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Solving and Dissolving Musical Affection: A Critical Study of Spotify and Automated Music Recommendation in the 21st Century

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Solving and Dissolving Musical Affection: A Critical Study of Spotify and Automated Music Recommendation in the 21st Century

A dissertation submitted in partial satisfaction of the
requirements for the degree
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in

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by

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The dissertation of Asher Tobin Chodos is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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2019

DEDICATION

This dissertation is dedicated to my parents, Alexandra Tracy Maeck and Daniel Chodos.

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ABSTRACT OF THE DISSERTATION

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by

Asher Tobin Chodos

Doctor of Philosophy in Music

University of California San Diego, 2019

Professor Chair David Borgo, Co-Chair
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Music has not been exempt from the so-called "curatorial turn" that is visible in so many parts of our culture – the turn, that is, toward machine learning to help consumers sort through the glut of media with which we are all confronted today. Automated music recommendations, in fact, are probably the single biggest driver of the music industry's recovery from the crisis it faced at the beginning of the 20th century. Nobody knows what shape the music industry will take if and when this recovery is complete, but it seems certain that automated curation will be at its center. This fact represents a confrontation of the human faculty of aesthetic judgment and machine learning at a scale the world has never seen. The issue of automated music recommendation raises many of the philosophical problems familiar from the critique of technology in culture. It does so, moreover, in a way that offers new insights into this familiar problem. In spite of this, little critical attention has been paid to music as a subject in the field of critical algorithms studies. In this dissertation, I provide an introduction to thinking critically about this crucial topic in algorithmic culture, taking Spotify as a case study that exemplifies many broader trends. I situate Spotify in the history of American copyright law, I perform a close reading of the Spotify platform, and I conduct quantitative experiments to analyze the large-scale behaviors of Spotify's recommendation engine. Although Spotify has often been seen as a singularly innovative company that somehow managed to "save" the music industry as a whole, this study shows that in many ways Spotify is better understood as an expression of attitudes toward musical meaning and commerce that are quite traditional in the music business.

Introduction

Every day, millions of people turn to Spotify to help them choose their music. This may seem like a simple statement about the company's enormous reach, but it is more than that. The interesting thing about Spotify is not that it has emerged as the world's most visible platform for music streaming, nor even that it signals a broader shift in the music industry away from traditional modes of distribution. Instead, what is interesting about Spotify today is the much more complicated – and much more culturally relevant – fact that the nature of its service is, more than anything else, to provide music recommendations. There was a time, not too long after Napster, when providing access to 30 million tracks was enough to distinguish Spotify from its competition, when having lots of music "at one's fingertips" was a huge draw for music consumers. At that time, Spotify users were still expected to choose for themselves what music to listen to. In fact, it was assumed that they would *want* to do so. But in recent years Spotify, like virtually all its competitors and most tech companies in general, has pivoted toward recommendation, assuming instead a "lean back" posture for its users. Customers today need more than just access; they need help choosing.

The idea that there is a digital "curatorial turn" analogous to the one scholars have spotted in theater and museum studies has, as a result, emerged as a common theme in studies of digital culture.[1] And when it comes to the "curatorial turn," Spotify is probably the most dramatic example. As of the last 10 years or so, it is not a place to go to listen to music so much as (quoting

1. See e.g. Tom Sellar, "The Curatorial Turn," *Theater* 44, no. 2 (May 2014): 21–29 and Maria Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music* (The MIT Press, 2019).

Spotify's promotional materials) a place to

> Find the right music or podcast for every moment.
> Soundtrack your life with Spotify.[2]

The key to Spotify and the recommendation industry in general, in other words, is personalization; "every pixel," claims Yves Raimond of Netflix, is personalized.[3] And the key to personalization is another technological development currently much in vogue: machine learning. As Tony Jebara, Spotify's current head of machine learning, puts it,

> Our algorithms allow us to scale out very personalized, hand-selected experiences that help members feel were made just for them. The goal is to deliver an amazing listening experience.[4]

That our lives need soundtracks, and that the primary role of music in general should be to provide them, and that the best way to achieve them is machine learning, are tacit assumptions of much more cultural import than the dazzling size of Spotify's catalogue or the low monthly subscription fee to access it. The real change ushered in by the era of streaming music is not its affordability, ubiquity or ease of access so much as its drift into a position adjunct to the rest of our lives. Market pressures have made personalization necessary; personalization has as its necessary correlate that music serves as part of a broader "listening experience." Music becomes paired with life, just as wine is paired with food, to cite a comparison that appears at least twice in Spotify's own promotional materials.

It is a general feature of our technologized culture that a rise in algorithmic mediation has been attended by this rise in digital curation. Brute computational tasks like sorting and document classification, traditionally relegated to the dry disciplines of information retrieval and, at their most colorful, library sciences, have assumed an epochal significance that their earliest

2. Accessed at https://www.spotify.com/us/about-us/contact/, on 08-08-2019. The addition of "podcasts" is new. Spotify has in recent years made them a bigger part of their strategy.

3. "From Listening to Watching, A Recommender Systems Perspective", given at ICML June 2019, https://slideslive.com/38917438/from-listening-to-watching-a-recommender-systems-perspective, accessed 9-01-2019

4. Accessed at https://newsroom.spotify.com/2019-10-24/6-questions-and-answers-with-tony-jebara-vp-of-machine-learning/, 10-15-2019

devotees could never have imagined. When Calvin Mooers heralded the dawn of the discipline of information retrieval in 1950 at a conference at Rutgers University, it was in a rarefied proceedings paper with the uninviting title "The theory of digital handling of non-numerical information and its implications to machine economics." In it Mooers expressed his frustration with the cumbersome process of finding relevant information at libraries, something his academic colleagues could all relate to. Technological mechanization offered the potential to give researchers easy access to relevant research without having to thumb through reams of irrelevant work. Machines could help researchers get more relevant documents faster; it had nothing titillating about it and certainly contained no special insights for culture at large. It wasn't particularly prestigious and it bore no conceivable relationship to the arts or consumer culture. Nevertheless it is this same essential project – the science of "machine searching and retrieval of information from storage according to a specification by subject," as Mooers puts it – that lies at the heart of Spotify and countless other daily features of life on the Internet today.[5]

Make an Amazon purchase and collaborative filtering algorithms will recommend others to you. Click on a news story and an aggregator will find you others like it. Send a Gmail and Google will use the information in it to serve you more "relevant" ads. Commit a crime and the COMPAS system may make a recommendation to a judge about an appropriate punishment.[6] Depending on where you stand on the social role of technology and the ethics of surveillance, these examples will hold different meanings for you. They might exemplify the inherent justice of dispassionate reason – this, at least, has always been the pitch for criminal recidivism predictions, which have a much longer history than is often acknowledged.[7] Or they may point to the hegemony of a way of thinking belonging to a small, powerful group of mostly white men; they may be classic examples of the false objectivity and gendered exnomination that, for feminist

5. Mark Sanderson and W. Bruce Croft, "The History of Information Retrieval Research," *Proceedings of the IEEE*, no. 100 (May 2012).

6. See Keith Kirkpatrick, "It's Not the Algorithm, It's the Data," *Commun. ACM* (New York, NY, USA) 60, no. 2 (January 2017): 21–23

7. See e.g. Don M. Gottfredson, "Prediction and Classification in Criminal Justice Decision Making," *Crime and Justice* 9 (1987): 1–20, which builds on his "Base Expectation Score" method from the 1960s.

theorists of science like Donna Haraway, this class customarily evinces.[8] But they are all, at their core, recommendation tasks, the same ones powering Netflix, Tinder, the Facebook news feed, and pretty much everything else we do on the Internet. The ubiquity of these machine recommendations, the way users are kept in ignorance of how they work, and the biases they must inevitably all contain, are issues of inestimable cultural importance. Real world applications of automated recommendation describe a spectrum from the utopian to the apocalyptic. At the core of this dissertation is the question of where on this spectrum we should locate Spotify.

The question is really alluring, especially because it has seldom been addressed from a specifically musical perspective. But it immediately begs another: who are "we?" If the destructive potential of algorithmic curation has received more attention in its non-musical deployments, that may be due as much to the difficulty of this second question as it is to the admittedly higher stakes of the social justice problems. More attention, for example, has been paid to the question of whether automated credit scores will lead to a form of data-driven redlining.[9] This is perhaps a more urgent question that the musical one, but in a way it is also a more straightforward one. It is almost impossible, in other words, to know what would actually represent a socially deleterious music recommendation system. Incidentally, as I show in this dissertation, it is also almost impossible to measure the successfulness of such a system, at least in any philosophically coherent manner. And the flatness of that argumentative conundrum – can't say anything certain against music recommendation, but for the same reason can't say anything for it either – is one of my core findings. Automated music recommendation presents this argumentative double bind from every angle. It is a weird tautology that the designers of Spotify can evade only by virtue of authoring recommendation software rather than music philosophy. But the puzzle is real for them too, or at least it ought to be; the notion of a "good" recommendation cuts in so many different analytic directions at once that critiquing a recommender system is probably as hard as building

8. Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (1988): 575–599.

9. Mark Andrejevic, "Big Data, Big Questions— The Big Data Divide," *International Journal of Communication* 8, no. 0 (2014).

one. Perhaps building one would be the truest mode of critique; in writing this dissertation, I have often wondered whether a random music recommendation system might actually make my point for me. What better way to deflate the illusory notion of "musical meaning" than to pay attention to the "meanings" that inevitably emerge from random random recommendations, and compare them with Spotify's?

