

Solving and Dissolving Musical Affection

A Critical Study of Spotify and Automated Music
Recommendation in the 21st Century

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Introduction

- Gert Lanckriet's UCSD presentation, of 2015?

¹Luke Barrington, Reid Oda, and Gert RG Lanckriet. "Smarter than Genius? Human Evaluation of Music Recommender Systems.". In: *ISMIR*. vol. 9. Citeseer. 2009, pp. 357–362.

- Gert Lanckriet's UCSD presentation, of 2015?

“We evaluate this comparison with a user study of 185 subjects. Overall, Genius produces **the best recommendations.**”¹

- Unapologetically commercial science (Amazon / UCSD) delivered in the context of a department of experimental music.

¹Barrington, Oda, and Lanckriet, “Smarter than Genius? Human Evaluation of Music Recommender Systems.”

- “Curatorial Turn” in Music Studies
 - Andrea Moore² (also presented in IS Focus)
 - William Robin³

²Andrea Moore. “Neoliberalism and the Musical Entrepreneur”. In: *Journal of the Society for American Music* 10.1 (2016), pp. 33–53.

³William Robin. “Balance Problems: Neoliberalism and New Music in the American University and Ensemble”. In: *Journal of the American Musicological Society* 71.3 (2018), pp. 749–793.

Motivating Factors

- MIR - “music informational retrieval”
- MER - “music emotion recognition”
- The “2DES” – valence X arousal
- Anecdotal dissatisfaction with Spotify recommendations

Spotify “Audio Features”

Ginuwine, “Pony” (1996)

```
{
  "danceability": 0.749,
  "energy": 0.605,
  "key": 8,
  "loudness": -9.359,
  "mode": 0,
  "speechiness": 0.086,
  "acousticness": 0.00186,
  "instrumentalness": 0.0381,
  "liveness": 0.115,
  "valence": 0.966,
  "tempo": 142.024,
  "type": "audio_features",
  "id": "6mz1fBdKATx6qP4oP1I65G",
  "uri": "spotify:track:6mz1fBdKATx6qP4oP1I65G",
  "track_href": "https://api.spotify.com/v1/tracks/6mz1fBdKATx6qP4oP1I65G",
  "analysis_url": "https://api.spotify.com/v1/audio-analysis/6mz1fBdKATx6qP4oP1I65G",
  "duration_ms": 251733,
  "time_signature": 4
}
```


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  "duration_ms": 251733,
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}
```

Machine listening: Ab minor, 142 bpm

Pony, transcribed

A musical score for a song titled 'Pony'. The score is written for voice and piano. The voice part is in the treble clef, and the piano part is in the bass clef. The key signature has two flats (B-flat and E-flat), and the time signature is common time (C). The lyrics are: 'got ta be com- pa- ti- b- le take me to my li- mit'. The piano accompaniment features a D-flat minor 7 chord (Dbm7) in the first measure and a G-flat minor 7 chord (Gbm7) in the second measure. The piano part consists of a series of eighth and quarter notes in the bass line.

got ta be com- pa- ti- b- le take me to my li- mit

Dbm⁷ Gbm⁷

“True” Key: D-flat...“minor”, tempo = ca. 70 bpm

Pony, transcribed

got ta be com- pa- ti- b- le take me to my li- mit

D \flat m⁷ G \flat m⁷

"True" Key: D-flat... "minor", tempo = ca. 70 bpm

Many other critiques are easy to make:

- “Valence” is too simple
- Does music even always “have” emotions?
- What about genres for which these audio features have no meaning?

Notorious BIG, Unbelievable (I) (2005 remaster)

