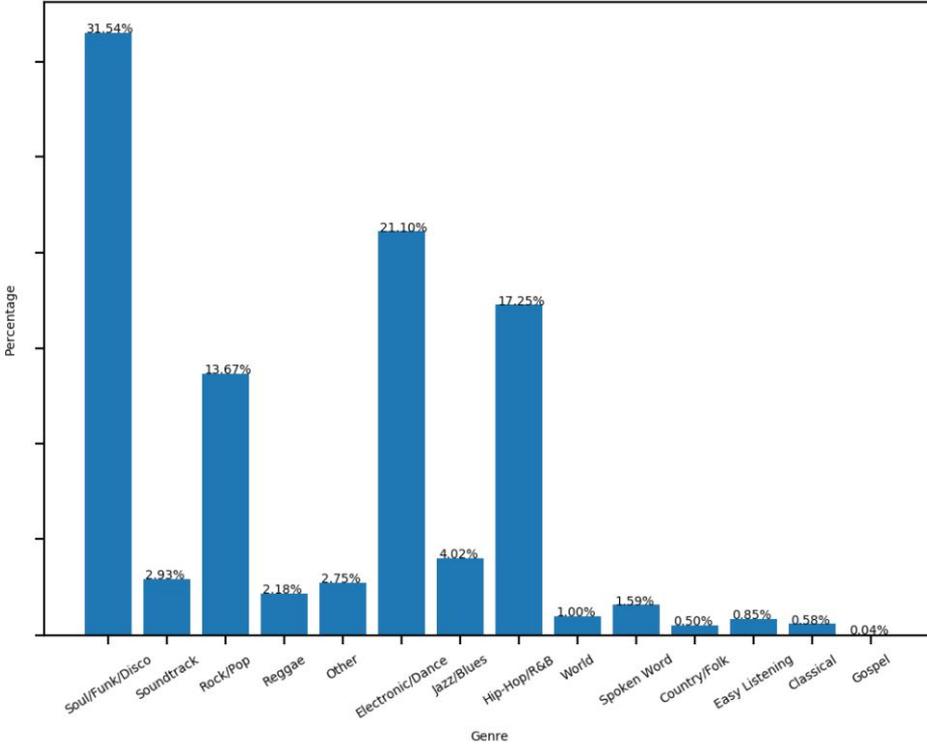


**How strong is
intra-genre
sampling?**

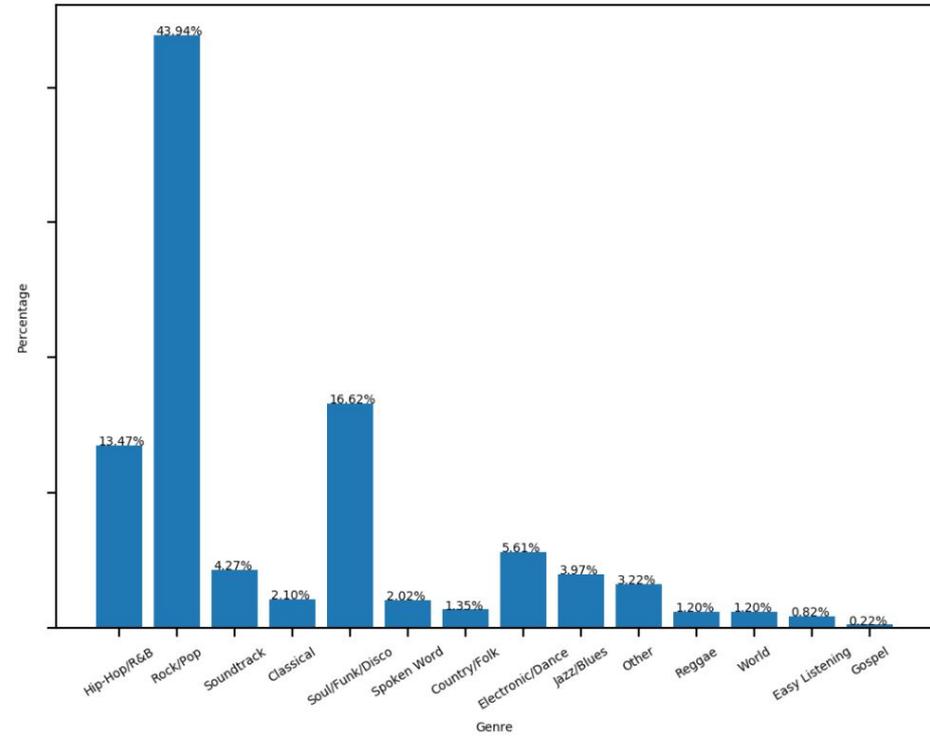
Hip-Hop/R&B's Most **Sampled** Genres



Electronic/Dance's Most **Sampled** Genres