It has always been the nature of aesthetic faculty, contingent and unruly as it is, to lead to this tricky argumentative predicament. Is not Kant's solution – purposiveness without purpose, the presumption of universal assent that you assume but never actually demand – a classic expression of this same problem? Nevertheless the allure of that first question, whether or not to call Spotify apocalyptic, is strong enough for me to believe that some kind of answer to it is possible. And that is what this dissertation arrives at: a kind of an answer. It is, of course, neither an endorsement nor a condemnation of Spotify and automated recommendation. I do show some small ways in which the system works, providing statistical sketches of its large-scale behaviors and an intimate look at an early version of its recommendation engine. Depending on the reader's commitments, these findings may motivate real judgments of Spotify's quality: a system that, say, is on the whole less "confident" in its assessment of "classical" music than "funk" (this is true of Spotify's; see Appendix 2) may, for some, be a bad one no matter what. But it is not my goal to arrive at this kind of claim. Nor do I claim to have caught Spotify in tacit acts of implicit bias or sinister collusion with its major label partners, even though these are some of the very considerations around which my experiments are structured. Instead, these issues serve as provocations to a long meditation on the effort to automate music recommendation in general, with conclusions that do not always point in the same argumentative direction. Thus my title's locution: this dissertation is an open essay on the effort to "solve" musical affection, with the ultimate conclusion being that it admits of no solution whatsoever, but instead "dissolves" before our eyes every time we attempt one.

The interesting thing about that is that musical affection doesn't dissolve like this until we try to solve it. The importance of musical affection for identity construction or the management of everyday activities (to cite just two of the many theories of "musical meaning" surveyed in the pages to come) testifies to the apparent solidity with which it constantly presents in real life. So, in a way, does the success of Spotify itself; is not the mere survival of Spotify, a considerable achievement in today's precarious music business, proof that we actually do know what we like, that our affection for music is as real as anything on earth? The answer to this question, I think, is basically yes. As we click around the Spotify app, we *do* know whether or not we like what Spotify suggests to us. The thumbs up/thumbs down adjudication is a case of genuine aesthetic judgment, one where we postulate a universal accord that we will never actually get. But this raises a related but different question: does the impressive survival of Spotify then prove that there are at some level "right" and "wrong" answers to the question "do I like this?" Does it prove, in other words, that there exists such a thing as a "good" recommendation? Countless other recommendation systems, some using real people where Spotify uses machines, have failed where Spotify has succeeded.[10] Does Spotify's success not, at some level, make the case that "solutions" to the problem of musical affection exist, even granting that Spotify's might be wrong or partial?

To that second question (are there "good recommendations"?), this dissertation responds in two ways: first, I go to considerable lengths to demonstrate that Spotify's answer to this question has to be yes. The system is necessarily predicated on a theory of musical meaning that, first, reifies it and, at second, externalizes it; Spotify seems to believe that there are right and wrong musical recommendations, and that those rights and wrongs involve connecting music to things other than itself. Second, I argue that the real answer to that question is no; in the end Spotify doesn't actually prove anything about anything about where or what "musical meaning" is. Spotify's continued existence proves only that Spotify exists – and given the "legal prehistory" of Spotify and its consistent operating losses, in a sense it doesn't even really prove that (see

10. Neil Young's fledgling service *PonoMusic,* for example, tanked in 2017. Earbits Media never really took off. There are many other examples.

Chapter One).

On a philosophical level, what Spotify offers are not "solutions" to musical affection in the sense that humanistic inquiry into musical meaning has always understood the problem, but what I term "dissolutions:" makeshift slices of data bludgeoned into an almost recognizable simulacrum of the love for music. This sounds like a condemnation but it is not; the whole enterprise of machine learning can be seen, not unflatteringly, as the creative and often useful practice of information bludgeoning. As a useful, or at least marketable act, of data reduction, I make no quarrel whatsoever with Spotify. Instead, I am making the distinction between a "solution" – a model, say, that offers real insight into some feature of how the world is or behaves – and what I term a "dissolution," a phenomenon wherein the object under scrutiny goes further and further out of focus the harder you look at it. The philosophical content contained in Spotify occupies the latter tier. If the various quantitative experiments undertaken in this dissertation do too (see Chapter Five), more to my point; the critic and the engineer both confront in musical affection the same evanescent substance, so it makes sense that their results might be philosophical mirror images.

Normative Commitments

One of the easiest places to take issue with Spotify and automated recommendation in general is its "audio features" object, which contains the dozen or so ways in which every track in Spotify's catalogue is measured. This object, and the difference between it and actual human listening, is a central provocation to this dissertation. The "audio features" according to which the Spotify catalogue is rated are dealt with at great length in Chapter Five, but let us examine them here too:

liveness, valence, energy, danceability, speechiness, instrumentalness, tempo, loudness, duration_ms, acousticness[11]

11. There are other measures, but they are ignored for reasons discussed in Chapter Five. See appendix 1 for

Although we can never know exactly *how* these measures are used in Spotify's system, we do know that they exist, and it seems safe to assume that they are used somehow. Indeed, it seems safe to assume that it is these very features that are brought together with "extra-signal" information like web crawls and purchase data to form the model of "musical meaning" at work in Spotify's system. That these assumptions are safe is one of the main arguments made in Chapter Three. But some of these features are musically naive; *valence* in particular – the "good/bad" emotional qualia of a song – although a standard term from music psychology, feels like it does a gross injustice to the nuance and precision of music as art, to say nothing of Adorno's aesthetic "truth content," if we believe in that nebulous quantity.[12] For the many musicians who today carry on with some version of Romantic aesthetics, seeing music as something like a depiction of the Will Itself, or as an "intimation of the absolute," or believing that it does something very serious with vital if ineffable bearing on world affairs, Spotify's features are dreadfully flat footed and trivializing. Whether or not we call ourselves Romantics, the idea that a statistically derived "valence" captures anything musically meaningful will, I think, rub many readers the wrong way. For these readers, then, the demonstration that machine recommendations are in part predicated on such blunt instruments may be all they need to hear; if it's this silly "valence" behind My Discover Weekly, they might say, then it's obviously a silly system. People should know, though, that in dismissing the "two dimensional musical space" of valence and arousal they will be dismissing much of the history of music psychology, the whole subfield of Music Emotion Recognition, and an unknown but substantial measure of how contemporary recommendation services actually work.[13] It is not the contention of this dissertation that these fields are inherently meaningless, but

Spotify's full definitions of these words – definitions, never explanations or derivations.

12. See Geoffrey L. Collier, "Beyond valence and activity in the emotional connotations of music," *Psychology of Music* 35, no. 1 (2007): 110–131 for an example that problematizes the idea of "valence," and in doing so demonstrates its ubiquity in music psychology.

13. See Huaping Liu, Yong Fang, and Qinghua Huang, "Music Emotion Recognition Using a Variant of Recurrent Neural Network," in *2018 International Conference on Mathematics, Modeling, Simulation and Statistics Application (MMSSA 2018)* (Atlantis Press, 2019) and Verena Haunschmid, Shreyan Chowdhury, and Gerhard Widmer, "Two-level Explanations in Music Emotion Recognition," *CoRR* abs/1905.11760 (2019) for contemporary examples that preserve these emotion categories.

it is important from the outset to note that within the basic building blocks of my experimental program (the audio features object) there are already in place certain problematic assumptions.

If we grant that these categories can say something meaningful at least some of the time, it is hard to imagine them being equally meaningful for all musical genres. They betray, in other words, a bias toward those musical forms for which they do represent meaningful musical categories. There are, of course, many musical traditions in which tempo, mode, etc, are analytically meaningless. Before any experimentation or analysis, then, the audio features object amounts to a *prima facie* case of implicit bias (the greatest sin in machine learning); if I make music that cannot ever be meaningfully plotted along those 10 axes, I might be forgiven for considering the system to be inherently biased against me. How exactly that bias actually operates – whether it would prejudice the system in favor of certain genres, lead to incoherent recommendations, or have some other effect – is anyone's guess, but that it on some level exists seems straightforwardly true.

So at a minimum we can tentatively say that Spotify has some normative commitments built into its API methods, and that those normative features probably surface somewhere in its recommendations. What about the commitments of this dissertation? This dissertation moves through a number of them, discards most of them, and concludes by tentatively embracing some of them, an embrace which amounts to the thesis about "dissolution" alluded to above. The experiments are in many cases motivated by clear normative ideas, but in most cases this dissertation tends to try them on without necessarily endorsing them. I occasionally assume normative positions, that is, but usually only as a way of getting inside a particular issue related to Spotify and music recommendation. My experiments play with the idea, for example, that aesthetic homogeneity would be an *a prioi* evil effect, but on a broader level I accept the idea that sometimes aesthetic homogeneity would be exactly what you might want from a recommendation engine. My experiments and discussions depart from certain positions for the purpose of exploratory data collection. In my concluding chapter, I revisit these findings an synthesize them into a claim about the whole problem of automating music recommendation, at which point I take positions that are no longer exploratory but genuinely held.