```
{
  "danceability": 0.78,
  "energy": 0.926,
  "key": 6,
  "loudness": -3.913,
  "mode": 0,
  "speechiness": 0.284,
  "acousticness": 0.224,
  "instrumentalness": 0.0000622,
  "liveness": 0.136,
  "valence": 0.781,
  "tempo": 91.627,
  "type": "audio_features",
  "id": "5qBfyjlx8U9Jgi4l1Y0e4C",
  "uri": "spotify:track:5qBfyjlx8U9Jgi4l1Y0e4C",
  "track_href": "https://api.spotify.com/v1/tracks/5qBfyjlx8U9Jgi4l1Y0e4C",
  "analysis_url": "https://api.spotify.com/v1/audio-analysis/5qBfyjlx8U9Jgi4l1Y0e4C",
  "duration_ms": 220040,
  "time_signature": 4
}
```

Machine Listening: Gb minor, 92 bpm

Notorious BIG, Unbelievable (I) (2005 remaster)

```
{
  "danceability": 0.78,
  "energy": 0.926,
  "key": 6,
  "loudness": -3.913,
  "mode": 0,
  "speechiness": 0.284,
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  "duration_ms": 220040,
  "time_signature": 4
}
```

Machine Listening: Gb minor, 92 bpm

True key: Ab...“minor”

Notorious BIG, Unbelievable (II) (original)

