Solving and Dissolving Musical Affection

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

Asher Tobin Chodos

12-10-2019

UCSD Dept. of Music

Table of contents

Introduction

Motivating Factors

- Gert Lanckriet's UCSD presentation, of 2015?

[1] Luke 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.

Motivating Factors

- 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.

[1] Barrington, Oda, and Lanckriet, "Smarter than Genius? Human Evaluation of Music Recommender Systems."

Motivating Factors

- "Curatorial Turn" in Music Studies
  - Andrea Moore[2] (also presented in IS Focus)
  - William Robin[3]

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

[3] William 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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  "time_signature": 4
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```
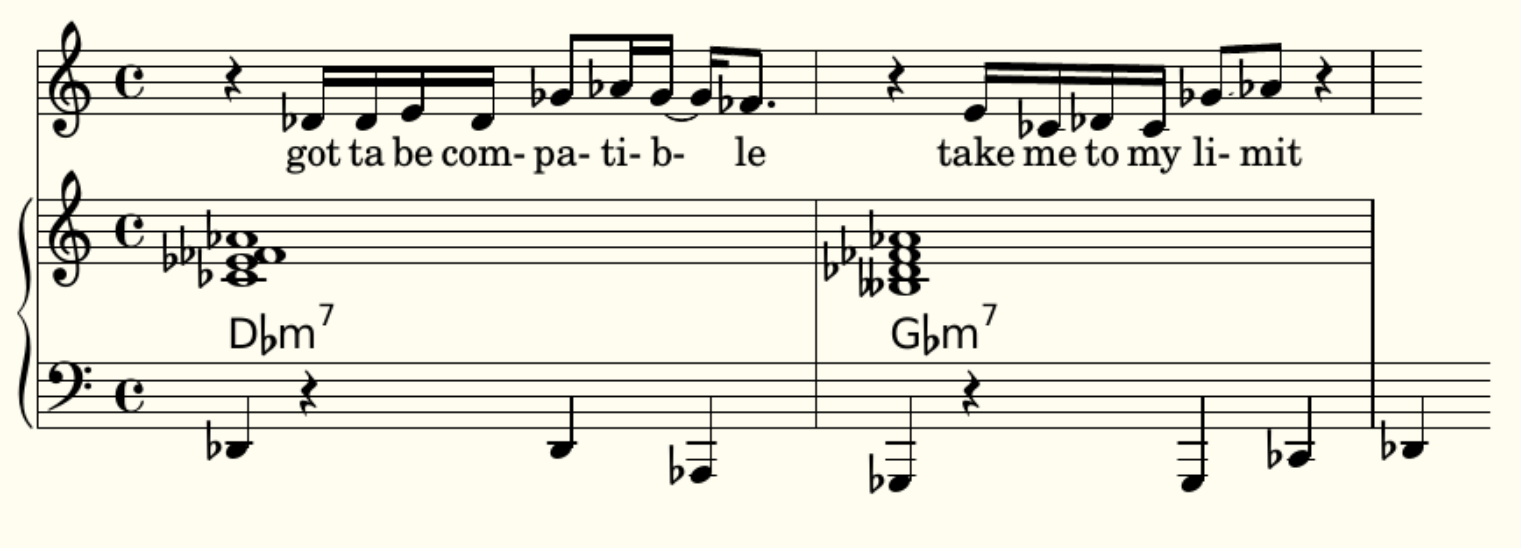