It makes sense, then, to flag these normative commitments ahead of time in this introduction. I mention above the one about aesthetic homogeneity being bad, but there are others. Chapter One, what I call a "legal prehistory of streaming audio," uses certain normative positions about copyright law in American culture as a way to begin studying the broader debate that has taken place beweem "copyright optimists" and "copyright pessimists" in the last half century. Without actually taking the position on, the chapter proceeds from the notion that copyright protections should, wherever possible, favor the interests of the public at large in accessing the collective fruits of society's creativity rather than the interests of copyright holders in profiting from that creativity. From this perspective, copyright should exist for the sole purpose of making more creative work happen; anything else is cynical overreach. This is the clear rhetorical charge of the US Constitution's copyright clause, and it is the issue around which the copyright wars of the latter half of the 20th century were fought.[14] Related to this commitment is the notion that there are modes of human creativity that are neither effectively incentivized nor eradicated by copyright enforcement, which therefore should be subject to some other regulatory paradigm. These are commitments with rejoinders from the other side, and the history narrated in Chapter One plays out on the intellectual terrain mapped by that opposition. This discussion also departs from a broadly anti-corporate posture, assuming the position (1) that corporate surveillance is bad and (2) that large conglomerates will tend to exploit unincorporated individuals like musicians. On the other hand are the claims of the record labels and free marketeers, who know the enormous costs needed to produce profitable music, and who see cultural production as just another commercial venture. That opposition, whose most famous case by far is the battle between Napster and the major labels at the turn of the century, leads directly to Spotify. The degree to which Spotify inherits from Napster cannot be overstated, a fact that any critique of the former must take into

14. US Constitution, Article 1, section 8, clause 8: copyright exists "to promote the progress of science and useful arts."

account. Early Spotify adopted Napster's technological design (P2P), appropriated much of its disruptive caché, and ultimately represents the mirror image of its (Napster's) relationship to copyright norms in law and culture. In neither case – the legislative nor the cultural – does the chapter take a side, but instead plays with the normative commitments outlined here in order to explore the legal topography Spotify has navigated since it arrived in the US market.

Perhaps the single biggest question behind all the others this dissertation raises is the same one motivating most work on machine learning in culture generally: the question of whether human experience and behavior is at all amenable to propositional logic and pattern recognition, whether human intelligence is reducible to symbolic logic, brute computational force, and statistical patterning. Or, put another way, it is the question of what exactly machine intelligence is. We may believe, like Roger Schank, that intelligence is as intelligence does, and that an intelligently behaving system is, by definition, so. Or, with Hubert Dreyfus, that human intelligence depends inevitably upon human corporeality and is fundamentally irreducible to the manipulation of logical symbols. Or, with John Searle, that syntax and semantics bear no special relationship to eachother and that, lacking the latter, a computer cannot be said to "understand" anything at all. Or, with Noam Chomsky, that the whole question is off-topic, philosophically confused, and scientifically irrelevant. In Chapter Two, I survey these and other authors, always from a perspective that combines Chomsky's ("can machines think?" is not a real question) with the heartfelt intuition of a professional musician (musical meaning can never be reduced to computation). Making music legible to a computer will always involve doing something like equating musical emotion to "valence" or the complex musical property of rhythm to "danceability." Or, for that matter, doing something like what I do in my experiments, where songs are reduced to 10-d vectors and aesthetic diversity to Euclidean distance measures in 10-d musical space. For many who have devoted their lives to the art of music, these kinds of reduction will probably never be acceptable. This is inevitably one of the central questions of this dissertation; the question of solution and dissolution, like the question of whether Spotify is musically apocalyptic, points back to the opposition of man and machine, and the question of whether there is a fundamental incommensurability between them (an opposition that one of Spotify's principal scientists has called "stupid"[15]). The normative commitment we are concerned with here is that, yes, they are in fact incommensurable, and that, no, human aesthetic behaviors are not fundamentally predictable given enough training data. These assumptions offer a lens through which I read the history of critical writing on technology in culture. Assuming the worst about technology is my way of extracting the best from its apologists.

The question of human programmability leads to fourth commitment, this time in the philosophy of mind: a commitment to Chomsky's "internalist" perspective in favor of behavioralism. The idea, that is, that the language faculty is a biological human endowment not unlike digestion or vision, whose development is regular (and therefore equal) across the species. Language acquisition is not a matter of instruction upon a blank slate, and the everyday creativity of normal language usage is not under any specifiable stimulus control.[16] This insight, and its implications for a theory of meaning, is both taken up directly in the discussion of technology in culture (Chapter Two) and related directly to my discussion of musical meaning (Chapter Three). Whether machines can ever possess intelligence, on the one hand, and whether a pre-theoretical notion of "meaning" exists for which to find a musical correlate are two central questions for this dissertation: taking just a little license in extending him to a musical domain, Chomsky offers a calm "no" to both of them. I read Chomsky to say that Putnam's "meaning" is nothing more than a stipulative, technical definition; if you say meaning is outside the head, we can imagine Chomsky saying, very well, but I fail to see what that tells me about the mind or the how language organ works. In this dissertation, I proceed under a musical translation of Chomsky's position, which is the assumption that musical meaning, like linguistic meaning, is not the *kind of thing*

15. In a Billbaord Q&A, since removed from the Billboard site, cited below in this dissertation.

16. See, e.g., Noam Chomsky, "A Review of B. F. Skinner's *Verbal Behavior*," *Language*, no. 1 (1959) for the famous review of *Verbal Behavior*, or Noam Chomsky, *Cartesian Linguistics: A Chapter in the History of Rationalist Thought*, Originally published 1966 (Cambridge University Press, 2009) for a work that situates his thought in the history of rationalist philosophy.

that can ever be specified apart from actual events of musical signification. It is not in the head, not in the the signal. It is not anywhere, because it is not a thing at all. To follow Hilary Putnam ("meaning ain't in the head") to the notion that, yes, musical meaning resides *somewhere* – and that the only problem is to discover *where* – is, from a Chomskian perspective, just silly. Or, at least, since it tells us nothing useful about the way the musical world works, offers no true explanatory power, and thus does not qualify as a form of knowledge. I argue that this is precisely the road taken in Brian Whitman's 2005 doctoral dissertation, which, moreover, almost certainly underpins much of Spotify's present day architecture. And here I must note that this commitment, to a musical version of Chomskian internalism, is not really "tried on" like the others but is in fact an important part of my overall argument. Although it is not an application of Chomsky's theory that he would ever countenance or probably even make sense of, I do believe that "musical meaning" as construed by Whitman and, I argue, by Spotify itself, is a coherent extension of Putnam's theory of meaning, and thus subject in a similar way to Chomsky's elegant rejoinder.

Finally, there is the commitment to heterogeneity. Here, I proceed under the assumption that it is, in general, better to have a variety of music than to have just one kind. This is motivated in part by the common anecdotal reports that Spotify just gives you "more of the same,"[17] but also by the familiar picture of what a technological apocalypse would look like: everything always the same, everything homogenized, all the idiosyncrasy of human interactions brought under the yoke of an indifferent Boolean logic. Diversity, after all, is in one way or another what is behind the growing literature of "fairness" in machine learning; this dissertation in some ways seeks to cast music recommendation as an analogous social problem.[18] The prospect of the long arm of Spotify's corporate stakeholders coming to neutralize en masse the critical faculties of the listening public (again, assuming we can follow Adorno in thinking that music does indeed serve the purpose of nurturing those faculties) motivates my "typology" of musical meaning (Chapter Four). Here, I offer a variegated response to the extremely short shrift given to humanistic theories

17. Pelle Snickars, "More of the Same–On Spotify Radio," *Culture Unbound* 9, no. 2 (2017).
18. Solon Barocas and Andrew Selbst, "Big Data's Disparate Impact," *California Law Review* 104 (3 2016).

of musical meaning by the technical literature in MIR and recommender systems research. Brian Whitman's dissertation, which cites a single musicologist (Leonard B. Meyer, *Emotion and Meaning in Music* (1956)), is the immediate provocation, but his low level of engagement is unexceptional in the field of music information retrieval.[19] Where the technical literature, then, tends to give us a very narrow sense of what musical meaning can be, I offer a representative (not exhaustive) typology of the many different things it has been in the scholarly study of music.

Heterogeneity is also the central concern behind my quantitative experiments in Chapter Five. Working with Spotify playlists seeded by all 125 of the musical "genres" in Spotify's system, my experiments establish various mathematical proxies for aesthetic diversity, and then ask the kinds of questions a critic suspicious of automated recommendation would ask: what are the most diverse genres? what are the features that vary least within each genre? Is there any correlation between evaluated "popularity" and Spotify's own "confidence" figures for a given genre? A determined anti-recommendation partisan might find these lines of inquiry emotionally satisfying, because ultimately Spotify is damned no matter how the results turn out: regardless of what genre turns out to rank as the "most diverse," we can read the results as evidence for a certain type of "implicit bias," the watchword of the critical algorithms studies community. A system where J-Pop is the most diverse? What, then, about Samba? Can we accept a system that seems to believe Samba is somehow less aesthetically diverse than J-pop?

My experiments, in other words, seem designed to corner Spotify into saying something no person would ever be caught dead saying in polite musical company – statements like "Samba is more diverse than J-pop" (not a genuine example). Especially since many of them are predicated on the audio features already shown to be ethically problematic (above), this kind of ethical condemnation might seem like a foregone conclusion. But in reality it is not, and in fact the data rarely support this kind of rhetorical flourish anyway. Examined responsibly, in a manner that divorces them from the normative commitments that originally animated them, these experiments

19. See Oscar Celma, *Music Recommendation and Discovery - The Long Tail, Long Fail, and Long Play in the Digital Music Space* (Springer, 2010) for a useful survey of MIR research.

do tell us valuable things about the Spotify system.