```
{
  "danceability" : 0.769,
  "energy" : 0.791,
  "key" : 6,
  "loudness" : -7.679,
  "mode" : 0,
  "speechiness" : 0.261,
  "acousticness" : 0.179,
  "instrumentalness" : 0.000642,
  "liveness" : 0.258,
  "valence" : 0.773,
  "tempo" : 182.949,
  "type" : "audio_features",
  "id" : "4heC6SnTBxTZZDef4AIB0k",
  "uri" : "spotify:track:4heC6SnTBxTZZDef4AIB0k",
  "track_href" : "https://api.spotify.com/v1/tracks/4heC6SnTBxTZZDef4AIB0k",
  "analysis_url" : "https://api.spotify.com/v1/audio-analysis/4heC6SnTBxTZZDef4AIB0k",
  "duration_ms" : 223707,
  "time_signature" : 4
}
```

Machine Listening: Gb minor, 182 bpm

Two versions, previewed



Figure 1: Quartal harmony in the Unbelievable beat

True key: Ab...“minor”

Version I (remaster) preview

Version II preview

Guiding questions

- Just how different are human and machine representations of music?
- What is lost in translating from one to the other?
- How does automated music recommendation work?
- Does it really just recommend more of the same stuff over and over?
- Is there implicit bias in automated music recommendation?
- What does it mean for our music culture that automated music recommendations are at the center of the music business today?

- Case Study: Spotify, the largest streaming site and the most conspicuously data-driven

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- Spotify's relationship to the history of US copyright law

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- Music and philosophical considerations about the role of technology in culture

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- Statistical Shadowboxing with Spotify's API: "dissolving" musical affection
- Spotify and Platform Capitalism

1. Spotify isn't as new as it seems.

⁴“All models are wrong, but some are useful.”

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2. Spotify API, Whitman (2005), Putnam (1975), and the GUI all go together well, in such a way as to sketch what can be termed a "theory" of musical meaning.

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2. Spotify API, Whitman (2005), Putnam (1975), and the GUI all go together well, in such a way as to sketch what can be termed a “theory” of musical meaning.
 - Human music behavior is predictable
 - Music as soundtrack/affect management/adjunct to activities
 - Surveilled user behavior + audio signal = meaning

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 - Human music behavior is predictable
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 - Surveilled user behavior + audio signal = meaning
3. This theory lacks explanatory power; its “usefulness” (Box) is commercial, not scientific.⁴

⁴“All models are wrong, but some are useful.”

4. Spotify represents the kind of social-scientific knowledge about which the “Chomskian Revolution” cautions humility.⁵

⁵Harry M. Bracken. “Minds and Learning: The Chomskian Revolution”. In: *Metaphilosophy* 4.3 (1973), pp. 229–245.

⁶Nick Srnicek. *Platform Capitalism*. Polity Press, 2016.

4. Spotify represents the kind of social-scientific knowledge about which the “Chomskian Revolution” cautions humility.⁵
5. Statistical probes (chap 5) are interesting because they confront the same logical conundrum facing Spotify itself.

⁵Bracken, “Minds and Learning: The Chomskian Revolution”.

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5. Statistical probes (chap 5) are interesting because they confront the same logical conundrum facing Spotify itself.
6. Spotify is a case of “platform capitalism.”⁶

⁵Bracken, “Minds and Learning: The Chomskian Revolution”.

⁶Srnicek, *Platform Capitalism*.

- Music is becoming “relational” (Whitman 2005)

“So whether you’re behind the wheel, working out, partying or relaxing, the right music or podcast is always at your fingertips.”⁷

⁷<https://www.spotify.com/us/about-us/contact/>.

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- Syntax, Semantics, Music

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- Syntax, Semantics, Music
- Solution and Dissolution: logical opacity of critiquing recommendations

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- Solution and Dissolution: logical opacity of critiquing recommendations
- Science vs. Engineering