Machine listening: Ab minor, 142 bpm

Pony, transcribed



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

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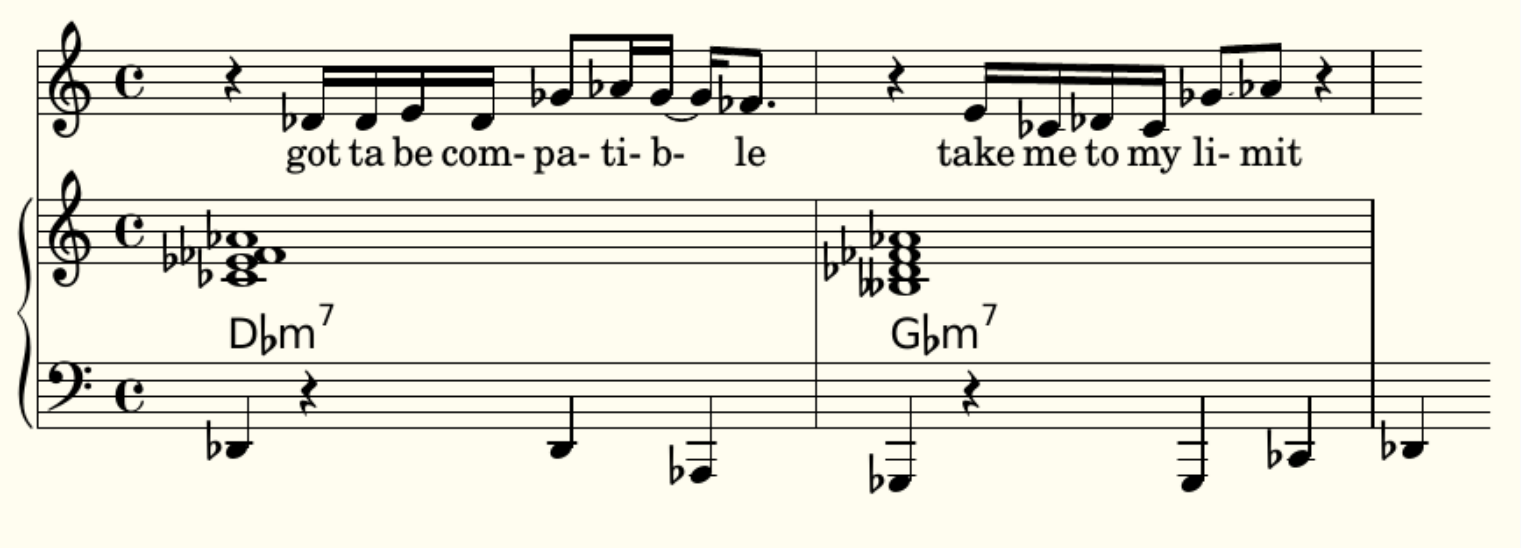

“True” Key: D-flat...“minor”, tempo = ca. 70 bpm

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": "5qBfyjlx8U9Jgi4l1YOe4C",
  "uri": "spotify:track:5qBfyjlx8U9Jgi4l1YOe4C",
  "track_href": "https://api.spotify.com/v1/tracks/5qBfyjlx8U9Jgi4l1YOe4C",
  "analysis_url": "https://api.spotify.com/v1/audio-analysis/5qBfyjlx8U9Jgi4l1YOe4C",
  "duration_ms": 220040,
  "time_signature": 4
}
```


Machine Listening: Gb minor, 92 bpm

Notorious BIG, Unbelievable (I) (2005 remaster)