These are frequently quite interesting in their own right as a brief glimpse under the hood of such a popular service. Funk, for example, is one of the most repetitive genres (just 80 unique items out of 500 recommendations), even though it is also fairly popular (ranks 39th out of 125). It's not clear if that supports any broader critique, but it is a fascinating finding on its own. But these experiments can, occasionally, form part of the broader philosophical conversation to which this dissertation is addressed. And in that conversation, there emerge commitments that are not stipulated but genuinely held, and which are the true thesis of this dissertation. Namely, that musical meaning is not any one thing, that attempts to precisify it are acts of definitional assignation rather than science or philosophy, and that we can maintain a line between the two (assignation and philosophy) without derogating either one. Spotify's system makes recommendations, and it may be that it makes them well, or, anyway, in a way that some customers find to be better than other companies that offer the same service. But to say that its system is better because it has come closer to realizing the "meaning of music" (quoting Whitman (2005)) is inaccurate. Not because there is some magical quintessence in music that can never be specified (this dissertation is basically unrelated to the question of the effability of music) but because there is nothing there, no pre-theoretical "meaning" to be sought prior to the one-at-a-time acts of musical perception that constitute real facts of musical affection. Musical meaning, if there is something worthy of the name, is nothing more special or elegant than a list of all the times music has happened. And lists have no solutions. They're just lists.

Chapters

That is the core claim advanced in the pages that follow, but it is a claim made by way of a general project of thinking critically about Spotify and automated music recommendation in culture. Existing writing on the subject of MIR ranges from the technical, which engages awkwardly or superficially with philosophical ideas, and the humanistic, which often ignores the design of the systems in question altogether. Critical algorithm studies, in other words, though it has a lot to say about algorithmic culture in general, frequently glosses over "actual" algorithms.[20] There is, to my knowledge, just one book that actually attempts to join the two, Maria Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music* (The MIT Press, 2019). The chapters outlined below are in many ways an attempt to cover areas that that work leaves out, or to cover the same areas in different ways. Eriksson et al tell the history of Spotify the corporation, but fail to situate that history in the context of the shifts in American copyright law that make Spotify possible and continue to shape its operation to this day. They develop ingenious experiments to probe Spotify's system (although their experiments, like mine, tend to "raise more questions than they answer"), but they are silent on the actual operation of the algorithm.[21] My project, by contrast, goes to great lengths to know as much as possible about how the thing actually works under the hood. Their experiments test for homogeneity, but ignore the audio features output of the Spotify API; my experiments are all built around that very API. It would not be unreasonable to see my project as a companion piece to theirs, a less technologically elaborate, but more historically and philosophically oriented response to the same core questions. We both note that, today, Spotify's idealized listener needs "help" knowing what to play; we both see that, and not the speed of information transfer itself, as a fact of epochal significance; we both worry about the possibility that algorithms might recommend the same stuff over and over; we both confront on an empirical level the confusions that inevitably follow from the effort to harmonize aesthetics and computation.

In Chapter One, I narrate the history of American copyright legislation from 1976 to present, situating its evolution between the poles of "copyright pessimism" and "copyright optimism." The trend, in general, has been a radical expansion of copyright protections; much more than a generation ago, these protections today favor the interests of the copyright holders

20. On this subject see Nick Seaver, "Algorithms as culture: Some tactics for the ethnography of algorithmic systems," *Big Data & Society* 4, no. 2 (2017), who puts welcome pressure on that slightly condescending "actual."
21. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 190.

over the public at large. They have, moreover, been extended to include things that traditionally had nothing to do with copyright at all, such as the right of a company to sell a recording device that could, in the wrong hands, cause copyright holders some market harm. This is a story that climaxes with the 1998 passage of the Digital Millenium Copyright Act and the infamous clash of Napster and the RIAA in 2001. The decisive resolution of this case represented the ultimate triumph of the new copyright norms, and it more than any other single event set the stage for Spotify. Spotify picked up exactly where Napster left off, even if it ran in the exact opposite direction. Any critique of Spotify – be it philosophical, empirical, or ethical – has to take stock of the ways in which Spotify represents a continuation of, not a "disruption" of, the radically expanded copyright norms successfully lobbied for by the RIAA in the decades before its arrival.

Chapter Two is a survey of the field to which this dissertation is a contribution, known (recently) as "critical algorithm studies."[22] Today, this is a field primarily concerned with the empirical facts of "algorithmic culture,"[23] especially where technology threatens to perpetuate social injustice. But the field has interesting forerunners from the early days of artificial intelligence research that are essential reading for a critique of technological mediation in the musical domain. This survey shows, first, that even though streaming music ought to be an excellent case study in algorithmic culture, very little attention has been paid to it directly. Second, it makes the case that, as a domain that is both philosophically stimulating *and* a pressing real-world matter of cultural representation, music is uniquely positioned to unite the two threads that have characterized this area since the 1970s. In joining these two historical threads, as well as joining the humanistic mode of critique with the technical, this dissertation is an attempt to bring that promise to fruition.

Chapter Three is two things: first, it recounts the corporate history of Spotify and the steady rise of its recommendation service as the core of its business model – the so-called "curatorial turn."[24] Second, it is an extended essay on the "theory of musical meaning" engendered

22. See the "Critical Algorithms Studies reading list" maintained by Tarleton Gillespie and Nick Seaver for Microsoft Research: https://socialmediacollective.org/reading-lists/critical-algorithm-studies/]

23. Alexander R. Galloway, *Gaming: Essays on Algorithmic Culture* (University of Minnesota Press, 2006).

24. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*.

by this turn, a theory that, I argue, aligns perfectly with the 2005 academic dissertation of Brian Whitman, a 2005 graduate of the MIT Media Lab whose work there formed the core of the music information company The Echo Nest, which Spotify acquired in 2014. Whitman posits a system based on the insight that, contrary to the dominant thinking at the time in MIR, musical meaning does not reside in the audio signal alone. Instead, it is to be sought in the relationship of the audio signal to various non-audio information streams: processed Google searches and other sources of "cultural metadata" representing actual human semantic reactions to actual musical stimuli. A machine learning model trained on these two data streams yields classifiers that can then evaluate as-yet-unheard music in ways, so the argument goes, that accurately model musical affection, or at least in ways that reflect the "learning" that has taken place about "musical meaning." That's a summary of the core insight at work in Whitman's dissertation, which some forensic work of mine suggests is indeed operational in Spotify today. But the real target is not the system itself but rather the philosophical orientation that it implies. All this technical stuff, I argue, implies a theory of musical meaning that is "relational," to use Whitman's word: it is a theory that locates meaning "outside the signal," (cf. Putnam) and in its connection to other things. This picture, in turn, matches perfectly the model of musical meaning that Spotify has found itself arriving at in the era of automated music curation, when what matters most is the ability of an internet company to make sense of the glut of information its users face. In today's internet culture, users need recommendations; recommendations need a theory of musical meaning; because of the shape of the market it faces and the intellectual bent of Brian Whitman, Spotify has arrived at one theory in particular, which this chapter attempts to ferret out. The fact that Spotify has arrived at this theory by way of answering a market need – namely, the increased need for curation – does not make it any less a theory; treating it as such, this chapter concludes by highlighting what I think are some contradictions and errors contained within it.

Those flaws have to do in large part with Whitman's reading of his only musicological source: Leonard Meyer's 1956 *Emotion and Meaning in Music.* In Chapter Three, I had argued that Whitman positions himself against Meyer in a way that does the latter a disservice, and which represents a real flaw in his own reasoning about musical meaning. A more serious error, however, is in the fact that Whitman ignores virtually all of musicological thinking on the subject, preferring instead to let Meyer stand in for the field as a whole (and, having done that, to dismiss the field as a whole). Of course, the field of musicology and music philosophy has been fixated on the question of musical meaning for hundreds of years. In Chapter Four, I produce a representative typology of such theories of musical meaning, so that that of Whitman/Spotify can be examined in relief against it. In part, this is a riposte to Whitman's straw man, which, it bears repeating, is not atypical for technical literature in MIR. It is not a subdiscipline renowned among musicologists for its philosophical nuance. It is in Chapter Four that I introduce the "internalist perspective" as a potential answer to Whitman's echo of Hilary Putnam. Linguistic meaning "ain't in the head," says Putnam. And, Whitman adds, musical meaning "ain't in the signal." It sounds reasonable, even satisfying, for the way in which it stands against the stodgy absolutists from the grand old days of positivist musicology. But it is by no means the only way to construe musical meaning; this chapter, while correcting the monochromatic picture of musical meaning painted in the technical writing about MIR, lays the groundwork for the conception of meaning the dissertation will eventually side with.