- Novelty, disruption

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Twin Earth, Internalism, Music

“Twin Earth” thought experiment (Putnam 1975)

| | |
|------------------|--------------|
| Earth | Twin Earth |
| Oscar | Twin Oscar |
| <i>Water</i> | <i>Water</i> |
| H ₂ O | XYZ |

Do Oscar and Twin Oscar “mean” the same thing when they say *water*?

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No. Therefore, meaning ain’t in the “head.” “Semantic Externalism.”

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Chomsky on “Meaning ain’t in the head”

The Rise of the Bad Machines: A Legal Prehistory of Spotify (chap 1)

MARKETS

Spotify CEO Daniel Ek: Once the Music Industry's Slayer, Now Its Savior

The Swedish entrepreneur built his business by proving its value to artists and record-label executives

Why Spotify may actually be the music industry's saviour



By **Rhiannon Williams**

Thursday, 5th April 2018, 8:58 pm

Updated Friday, 6th September 2019, 8:09 pm



Spotify Saved the Music Industry. Now What?

Profits are hard to come by—and Apple and Amazon aren't going away.

By [Andrew Nusca](#)

October 21, 2019

How Spotify Saved the Music Industry (But Not Necessarily Musicians) (Ep. 374)

April 10, 2019 @ 11:00pm

by **Stephen J. Dubner**

Produced by **Matt Frassica**



If Spotify is the “savior” of the industry, how does it manage to succeed where Napster failed?

⁸Benjamin W. Rudd. *Notable Dates in American Copyright, 1783-19669*. URL: <https://www.copyright.gov/history/dates.pdf> (visited on 06/13/2019).

If Spotify is the “savior” of the industry, how does it manage to succeed where Napster failed?

- 1909 Copyright Act. Copyrights are “not primarily for the benefit of the author, but primarily for the benefit of the public.”⁸

⁸Rudd, *Notable Dates in American Copyright, 1783-19669*.

If Spotify is the “savior” of the industry, how does it manage to succeed where Napster failed?

- 1909 Copyright Act. Copyrights are “not primarily for the benefit of the author, but primarily for the benefit of the public.”⁸
- 1976 Copyright Act: Audio recordings become copyrightable, works are protected at the federal level from the moment author begins work on them.

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If Spotify is the “savior” of the industry, how does it manage to succeed where Napster failed?

- 1909 Copyright Act. Copyrights are “not primarily for the benefit of the author, but primarily for the benefit of the public.”⁸
- 1976 Copyright Act: Audio recordings become copyrightable, works are protected at the federal level from the moment author begins work on them.
- 1984 *Sony v. Universal City Studios, Inc.* – “Betamax Rule”
 - “Time shifting” is legal, and so is the Betamax even though it makes certain infringing activities possible.

⁸Rudd, *Notable Dates in American Copyright, 1783-19669*.

Justice Stevens Questions Stephen Kroft in the Betamax Case

Stevens and Kroft

(begins with Kroft talking about Xerox inoculating itself from charge of contributory infringement)

Stevens: But your view of the law is that as long as Xerox knows that there's some illegal copying going on, Xerox is a contributory infringer?

.....

Kroft: To be consistent, your honor, I'd have to say yes.

Stevens: A rather extreme position.

- 1992 Audio Home Entertainment Act: Grapples with the advent of DAT (“The Technical Fix”⁹)
- 1998 Digital Millenium Copyright Act
 - “The protection of expression is for the first time achieved through the regulation of devices.”¹⁰
 - “Bad Machines” and “Bad Services”
 - Section 1201

⁹Tarleton Gillespie. *Wired Shut: Copyright and the Shape of Digital Culture*. MIT Press, 2007.

¹⁰Robert P. Merges. “One Hundred Years of Solicitude: Intellectual Property Law, 1900-2000”. In: *California Law Review* 88.6 (2000), pp. 2187–2240, p. 2202.

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 - “Bad Machines” and “Bad Services”
 - Section 1201
- *A&M Records, Inc. v. Napster, Inc.* (settled 2001)
 - Industry “war” with customers (Edgard Bronfman)...but who won?

⁹Gillespie, *Wired Shut: Copyright and the Shape of Digital Culture*.

¹⁰Merges, “One Hundred Years of Solicitude: Intellectual Property Law, 1900-2000”, p. 2202.