```
{
  "danceability": 0.78,
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  "key": 6,
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  "mode": 0,
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  "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" : "4heC6SnTBxTZZDef4AIBOk",
  "uri" : "spotify:track:4heC6SnTBxTZZDef4AIBOk",
  "track_href" : "https://api.spotify.com/v1/tracks/4heC6SnTBxTZZDef4AIBOk",
  "analysis_url" : "https://api.spotify.com/v1/audio-analysis/4heC6SnTBxTZZDef4AIBOk",
  "duration_ms" : 223707,
  "time_signature" : 4
}
```


Machine Listening: Gb minor, 182 bpm

Two versions, previewed

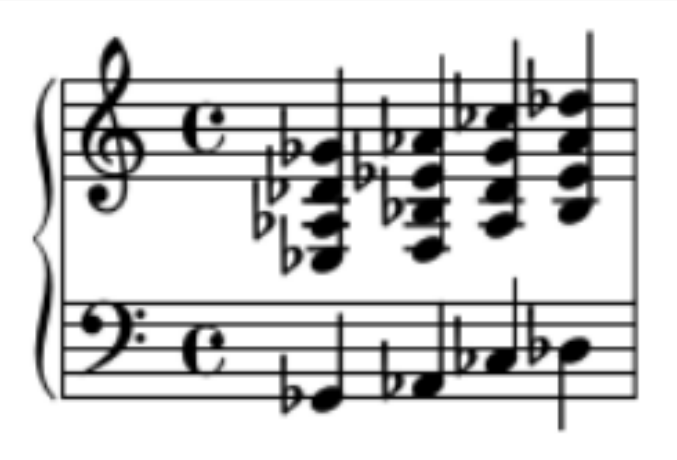

Figure 1: Quartal harmony in the Unbelievable beat

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?

Arrivals

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

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

Claims

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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    - Human music behavior is predictable
    - Music as soundtrack/affect management/adjunct to activities
    - 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."

Claims

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

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

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

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6. Spotify is a case of “platform capitalism.”[6]

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Themes

- 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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Twin Earth, Internalism, Music

"Twin Earth" thought experiment (Putnam 1975)

Earth	Twin Earth
Oscar	Twin Oscar
Water	*Water*
H20	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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Oscar	Twin Oscar
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H20	XYZ

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

No. Therefore, meaning ain't in the "head." "Semantic Externalism."

Chomsky on "Meaning ain't in the head"

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