Chapter Five is a set of empirical experiments designed to probe the Spotify system in the spirit of the questions laid out in the preceding sections. A series of geometric proxies for musical heterogeneity is established and experiments are designed to produce "winners" and "losers" on the diversity metric. This is done using "audio features" from songs in a a 500 song X 125 genre database of tracks recommended by Spotify. I look at which genres tend to repeat themselves most frequently and which audio features tend to vary least over each genre. I also consider the "confidence" measures associated with the machine listening output and the "popularity" of recommended tracks, including possible correlations between these two values. As noted above, these experiments face the same intractable ambiguities and contingencies faced by the designers of the system in the first place, and it is often unclear what exactly the results show. If you try to distance yourself from the granular data, abstracting from it a broader claim about Spotify or automated recommendation generally, sometimes the results seem to support one conclusion and its opposite simultaneously. A low diversity score is the perfect example: is the fact that Spotify consistently picks just a handful of genres as least and most diverse evidence of its ethical corruption? It seems possible, because surely from the human perspective, all genres ought to be equally artistically variegated, otherwise the implicit value judgment about some genres is not far off. But it is also possible that this finding is a case of the recommender system behaving exactly right, giving the right music for the right genre in the right way? It's pretty much an undecidable question, which, in the end, is actually what the experiments tend to demonstrate. Thus the "dissolution" effect of my title is not a humanistic feint or some belief in musical magic, but actually an empirical fact visible in the data itself.

This dissertation combines two different types of investigation. On the one hand, it offers an overview of Spotify and the automated music recommendation space from a musicological perspective. In this capacity it both remedies the lacuna left in "critical algorithm studies" where music should be, and at the same time offers a rejoinder to the discipline of MIR, which is mostly populated with studies of music that replace musicians' critical apparatus with its own. If they have been studying us for years without paying attention to anything but their own intellectual norms, this dissertation gives them a bit of their own medicine. But it is also an extended essay on the problem of musical meaning and musical affection in the context of the world's most prominent effort to find a solution. Spotify is by far the biggest service, emblematic the world over of the new way of doing business in music. I ask how that system behaves, what kind of musical meaning it presupposes, and ultimately what kind of listening it will tend to encourage. These issues are abstract and far removed from the pragmatic world of product design and software engineering, and Spotify will always have an easy way of deflecting the critiques contained in this dissertation: the system is not a theory of musical meaning, it's not a inquiry into the future of listening, it's not a philosophical treatise, it's just a product doing its best to help people navigate the morass of musical information on the internet. This is not an unfair parry, but it is also one that fails to answer the critiques on their merits, or to make them any less necessary. No matter how you slice it, the system works *somehow* (although a system of strict NDAs may keep us in the dark forever), does presuppose *something*, and one way or another represents an attempted "solution" to the problem of musical affection, as well as the preeminent solution to the financial woes facing the music industry in the last quarter century. But music has a long history of resisting solutions like this. Like linguistic meaning, musical meaning is a very unruly thing. If, as Raymond Monelle points out, music's half-representational character is something it *shares* with language rather than something that distinguishes the two, this dissertation ultimately documents one more failure to use one to bring the other into focus.[25]