A.I., Critical Algo Studies and Music (chapter 2)

What can music tell us about algorithmic mediation in culture?

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- Searle, Putnam, Weizenbaum, Dreyfus, Schank, RAND corporation

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3. Technology in musical culture
 - Greg Kot, *Ripped: How the Wired Generation Revolutionized Music* (2009)
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 - Johansson et al, *Streaming Music: Practices, Media, Cultures* (2018)

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- Nolan Gasser, *Why You Like It: The Science and Culture of Musical Taste* (2019)
- Johansson et al, *Streaming Music: Practices, Media, Cultures* (2018)
- Eriksson et al, *Spotify Teardown: Inside the Black Box of Streaming Music* (2019)

Unique position of Music

- Philosophical
- Empirical/ethical

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→ Music has a foot in both doors. E.g. it can involve,

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→ Music has a foot in both doors. E.g. it can involve,

- Emotional qualia, and their derivability from matter.
- An algorithm's potential to reproduce the structural prejudice in its ground truth data.

What does Music Mean to Spotify? (chap 3)

What does Music Mean to Spotify?

1. History of Spotify: Toward Curation
2. Brian Whitman, 2005 MIT Media Lab Diss, “Learning the Meaning of Music”
3. Is Spotify Using the Echo Nest?

What does Music Mean to Spotify?

1. History of Spotify: Toward Curation
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What does Music Mean to Spotify?

1. History of Spotify: Toward Curation
2. Brian Whitman, 2005 MIT Media Lab Diss, “Learning the Meaning of Music”
3. Is Spotify Using the Echo Nest? (basically, yes)
4. What is the nature of that “theory”?

History of Spotify: Toward Curation

- 2005, founded in Sweden
- 2005 – “Learning the Meaning of Music,” Brian Whitman, MIT Media Lab
- 2008, Spotify enters US market: “You’ll be amazed by the speed and control...”
- ca. 2012, partners with Facebook
- 2013, Acquires Tunigo
- 2014, acquires the Echo Nest
- 2015, launches Discover Weekly
- 2015, Acquires Seed Scientific
- 2016, launches Daily Mix
- 2019, Daily Drive: “Soundtrack your life with Spotify.”

Spotify Promotional Materials, then and now

2006:

Spotify gives you the music you want, when you want it. Your choice is just a search box or a friendly recommendation away. You'll be amazed by the speed and control you have with Spotify.

2019:

With Spotify, it's easy to find the right music for every moment. Choose what you want to listen to, or let Spotify surprise you. Soundtrack your life with Spotify.

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Daniel Ek, founder of Spotify

We believe that music should be like water. It should just exist everywhere so if you think about that for a moment. What we are really trying to do (is) making music more accessible.

We want music to be everywhere and in every device, in every place. It really doesn't matter where in the world that is or on what device that is or what I'm doing. I should always have music accessible.

- Market pressures make automated recommendations necessary

Striking Correspondence

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- Automated recommendations make a codified “theory of musical meaning” necessary

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 - Musical meaning “ain’t in the head” (citing Putnam). It’s, instead, in the relationship between “cultural metadata” and audio signal.

- Market pressures make automated recommendations necessary
- Automated recommendations make a codified “theory of musical meaning” necessary
- “Learning the Meaning of Music” (Whitman 2005)
 - Musical meaning “ain’t in the head” (citing Putnam). It’s, instead, in the relationship between “cultural metadata” and audio signal.
- This “theory” makes musical meaning “relational.”

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- Market pressures make automated recommendations necessary
- Automated recommendations make a codified “theory of musical meaning” necessary
- “Learning the Meaning of Music” (Whitman 2005)