Savior?

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

Savior?

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

Savior?

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

Savior?

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**

Legal Prehistory I

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

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

Legal Prehistory I

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]

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- 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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- 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.

[8] Rudd, *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 innoculating 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.

Legal Prehistory

- 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

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

[10] Robert 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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  - "The protection of expression is for the first time achieved through the regulation of devices."[10]
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  - Section 1201
- *A&M Records, Inc. v. Napster, Inc.* (settled 2001)
  - Industry "war" with customers (Edgard Bronfman)...but who won?

[9] Gillespie, *Wired Shut: Copyright and the Shape of Digital Culture*.
[10] Merges, "One Hundred Years of Solicitude: Intellectual Property Law, 1900-2000", p. 2202.

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

AI, Critical Algo Studies, Music

What can music tell us about algorithmic mediation in culture?

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    - Eriksson et al, *Spotify Teardown: Inside the Black Box of Streaming Music* (2019)

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- Empirical/ethical

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- An algorithm's potential to reproduce the structural prejudice in its ground truth data.

What does Music Mean to Spotify? (chap 3)

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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?

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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.*

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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.

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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.
- This “theory” makes musical meaning “relational.”
- Hence Ellen’s music is “like salt,” Ek’s “music is like water,” or the citation of Putnam.

Whitman and Meyer

Whitman positions himself against:

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- 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, Chomsky, Music

- 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

Issues

- 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

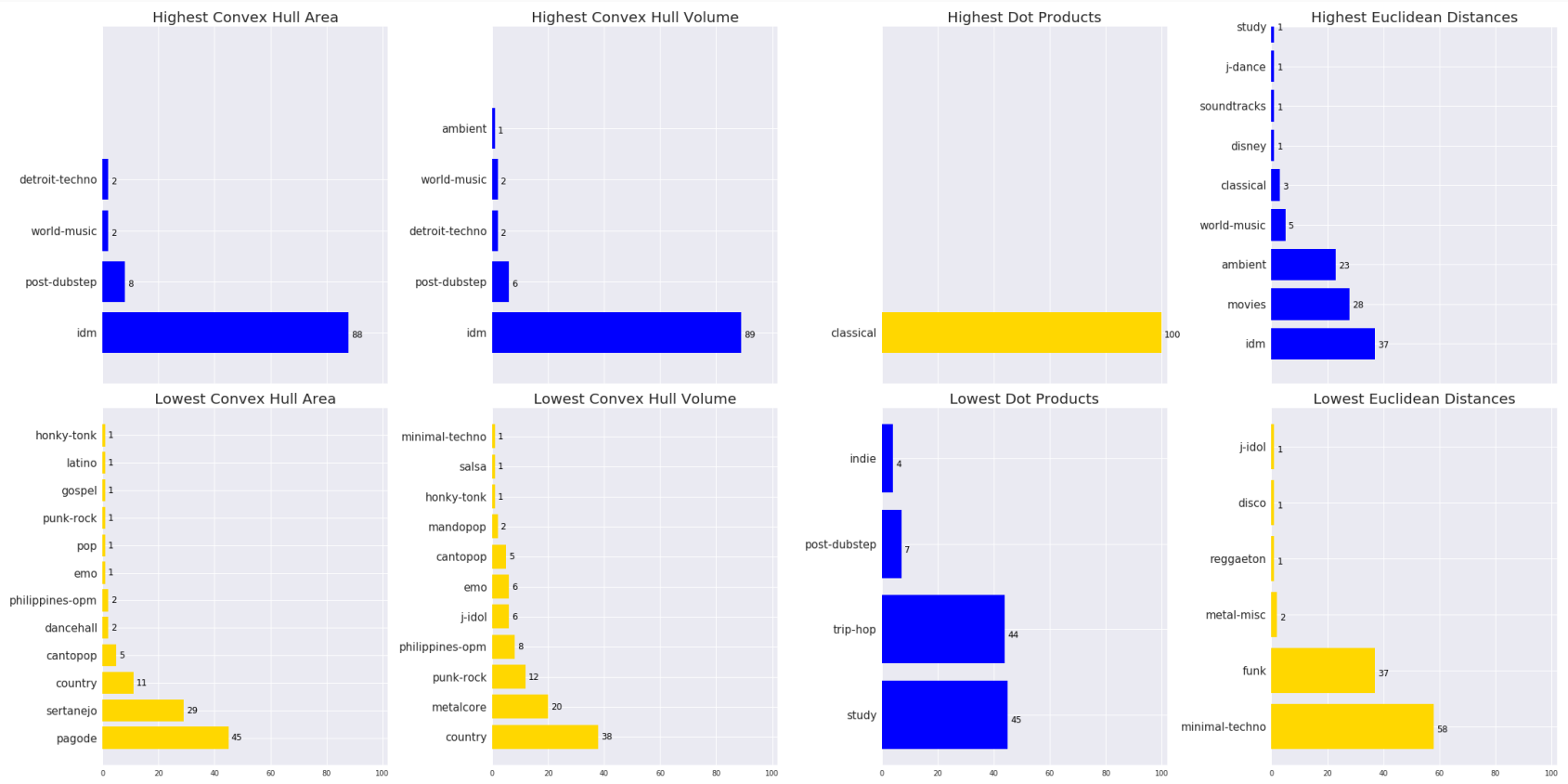
Least repeating genres

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

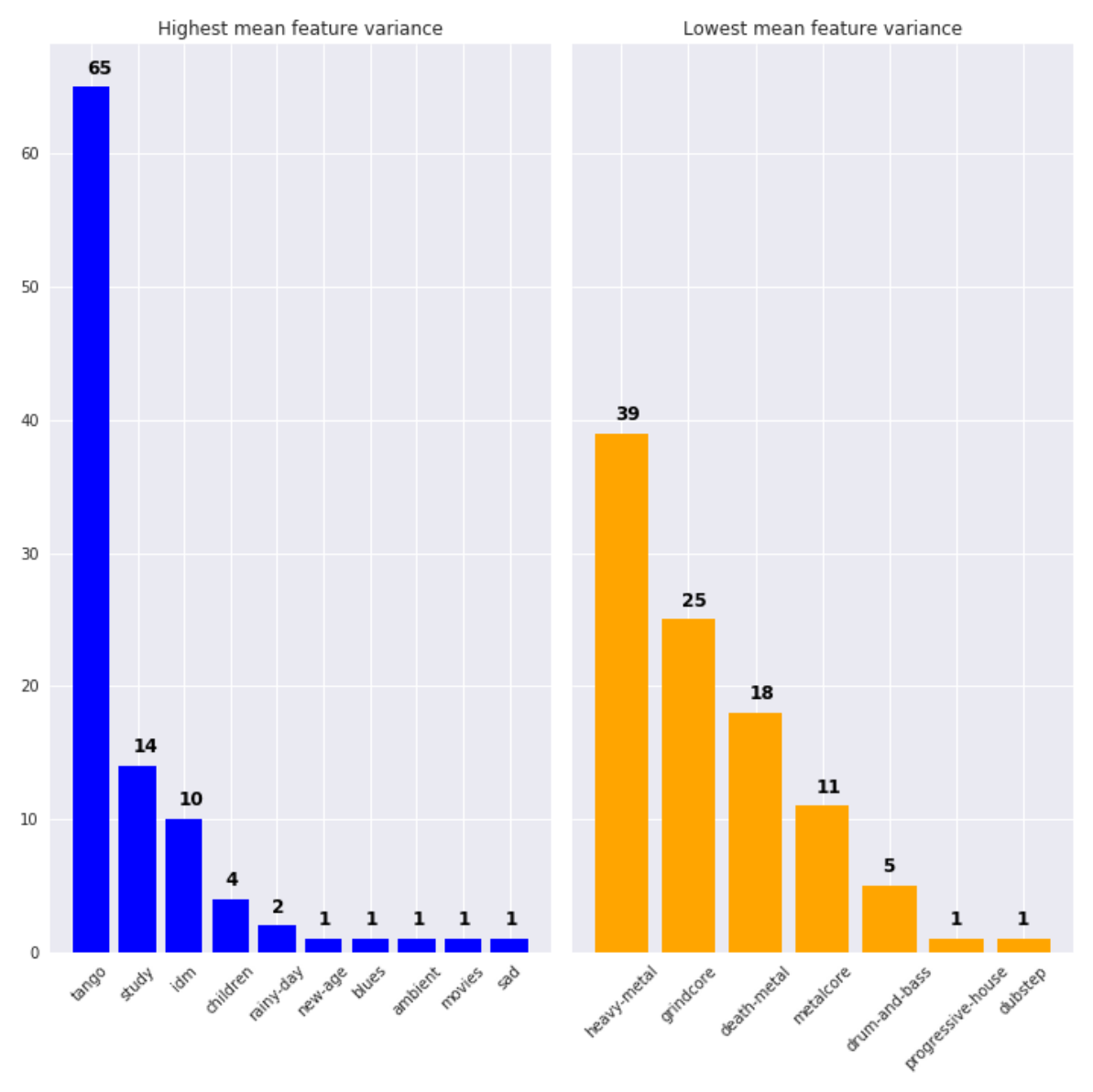
Diversity, four metrics

- 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

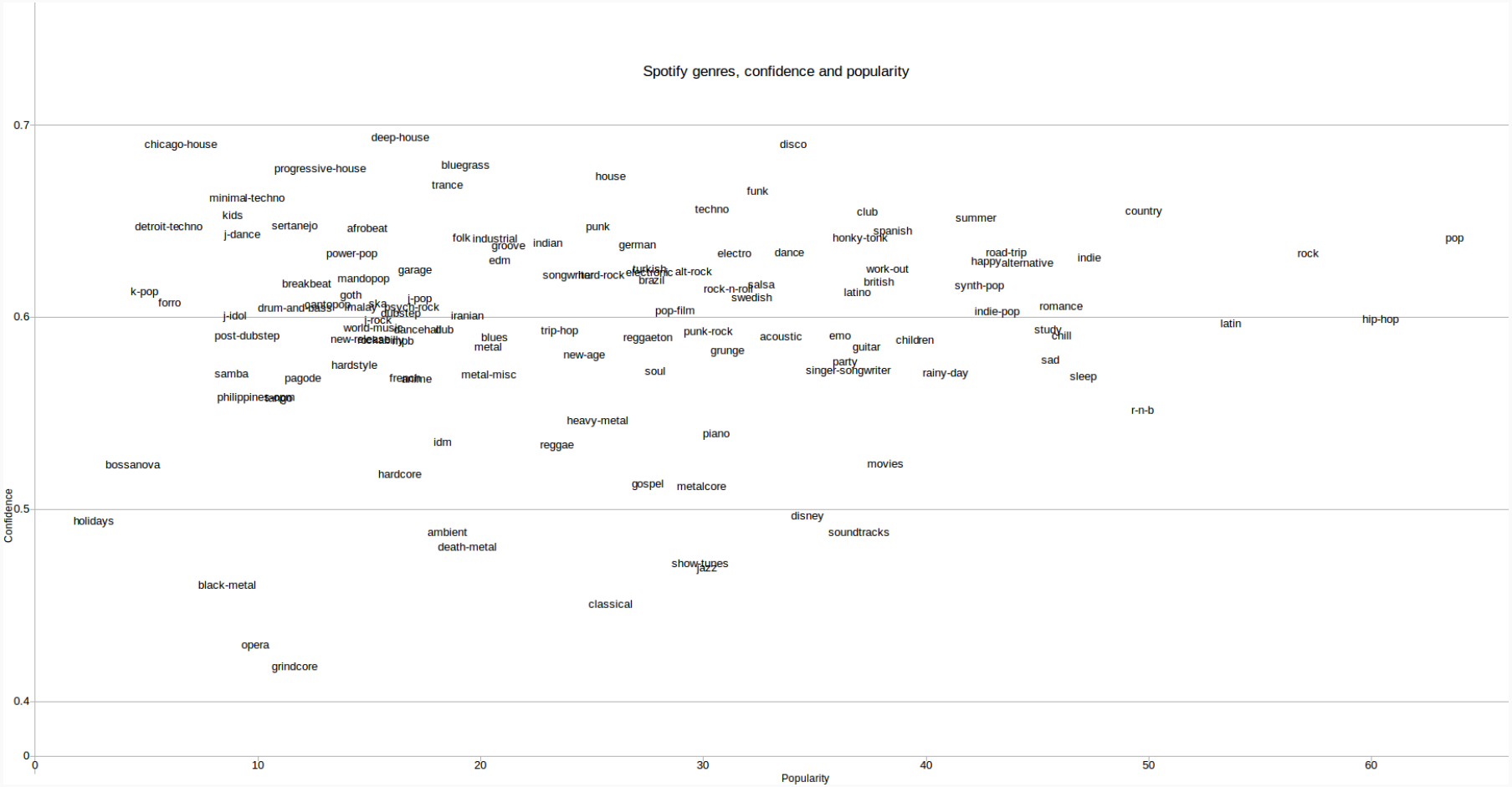


Other experiments

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.

Shadowboxing

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But which, ultimately, points back to the argumentative double bind facing the critic (me) and the developer (Spotify).

“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

Semantic Skepticism

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

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

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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, mayb eeven more so, than the actual product or service that they’re selling to the individual.” (quoted in dissertation, p. 214)

Claims: Conclusion

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

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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 gamificaiton and platform capitalism.

Claims

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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