25. Raymond Monelle, *The Sense of Music: Semiotic Essays* (Princeton University Press, 2000), 12.

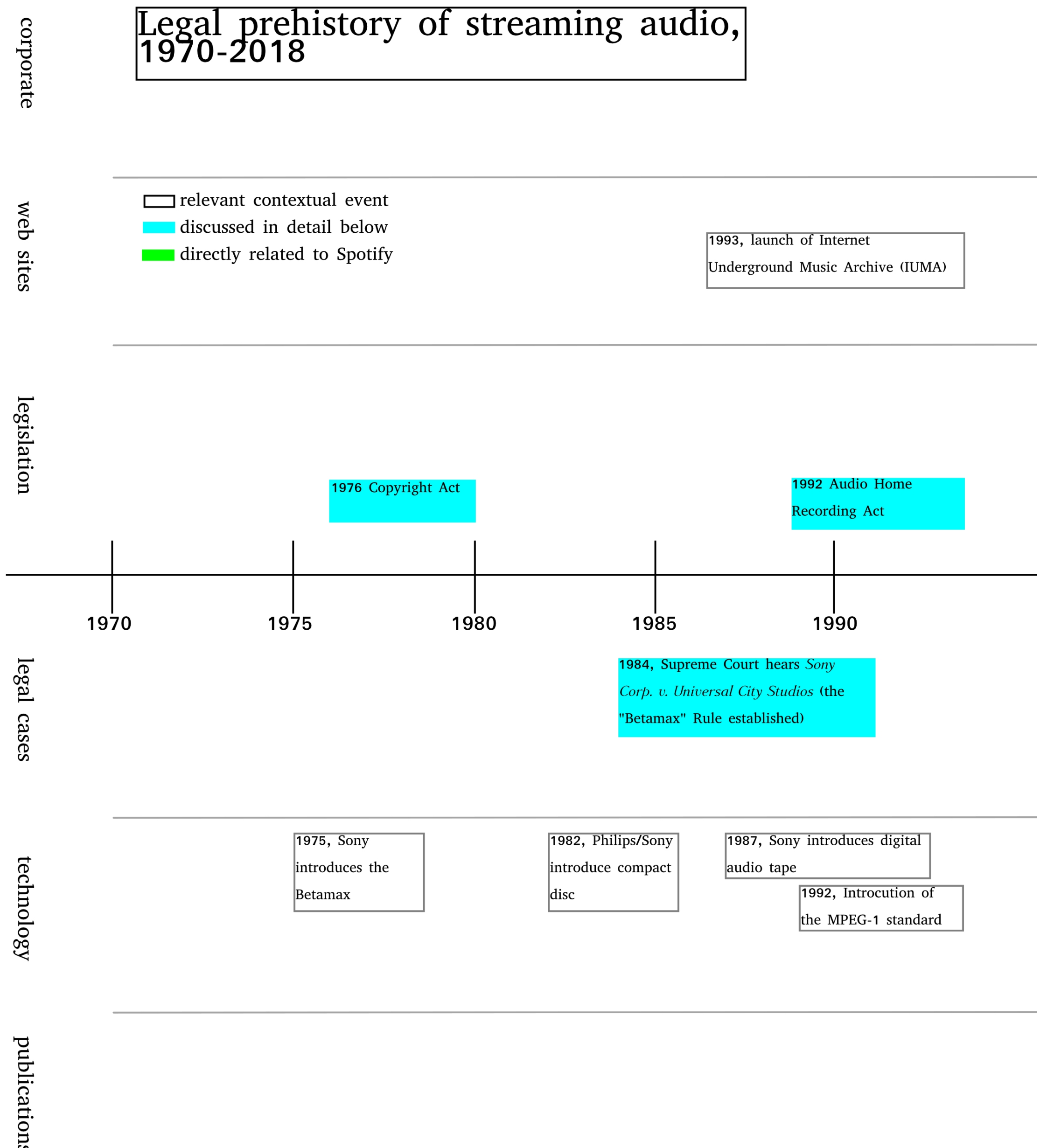

Figure 0.1: Legal Prehistory of Streaming Audio

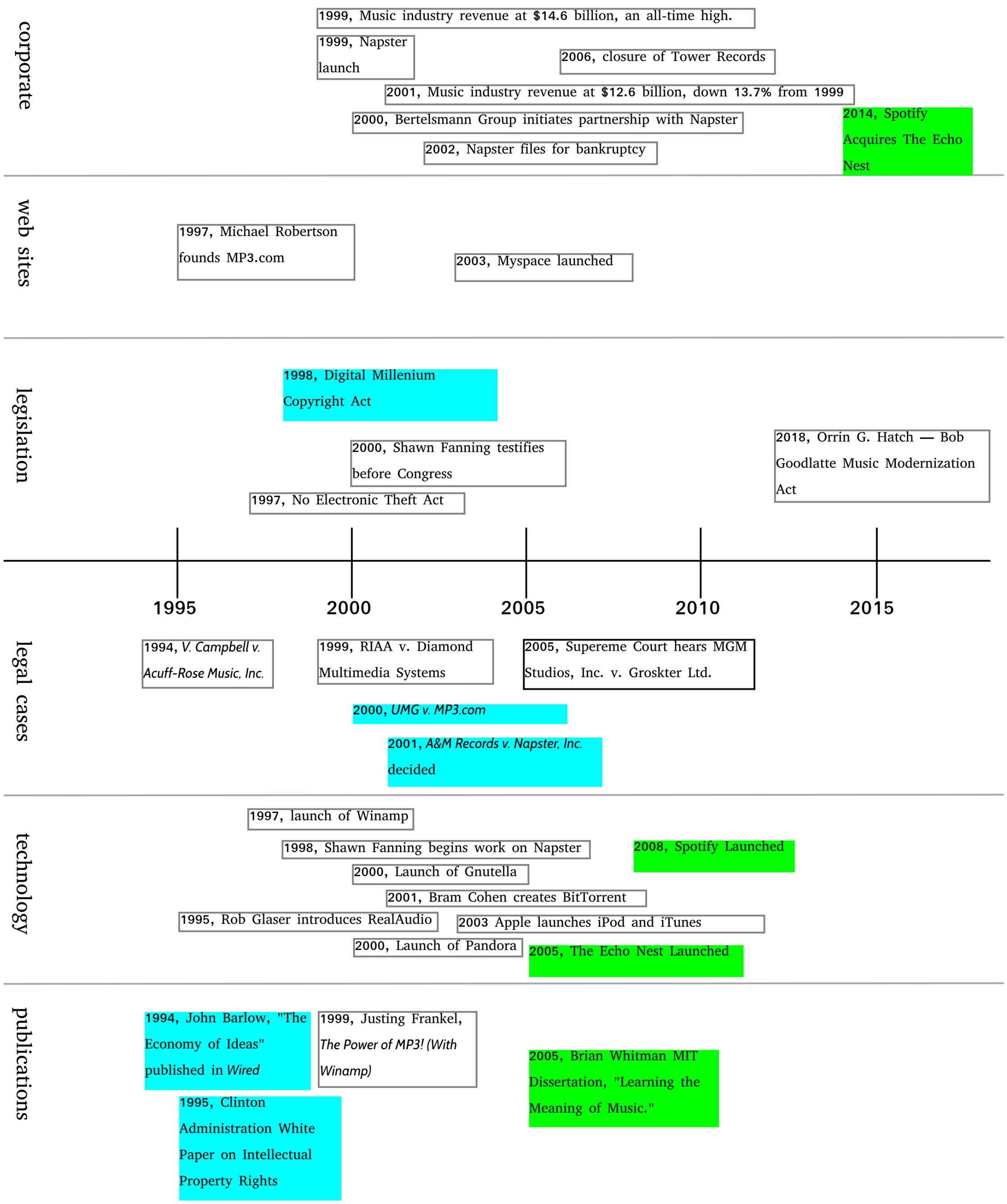

Figure 0.1 (cont.): Legal Prehistory of Streaming Audio

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

In this chapter, I examine the history of American copyright law in the area of music and entertainment, especially where that history is relevant to contemporary issues facing Spotify and the music streaming industry. Following the timeline in Figure 0.1, I proceed by detailed examinations of several key moments in this history (the moments highlighted in blue). By focusing on these pieces of legislation and landmark legal cases, I will show that the history of copyright protection since 1909 has, in general, seen its dramatic expansion. Copyrights have become easier to obtain, they have grown dramatically in duration, and, perhaps most importantly, they have come to encompass articles of commerce to which they traditionally bore no direct relationship. Today, digital technologies are legally bound to include all kinds of protection schemes in their design, and efforts to evade such schemes have become criminal offences unto themselves, apart from whatever infringing activity such evasions make possible. The interests of the copyright holders – interests, which, thanks to the wave of corporate consolidation the music industry saw in the 1980s and 1990s, have grown ever more distant from the actual creators of copyrighted content – are, as a matter of law, woven into the design of every technological innovation which could conceivably cause copyright holders some market harm.

This narrative of radically expanded copyright leads us directly to Spotify, which, although it has successfully marketed itself as a disruptive technology (in part cashing in on the anarchic appeal of its predecessor and model Napster), is actually the apotheosis of 21st century copyright paradigms. The castigations of the music industry that we frequently hear – that it failed to develop effective digital distribution systems quickly enough, that it clings irrationally to outmoded copyright norms – are actually rather misleading.[1] I argue that, in fact, the music industry has not clung to outmoded copyright norms. Instead, it has radically expanded its vision of copyright and, moreover, succeeded in imposing that transformation on American law and culture. These new norms of copyright leave a small space for lawful digital music distribution; instead of creating an innovative new space with the potential to transform the industry, we should see Spotify as profoundly submissive to the new paradigm, ekeing out an existence in a cramped corner of the indusry, hemorraghing its venture capital faster and faster funding even as its user base continues to grow.

One result of the 20th century "copyright grab" was the birth of the idea of a "bad machine" – a machine that is statutorily prohibited, its potential usages notwithstanding. A bad machine is illegal because it makes illegal copyright infringement possible, and can therefore include activities like DRM evasion schemes that, although they bring certain kinds of illicit copying into the realm of possibility, are not really machines at all. In this way, a "bad machine" is just an idea, but we live with its real-world counterparts everyday: it is the central claim of this chapter that Spotify is first and foremost a "good machine" that, in spite of its rhetorical participation in the culture of innovation, has thoroughly imbibed the interests of the major labels – who, it turns out, actually own a lot if it.

Before we proceed to a critique of Spotify itself on philosophical, technical, or ethical grounds, in other words, it is necessary first to understand what kind legal philosophy it embodies. The utopian aura hovering around the tech sector in the popular imagination is so thick, its marketing wing so formidable, and its hold on the industry so decisive, that before moving to the

1. See, e.g. "The Katy Perry Verdict Proves Our Music Copyright Laws Need a Tune Up," in *IP Watchdog,* Aug. 19 2019, https://www.ipwatchdog.com/2019/08/29/katy-perry-verdict-proves-music-copyright-laws-need-tune/id=112644/, accessed 09-09-2019

system itself, it requires some effort to see Spotify for what it is. In order to do that, this chapter revisits the legal history that makes Spotify inevitable. Doing so will reveal that Spotify has not discovered any novel solutions to the problems that have plagued the music industry since its decline began at the end of the 1990s, and that there is nothing novel about Spotify from a legal perspective. There's nothing wrong, necessarily, with corporations in the music business, nor is there anything inherently evil in the effort to preserve traditional copyright norms in the face of a culture that poses serious threat to the very idea of intellectual property. There are sound arguments in favor of preserving such protections, some of which are addressed below. But the clash between such norms and such a culture remains as difficult a problem for Spotify as it was for Napster. What bankrupted the one is exactly what sustains the other.

In recent court filings over whether or not to classify music streams as capable of infringing on "mechanical rights" (discussed below), the plaintiff Bob Gaudio – lead singer from Franki Valli and the Four Seasons – describes Spotify as "reminiscent of the primitive illegal file sharing companies." Or, as the Spotify defense spits the accusation back at him, as a "New Napster." The defense, of course, denies the claim categorically, insisting that Spotify bears "no resemblance to Napster." In a way they're both right; in the way that mirror images always are, Spotify and Napster are at once opposite and identical. In any case the specter of Napster and its infamous relationship to U.S. copyright law continues to hover over Spotify's ongoing legal troubles today, many of which center on precisely the same kind of legal issues that brought Napster down. How to regulate copyright has never been an easy question, and its difficulties have only compounded in the digital era. The fact that the two companies tried to solve this problem differently is of little consequence, especially because, by the time of the 2001 trial Napster was actively developing a subscription service like Spotify in partnership with the Bertelsmann Group. Even Napster seems to have wanted, eventually, to become Spotify. What matters, instead, is that the exact same problems persist even though Spotify exists, and that Spotify represents just the latest, most rigid version of the solution the industry has been pushing since before the dawn of the Internet era. If Spotify contains a transformative insight, it is simply in the way it has managed to turn what was previously a good (a "digital phonorecord delivery," to use the legal term of art) into a service.[2] But it has done so in a way that reinforced rather than challenged traditional ideas about music copyright.

1.1 Copyright Optimism and Pessimism

Copyright law at its heart is the search for a reasonable compromise between two conflicting interests. On the one hand, copyright must protect the interests of copyright holders; people who create works (or, at least, the people who have paid for the copyrights to those works) deserve to be compensated for their labor. On the other hand, there are the interests of the public at large; from this perspective, copyright exists merely to incentivize the labor of creative people, and the ultimate goal is for the public to have at its disposal as large and robust a corpus of works as possible. Copyright holders deserve remuneration, but the public deserves access. It is worth noting preliminarily that the U.S. Constitution seems to favor the latter claim: copyrights exist there "to promote the progress of science and useful arts."[3] Not, that is, to make sure we compensate playwrights and composers. By contrast, many of today's norms in the philosophy of copyright seem to incline toward the former position. At any rate, the tension between these two poles constitutes the fabric from which courts have fashioned a century of copyright case law, the terrain over which several landmark pieces have taken place, and the stage upon which Spotify made its U.S. debut in 2012.

In the 21st century, when the free flow of information seems (to some) to threaten the very foundations of copyright itself, these two conflicting interests have hardened into political positions, with either side implying certain ideological commitments. Tracing a pattern familiar

2. This is, in fact, one of Srnicek's criteria for status as a "platform." See Nick Srnicek, *Platform Capitalism* (Polity Press, 2016), discussed at length in the Conclusion of this dissertation.

3. U.S. Constitution, Article 1, section 8, clause 8

from much of today's political and social landscape in general, debate about copyright law has responded to the disruptions of the 21st century by becoming fractured and polemical, with the optimists and pessimists vaguely aligned with corporate and countercultural interests. These two sides generally agree that the technological revolutions of the late 20th and early 21st century pose profound threats to traditional notions of copyright protection. They take opposite positions, however, on what should be done about it.

"Optimists" argue that digital technology should lead to greater copyright protection. Copyrights should be issued as freely as possible, as early in the process of authorship as possible, and with a minimum of bureaucratic effort on the part of the author. They should, moreover, entitle the author to as much of the money the work ends up generating as possible, ideally all of it. As Paul Goldstein, a self-styled copyright optimist, puts it, copyright ought to extend into "every corner where consumers derive value from literary or artistic work."[4] In this line of argumentation, the role of the "fair use" exemption, which will become enormously important in the legal history of digital music, should be minimal. It exists not as any kind of moral entitlement but simply as a way of accommodating the dysfunctions that will inevitably arise in the market for copyrighted material. Fair use is, for the optimists, a regrettable matter of practical necessity, useful when, for example, there are "high transaction costs associated with negotiating, monitoring, and controlling" potential infringement.[5] Fair use, in this line of thinking, is nothing more than a deprivation of an author's true market entitlement, one that should be tolerated only when "the possibility of consensual bargaining has broken down in some way."[6]

Fair use, of course, was the core of Napster's unsuccessful defense against the RIAA in 2001. The fact that the defense failed, and did so decisively and quickly, may be seen as a victory for the optimists, emblematic of the general way in which the field has turned in their favor.