 - Musical meaning “ain’t in the head” (citing Putnam). It’s, instead, in the relationship between “cultural metadata” and audio signal.
- This “theory” makes musical meaning “relational.”
- Hence Ellen’s music is “like salt,” Ek’s “music is like water,” or the citation of Putnam.

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1. People who want musical meaning to come from the audio signal alone.
2. “Absolutists” like Leonard Meyer.

Whitman positions himself against:

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2. “Absolutists” like Leonard Meyer.

But...

- Leonard Meyer *does* in fact address what Whitman terms “cultural metadata” – it’s just not relevant to his inquiry into “musical meaning.”

Whitman positions himself against:

1. People who want musical meaning to come from the audio signal alone.
2. “Absolutists” like Leonard Meyer.

But...

- Leonard Meyer *does* in fact address what Whitman terms “cultural metadata” – it’s just not relevant to his inquiry into “musical meaning.”
- Both theories (Meyer’s and Whitman’s) privilege the signal equally – signal goes in, reaction comes out. Whitman’s signal goes into a machine, not a person, and is in a sense more “absolutist” than Meyer’s.

Whitman and Meyer

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2. “Absolutists” like Leonard Meyer.

But...

- Leonard Meyer *does* in fact address what Whitman terms “cultural metadata” – it’s just not relevant to his inquiry into “musical meaning.”
- Both theories (Meyer’s and Whitman’s) privilege the signal equally – signal goes in, reaction comes out. Whitman’s signal goes into a machine, not a person, and is in a sense more “absolutist” than Meyer’s.
- This is not the difference between “absolutists” and “relationists,” but between theories of meaning that **do and don’t have explanatory power.**

Summary, chap 2-3

- Two periods of “critical algorithms studies,” neither of which addresses music, though both should or could.
- Whitman’s dissertation (2005), Spotify today articulate similar values, which Whitman is **correct** to associate with Putnam.
- “Theory of musical meaning”:
 - Human behavior, including musical, is predictable.
 - It’s “relational” – “sloppy social science” (putnam)
 - It’s in the data somewhere, doesn’t matter where.
- Whitman misreads Leonard B. Meyer – they’re not actually on different sides of the Meaning question. They differ, instead, in terms of what “usefulness” means.

Typology of Theories of Musical Meaning in 20th Century (chap 4)

- Putnam/Whitman: Twin Earth, “sloppy social science”
- Chomsky: You can locate “meaning” wherever you want, so that it’s in the head or not.
- Explanatory power frames the “typology.”

Typology of Theories of Musical Meaning

Table 4.1: Typology of theories of musical meaning

| | |
|--|--------------------------------|
| Musical meaning is a category error | Kivy, Lerdahl and Jackendoff |
| Musical meaning is affective | Meyer, Davies |
| Music has semiotic properties if not linguistic | Nattiez, Agawu, Ratner, Monson |
| Musical meaning resides in its very interpretation | Kramer, Serafine, Monelle |
| Music discloses and critiques social truths and contradictions | McClary, Subotnik, Adorno |
| Music's meaning resides in how we use it to create identity and regulate behavior | Frith, DeNora |

Questions these theories answer

- Why do we love music?
- According to what rules does the music organ function?
- Why do we write about music?
- Why do some musical tropes have such unmistakable connotative power?
- What do certain pieces of music “say” and “do?”

...what question does Whitman (2005) or Spotify answer?

Statistical Shadowboxing with Spotify (chap 5)

Experiment Design

1. Get all 125 Spotify musical “genres”
2. API can use these genres as recommendation “seeds”
3. API yields “analysis” and “audio features” for each song ID
4. Data set:
 - 500 audio features objects per genre
 - 100 audio analysis objects per genre
5. Sample from the data set to get synthetic “playlists”
6. Observe geometric properties of those playlists

- 1 recommendation many times or many recommendations one time?
- Spotify API vs. Spotify GUI/actual service
- Normalization
- Repetitions
- What is a good recommendation?

Most repeating genres