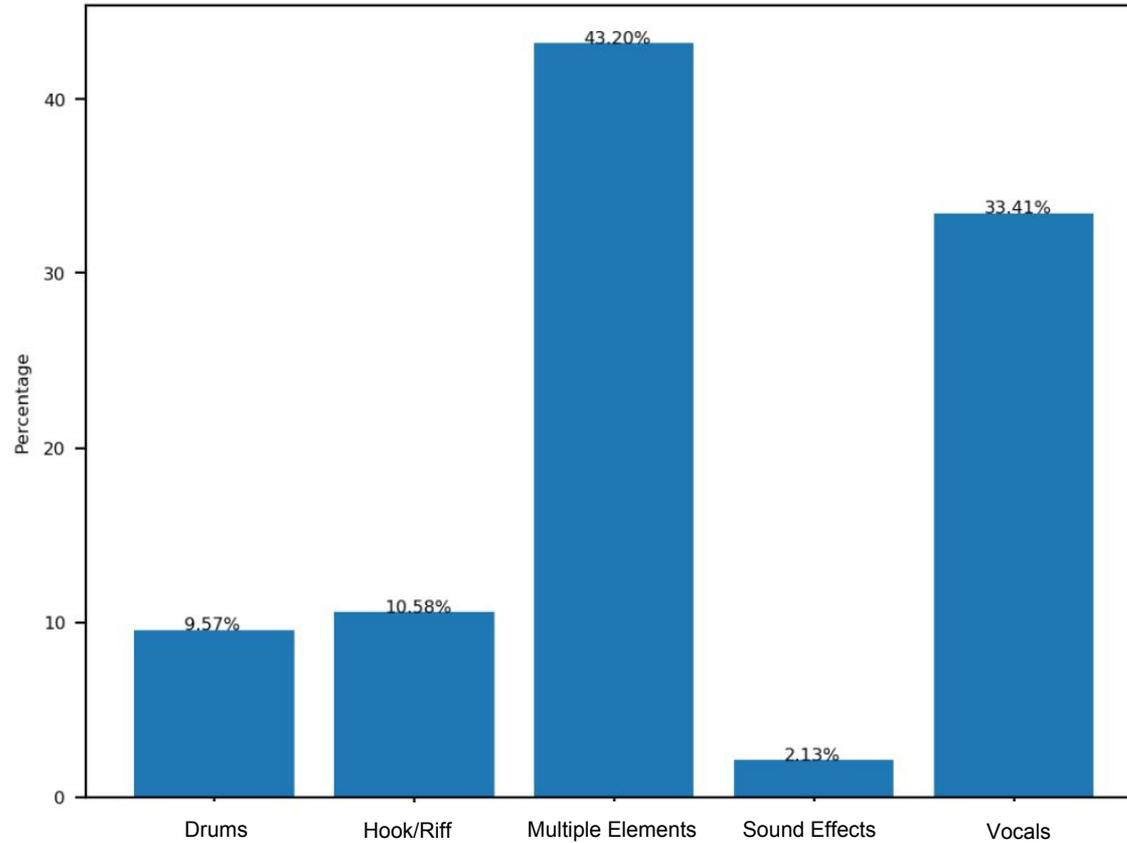
Rock/Pop's Most **Sampled** Genres



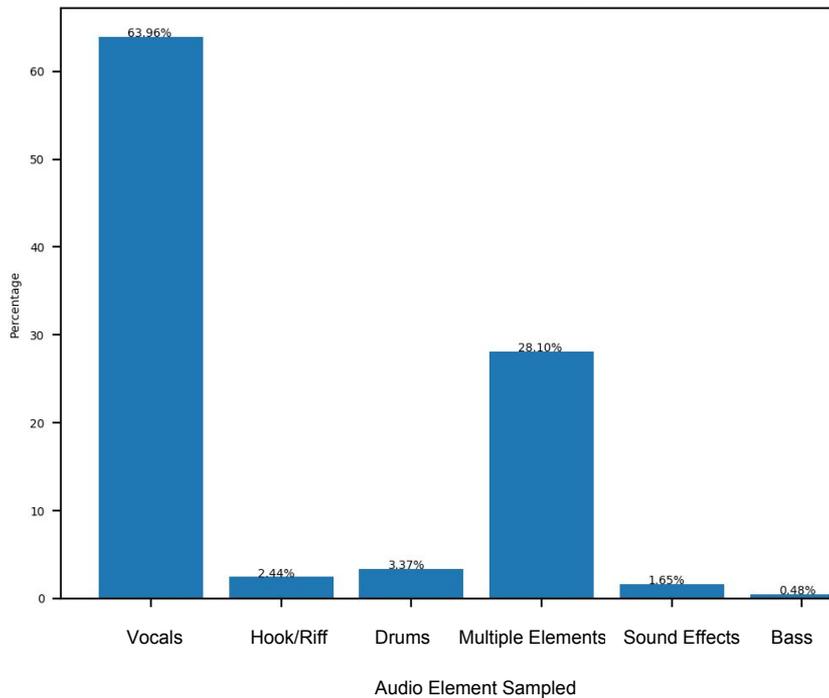


Audio Elements
were not the
most telling
property...