4. Paul Goldstein, *Copyright's Highway: From Gutenberg to the Celestial Jukebox* (Stanford University Press, 2003), 279.

5. Raymond Shih Ray Ku, "The Creative Destruction of Copyright: Napster and the New Economics of Digital Technology," *The University of Chicago Law Review* 69, no. 1 (2002): 2002.

6. Wendy J. Gordon, "Fair Use as Market Failure: A Structural and Economic Analysis of the "Betamax" Case and Its Predecessors," *Columbia Law Review* 82, no. 8 (1982): 1615.

Although digital technology puts all manner of piracy within reach for millions of people, for copyright optimists it also makes these kinds of market dysfunction less frequent, and copyright law more enforceable – and, therefore, fair use *less* necessary and *less* plausible as a legal defense. In the internet era, so the argument goes, creative people are newly empowered to self-publish and make contractual arrangements directly with customers in new ways. Consensual bargaining is possible on a larger scale than ever before, and instances where it "breaks down" – the only instances when fair use should apply – should be relatively infrequent. For this reason copyright optimists see the digital era as an opportunity for a tightening rather than a relaxation of copyright enforcement: as Goldstein writes, "as new technological uses of copyrighted works emerge, lawmakers should be quick to extend copyright to encompass these uses, even those that are private."[7] This kind of tightening is what choked Napster to death, and what drove the RIAA to make examples out of, say, a handful of post-adolescents downloading music in their UCSD dorm rooms.[8]

It bears repeating that this position explicitly advocates for the *restriction* of fair use and the aggressive expansion of copyright protections. This, obviously, is a trend of which the copyright "pessimists" disapprove. It is derided, for example, by Pamela Samuelson as the "copyright grab."[9] Pessimists tend to favor the interests of the public over the interests of copyright holders. The position hearkens back to the language of the Constitution; copyright monopolies should exist only for the purpose of increasing the amount of material to which the public has access. Yochai Benkler, focusing his argument primarily on issues of software intellectual property and the open source movement, argues that the kind of copyright expansion championed by the optimists is proscribed by nothing less than the First Amendment; the right to information, for Benkler, is so fundamental as to be analogous to the right of speech. Legislation

7. Goldstein, *Copyright's Highway: From Gutenberg to the Celestial Jukebox*, 188.

8. See, e.g. http://www.mtv.com/news/1471036/riaa-sues-four-college-students-for-file-sharing/, accessed 08-20-2019

9. Pamela Samuelson, "The Copyright Grab," *Wired*, 1996, accessed June 7, 2019.

that curtails it unduly, therefore, is downright unconstitutional.[10] Even when it is constitutional, moreover, Benkler sees today's copyright law as premised on the spurious equation of information and physical property. Existing copyright laws, for Benkler, assume erroneously that "property and markets are the roots of all growth and productivity," and that that intellectual property should therefore be regulated in the same way as physical property. Benkler's reservations about the trend to strengthen copyright protections, then, are rooted not in the common techno-utopian rhetoric about the incommensurability of copyright and the new digital culture (which is the argument advanced in John Barlow's infamous essay, "The Economy of Ideas," discussed below) but rather in his conviction that information is fundamentally different from physical property. Scarcity in information is always artificial, Benkler points out, and the creative labor that goes into producing it is not necessarily incentivized (or prevented) as is the case with physical labor. Information is so qualitatively different, in fact, that consuming it is almost like a form of expression – and thus deserves to be so treated, hence the constitutional argument. For many reasons – cold war anti-communism, the lobbying power of certain industries, among others – Benkler argues that the equation of physical property and intellectual property has won out. Thus we sought to protect it like other property. We have sought to make information behave like iron ore. The assumption was that the closer copyright law was to these kinds of traditional property rights, the more production we would get.[11] But, for Benkler, that whole idea is factually and morally wrong. Many features of our society – Benkler's favorite example is the open source movement, but there are others – are plainly not property- or market-driven. There are certain things we do, and certain kinds of information we create, that, as a matter of empirical fact, cannot be effectively incentivized by the provision of temporary monopolies. And to pretend otherwise amounts to an unconstitutional and toxic form of censorship.

But there is also a more familiar argument from the copyright pessimists: that traditional

10. Yochai Benkler, "Free as the Air to Common Use: First Amendment Constraints on Enclosure of the Public Domain," *NYU Law Review* 354 (1999).

11. Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (Yale University Press, 2006), 461.

copyright is just out of date. This is a line of thinking whose appeal has been mainly outside the legal community (the fact that something is out of date is basically immaterial from a legal perspective). The idea that "information wants to be free," an aphorism usually credited to Stewart Brand as early as the 1980s,[12] while it may strike many jurists as facile or meaningless, has nevertheless resonated with a generation of anti-establishment technology users. As Fred Turner notes in *From Counterculture to Cyberculture,* the 20th century saw the steady fusion of what, in the 50s, would have seemed the unlikeliest of bedfellows: hippies, government types and computer people.[13] And yet, in the hands of pseudo-prophetic figures like Stewart Brand, Buckminster Fuller, and Kevin Kelly, the information society and its new arsenal of technological tools were imbued with a broadly liberatory ethos as early as the 1960s. While the computer represented the lifestyle of the mindless corporate drone for Mario Savio, it was the summit of freedom and creativity for a subsequent generation of Californians, who have enthusiastically embraced the culture of radical transparency. There is a strange rhetorical slide from the hackerish commitment to transparency, to radical libertarianism, finally landing in the widely tolerating practices of mass surveillance that we all live with today. This slide has a musical dimension, one that is exemplified nowhere better than in the Spotify company.

The idea that information "wants to be free" has its advocates in the legal profession. As William Patry puts it, "market forces and technology have moved well beyond our current laws and are now in conflict with them."[14] In this perspective, the "democratization of creation" that has followed the advent of the Internet means that "digital abundance" has utterly displaced "artificial scarcity," with the latter cast as the essential pillar upon which traditional copyright norms are now scaffolded. That artificial scarcity is a thing of the past seems straightforwardly true as a practical matter; music especially no longer needs be tethered to any physical medium

12. See, e.g. "Hackers at 30: 'Hackers' and 'Information Wants to Be Free'," in *Wired*, 2014: https://www.wired.com/story/hackers-at-30-hackers-and-information-wants-to-be-free/, accessed 09-09-2019

13. Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (University of Chicago Press, 2006).

14. William Patry, *How to Fix Copyright* (Oxford University Press, 2011), 2.

for the vast majority of consumers. Whether or not information "wants" to be free, or whether we can imbue copyright anarchism with the moral rectitude assumed by Stewart Brand and his acolytes in the Whole Earth Catalogue,[15] we may still want to bring our copyright system in line with the lived reality of media consumers today. This is an environment, so the argument goes, in which the copyright inflation that we have seen in recent decades can only harm consumers and other sectors of the economy.[16]

If copyright law has hardened into an ideologically polarized spectrum, one thing upon which all parties can probably agree is that U.S. law over the course of the 20th century moved steadily from one side of that spectrum to the other. As the discussion below shows, U.S. copyright law has increasingly favored the interests of copyright holders over the interests of the public, both in case law and statutory law. The same period, of course, has also seen the profound erosion of traditional impediments to the flow of information, including some very prominent cases involving musical information. This leads to an interesting and precarious state of affairs: our copyright laws have expanded and hardened, while at the same time, we occupy a culture less inclined than ever to respect traditional copyright norms. The industry's various campaigns to convince people not to pirate – campaigns like "You wouldn't steal a car" and "You can click but you can't hide" – are an indication of how acutely it feels the threats to copyright protections.[17]

Although it seems safe to say that those messages will probably never really take hold, we have a legal system increasingly committed to enforcing those same norms, and doing so in creative and ambitious new ways. This in turn has led to a new polarization, one that is related but not identical to "optimist-pessimist" dichotomy discussed above. If, as Edgard Bronfman (the CEO of Warner Music) observed, the music industry has "inadvertently gone to war with its customers" through its inflexible thinking about copyright, the widening gulf between our laws

15. A techno-utopian publication with which he was closely associated. See Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*

16. Patry, *How to Fix Copyright*, 12.

17. These are just two of several propaganda campaigns designed to educate the public about the criminality of copyright infringement in the digital age. These kinds of campaigns were explicitly encouraged by the Clinton Administration and included as part of the remedy for some high profile infringement cases, as discussed below.

and our consumer practices is where the battle lines were first drawn.[18] Bronfman, in the very same breath, claims that this is a war the music industry lost. But to judge from the history of American IP laws, and crucially, to judge from the existence of Spotify, it is actually a war they have won decisively.

1.2 Eight landmarks in the modern history of copyright law

1.2.1 The 1976 Copyright Act

In 1976, Congress passed the first major overhaul of U.S. copyright law since 1909. As is true in general of major pieces of copyright legislation, the 1976 act casts itself as simply an effort to accommodate copyright law to new media technologies. Even when they are advancing radically new intellectual paradigms, copyright laws continually claim merely to be remedying perceived incongruencies between novel technology and existing law. A particularly relevant novel technology in the case of the 1976 act was commercial audio recordings, which before 1976 were not unto themselves copyrightable works. In an example of the slow pace with which copyright law has traditionally accommodated technological changes, the recording industry had actually existed for a generation before this act finally got around to granting them official protectable status.[19]

Under the 1976 act, a "work" can now be fixed in a recording rather than the traditional mode of fixation (a "composition"). Recognizing recordings as copyrightable works in this way seems legitimately nonpartisan – what could be more straightforward than granting legal status to the "recording artist," a figure that was already dominating the music business at the time of the act's passage? The 1976 act, however, also does other things. It represents the country's first

18. Greg Kot, *Ripped: How the Wired Generation Revolutionized Music* (Scribner, a division of Simon / Schuster, 2009), 56.