| genre | total number of unique songs in playlist, n=500 |
|------------------|---|
| new-release.json | 50 |
| funk.json | 80 |
| pop-film.json | 96 |
| indie-pop.json | 98 |
| club.json | 99 |
| groove.json | 99 |
| metal-misc.json | 99 |
| brazil.json | 100 |
| hard-rock.json | 100 |

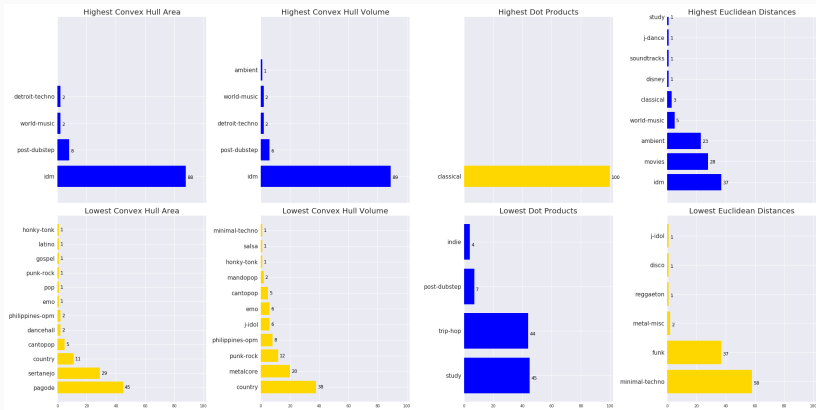
Least repeating genres

| genre | total number of unique songs in playlist, n=500 |
|-----------------|---|
| j-rock.json | 321 |
| party.json | 321 |
| reggaeton.json | 320 |
| british.json | 319 |
| ska.json | 319 |
| electronic.json | 318 |
| deep-house.json | 315 |
| indian.json | 315 |
| turkish.json | 315 |

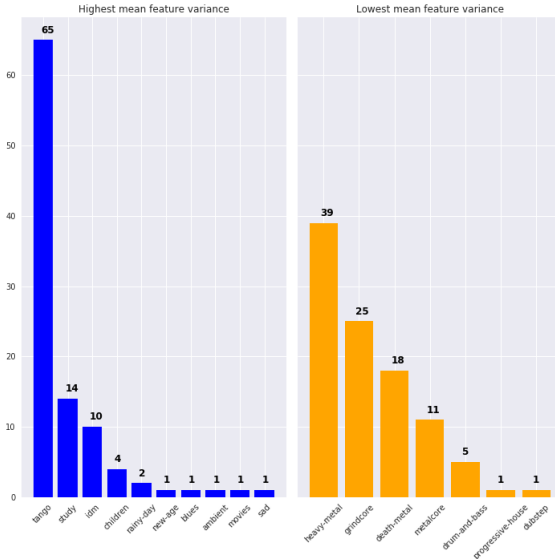
Diversity, four metrics

- Convex hull area
- Convex hull volume
- Average Euclidean distance between all track pairs
- Average dot product between all track pairs.

Diversity, by four metrics



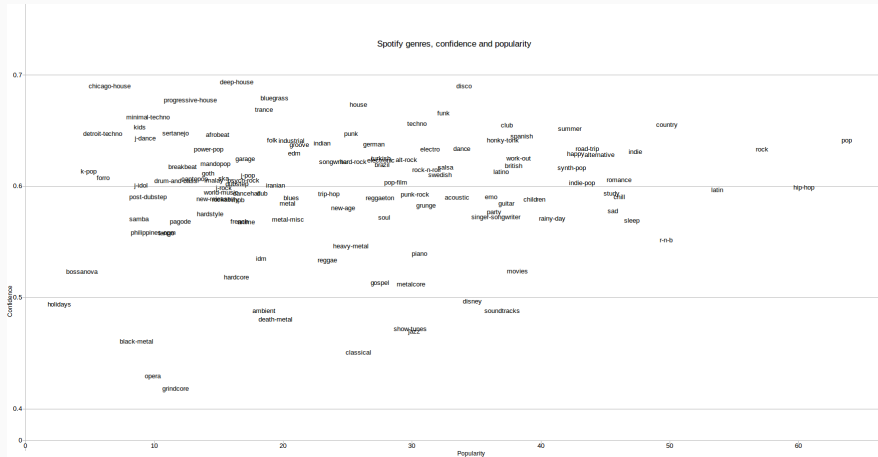
Diversity, average feature variance



Determine least and most varying feature per genre. E.g., the feature that varied least for genre “alt-rock” (i.e. the most discriminating musical quality), was “speechiness” 100% of the time. (Table 5.1, pp. 187ff.)

Plot average “confidence” against average “popularity” per genre.

Confidence and popularity (p. 192)



Discussion of experiments

- There are significant differences in how many original tracks are recommended per genre, an effect apparently not reducible to overall corpus size.
- It is not the case that the most diverse genres are the ones with most unique tracks.
- IDM seems to rank as the most “diverse” genre.
- Total number of “winners” and “losers”: it’s clustery on either end.
- For the vast majority of genres, there is one feature that we can say with high confidence is the least variant.

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“Musical meaning is elusive, in such a way that the most you can do with it is play around. That’s what these experiments are doing, and that’s what they tell us that Spotify is doing.” (p. 199)

Conclusion: Spotify, Semantic Skepticism, Platform Capitalism

Searle: “Meaning is too vaporous and unscientific a notion for use in a rigorous science of language.”

¹¹Bracken, “Minds and Learning: The Chomskian Revolution”.

Semantic Skepticism

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A doctrine which is connected to:

- “creativity” not under stimulus control (non-programmability of human language use).
- scientific humility; we know little, the validity of a given theory is in its explanatory power.
- A broad critique of social scientific knowledge.¹¹

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Spotify vs. Angry Birds vs. Tinder – which one has greater insight into musical meaning?

Possible revenue stream for Spotify

Tom Sparapani, former director of public policy at Facebook:

“most retailers are finding out that they have a secondary source of income, which is that the data about their customers is probably just about as valuable, maybe even more so, than the actual product or service that they’re selling to the individual.” (quoted in dissertation, p. 214)

- The innovation upon which the Spotify product is predicated (“learning the meaning of music”) is “vaporous.”

Claims: Conclusion

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- Its “usefulness” was always commercial.
- Its financial structure, however, is not vaporous.
- This suggests that it is something roughly equivalent to Tinder and Angry Birds, conforming to patterns of gamification and platform capitalism.

1. Spotify isn't as new as it seems.
2. Spotify API, Whitman (2005), Putnam (1975), and the GUI all go together well, in such a way as to sketch what can be termed a “theory” of musical meaning.
3. This theory lacks explanatory power; its “usefulness” (George Box) is commercial, not scientific.¹²
4. Spotify represents the kind of social-scientific knowledge about which the “Chomskian Revolution” cautions humility.
5. Statistical probes (chap 5) are interesting because they confront the same logical conundrum facing Spotify itself.
6. Spotify is a case of “platform capitalism.”

¹²“All models are wrong, but some are useful.”

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