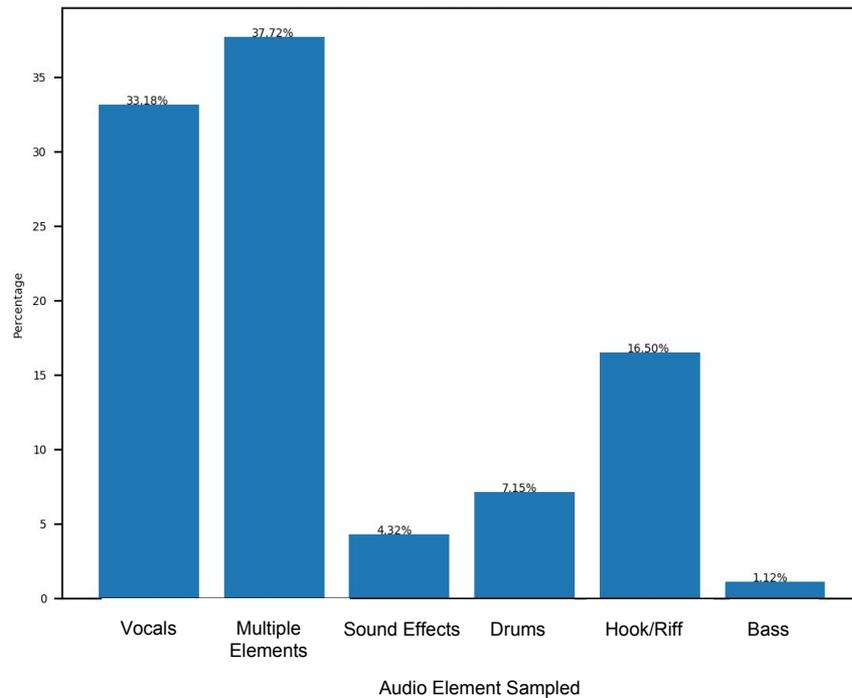
Percentage of Audio Elements **Sampled** Overall



Hip-Hop/R&B's Most **Sampled** Audio Elements



Electronic/Dance's Most **Sampled** Audio Elements





What about Centrality Influence?

In-Degree Centrality

(Calculates the fraction of nodes from the entire graph that the node is connected to)



Year	Overall	1980's	1990's	2000's
Top 5 Artists	1. James Brown	1. James Brown	1. James Brown	1. James Brown
	2. The Winstons	2. Beside	2. Public Enemy	2. The Winstons
	3. Public Enemy	3. Run-DMC	3. The Winstons	3. The Notorious B.I.G.
	4. Lyn Collins	4. Public Enemy	4. Lyn Collins	4. Beside
	5. Beside	5. Kurtis Blow	5. Run-DMC	5. Public Enemy

Katz Centrality

(Determines a node's centrality based on the centrality of its neighbors)



Year	Overall	1980's	1990's	2000's
Top 5 Artists	1. James Brown	1. James Brown	1. James Brown	1. The Notorious B.I.G.
	2. Public Enemy	2. Beside	2. Public Enemy	2. James Brown
	3. Lyn Collins	3. Run-DMC	3. Lyn Collins	3. Public Enemy
	4. Run-DMC	4. Kurtis Blow	4. N.W.A	4. Beside
	5. LL Cool J	5. Public Enemy	5. Run-DMC	5. The Winans

PageRank

(Similar to Katz Centrality but uses the directed nature of the network)



Year	Overall	1980's	1990's	2000's
Top 5 Artists	1. James Brown	1. James Brown	1. James Brown	1. Run-DMC
	2. Lyn Collins	2. Fred Wesley	2. Lyn Collins	2. Public Enemy
	3. Afrika Bambaataa	3. The J.B's	3. Afrika Bambaataa	3. The Notorious B.I.G.
	4. Public Enemy	4. Afrika Bambaataa	4. Public Enemy	4. James Brown
	5. The Winstons	5. Beside	5. The Winstons	5. Beside



Conclusion

- Soul/Funk/Disco is the **most influential genre** overall but Hip-Hop/R&B has recently challenged this
- James Brown is **one of the most influential artists** throughout all eras of music
- **Intra-genre influences** are strong!
- Artists tend to sample Multiple Elements of a song OR just Vocals BUT **no genre-based patterns emerged**



Acknowledgements

- Professor Andrea LaPaugh
- Princeton University Library
- WhoSampled Support



Citations

- [1] N. J. Bryan and G. Wang, "Musical influence network analysis and rank of sample-based music," in ISMIR, 2011.
- [2] M. G. Albán, V. Choksi, and S. B. Tsai, "Cs 224 w final report: Influence networks in popular music," 2015.