19. The DMCA, by contrast, a major piece of copyright legislation passed in 1998, is notorious for not following this pattern, and instead rushing through a spate of policies before the judiciary had a chance to establish a body of case law, or the media culture to get to know the new technologies to which it is addressed.

dramatic pivot away from the interests of the public in favor of those of copyright holders, the first milestone in the advance of copyright maximalism in U.S. law. This movement can be seen by comparing the 1909 and 1976 acts. Under the 1909 act, federal copyright law had applied only once a work was "published."[20] Before publication, copyright was a matter of state and common law, and the nature of the protections varied from place to place. Even when federal law did apply, moreover, the default course had always been that a work would become public. A work would be copyrighted only if the author took certain steps to ensure her limited monopoly on a work. Failing this, the work would fall irretrievably into the public domain, becoming freely copyable or performable with no authorization required. The steps to gain federal copyright protections were actually quite simple (the word "copyright," or a symbol representing it, had to be printed at a specified location on every distributed copy) but the natural course in 1909 is assumed to be that everyone should have access to a given work. Although federal copyright protections were freely accessible, they were of a much shorter term than the protections we know today, and the spirit of the law shows a clear preference for public access over private remuneration.

The 1909 act even permitted performances of copyrighted materials, including public performances, provided they were not for "profit." What exactly constitutes a profit-driven performance is not always easy to determine, but in permitting them the 1909 law shows a markedly different attitude from the 1976 act and from contemporary copyright norms. Since performances without a profit motive were thought not to interfere with the financial remuneration of the author, they would therefore not diminish the incentive to produce, which is what, according to the Constitution, all copyrights are ultimately designed to encourage ("to promote the progress of science and useful arts"[21]). The 1909 Act even went so far as to include a "jukebox exemption" specifically designating the use of copyrighted materials in jukeboxes as *de minimis* and therefore

20. "Publication," a legal term of art, has a technical definition in copyright law. It is nevertheless a definition about which reasonable people can (and have) disagreed. Martin Luther King's "I have a dream" speech, for example, turns out not to have been "published" although it was broadcast to millions on the radio. See Thomas F. Cotter, "Toward a Functional Definition of Publication in Copyright Law," *Minnesota Law Review* 1724 (2008)

21. U.S. Constitution, Article 1, section 8, clause 8

not legally actionable.

It is worth pointing out here that it was the 1909 act that first established the distinction between two types of royalty payment that still exist today: "performance royalties," paid to the composers of music when their works are performed in public, and "mechanical royalties," paid on the basis of "mechanical" reproductions of music such as recordings, or, to take the actually motivating example, player piano rolls. The former are distributed by performance rights societies such as ASCAP and BMI, which collect fees from venues of public performances and distribute them appropriately to their members, who are the holders of the performance rights, or the "publishing rights," as they are sometimes called. Owners of the mechanical rights (not always the composers) are entitled to compensation for each mechanical reproduction that is made of their music, such as a recording or, lately, a "digital phonorecord delivery" (see below). What qualifies as a "performance," what as a "mechanical reproduction," and the size of the remunerations attaching to either, have shifted over the years.

In an illustrative example of the reorientation the 1976 act represents, it would essentially scrap the jukebox exception, re-classifying jukebox plays as "performances" and entitling copyright holders to appropriate royalties for them. But there were other changes too. Probably the single most important one is that the 1976 act makes federal copyright protection apply from the very moment an author begins work. No longer does an author need to take specific actions to create a copyright; now a work is protected from the moment it is "fixed" in some external, tangible medium of expression.[22] This protection, moreover, exists at the federal level and therefore applies uniformly throughout the country. Under the 1976 law the right of first publication is protected, instantly and exclusively and by default.

One crucial consequence of this act is that it decoupled copyright from the concept

22. The fixation requirement was instituted in 1976 as part of Congress's recognition that authors were continually finding new expressive means beyond the traditional medium of text. "Fixation" did create the flexibility needed to render many new forms of expression copyrightable, witness the new protections for audio recordings. Nevertheless the concept has proven problematic in the 21st century, most notably in the question of the "fixity" of computer software. See Evan Brown, "Fixed Perspectives: The Evolving contours of the Fixation Requirement in Copyright Law," *Washington Journal of Law, Technology and the Arts* 10/1 (2014)

of "publication," which had always been somewhat loosely defined, and centered it instead on "fixation."[23] The magic moment of publication is replaced by the magic moment of externalization, and the default course of action is reversed. The duration of these instant copyrights was also substantially extended, from 28 years in 1909 to "life plus fifty" – that is, until 50 years after the death of the author. Even when a work bears no visible copyright symbol, moreover, the burden as of 1976 is upon the person seeking to copy or perform it to consult the records of the Copyright Office to determine whether it has been filed there. If it has, the work is protected, regardless of whether its published versions say so or not. In 1909 the mere absence of the mark would generally have put the work in the public domain. Under the 1976 act, many previously legal performances, most notably public performances not for profit, would thus become illicit.

The 1976 act has a convoluted legislative history, with Congress trying and failing several times to pass a badly needed copyright overhaul. Copyright law is complex and technical, and, as noted above, not everything about the 1976 act carries an ideological charge. Nevertheless it does reflect an unmistakable shift in philosophical orientation, one that was not missed by contemporary observers. As Robert Gorman wrote just two years after its passage, "the 1976 act can be read as rather consistently expanding the exclusive rights of the copyright holder."[24] This represents a totally different orientation from the 1909 act, which, in a report published by Congress alongside it, was characterized quite explicitly as "not primarily for the benefit of the author, but primarily for the benefit of the public."[25] The goal was to allow the public to enjoy its citizenry's creativity, and to compensate authors only insofar as doing so served the primary goal of public enrichment.

Another important intervention of the 1976 act concerns the relationship of copyright to profit seeking. Whereas the 1909 law protected copyright holders only when infringers sought

23. Robert A. Gorman, "An Overview of the Copyright Act of 1976," *University of Pennsylvania Law Review* 126, no. 4 (1978): 866.

24. Ibid., 874.

25. Benjamin W. Rudd, "Notable Dates in American Copyright, 1783-19669," 141, accessed June 13, 2019, https://www.copyright.gov/history/dates.pdf.

profit, section 106 of the 1976 act grants exclusive rights to the copyright holder, regardless of whether profit was sought. As Michaell Jarret writes, "in expanding the control of copyright holders into the new terrain of noncommercial use, this small change represents an erosion of user prerogatives that would have been allowable as a matter of course under the 1909 law and establishes a new logic for the application of copyright law."[26] This is a logic that has been sustained and developed over many subsequent pieces of case and statutory law, whose 21st century refinements are visible nowhere more clearly than in Spotify. As the legally sanctioned version of various illicit services whose primary defense had always been that they enabled not-for-profit, non-infringing private home uses, Spotify can be seen as a corporate elaboration of this signal feature of the 1976 act.

Fair Use as of 1976

On the other hand, the 1976 act is also where U.S. law first formalized the doctrine of "fair use," that is, a specific exemption for certain kinds of otherwise infringing behaviors. Fair use had always existed as a possible defense against an infringement action, but its definition had been notoriously murky; as one judge wrote, it was "so flexible as virtually to defy definition."[27] In determining if a given use is fair, and therefore immune to litigation, judges after 1976 are advised to consider the following four factors:[28]

1. the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;

2. the nature of the copyrighted work;

26. Michael Jarrett, "I Want My MP3: Who Owns Internet Music?," in *Policing Pop* (Temple University Press, 2003), 34.
27. See Time Inc. v. Bernard Geis Assoc., 293 F. Supp. 130, 144 (S.D.N.Y. 1968).
28. U.S. Code, title 17, chapter 1, section 107, available, e.g., at https://www.law.cornell.edu/uscode/text/17/107, accessed 06-06-2019

3. the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and

4. the effect of the use upon the potential market for or value of the copyrighted work.

These are the "factors to be considered." Satisfying one is not a guarantee of statutory fairness, nor is it necessarily the case that failure to satisfy all four means a given use is not fair. Determinations of fair use, in other words, remain somewhat less systematic than these four items would lead one to believe. As William S. Strong puts it, "fair use is really a gestalt," one that often involves the "instincts" of the judge and jury.[29] As the "fair use" defense is the one most commonly invoked by streaming companies sued for infringement, this defense (and the various grounds upon which it has been rejected, which is usually what has happened in the music industry) can be an especially instructive place to take the measure of those judicial "instincts" at any given time.

1.2.2 *Sony Corporation vs. Universal City Studios Inc.* – The "Betamax Rule" of 1984

Of the technologies motivating the 1976 act, few loomed larger on the landscape of American copyright law than the Sony Betamax, an innovative video recording and playback device that Sony introduced in 1975. The Betamax brought a new level of fidelity to consumer grade home recording, enabling users to record broadcasted TV to magnetic tape and replay it on their own time, skipping the commercials if they desired. In the years of legal disputes that would follow this case and others like it, this feature came to be known as "time shifting," a broadcasting term of art that, for anyone who followed the "copyright wars" of the late 20th century, conjures the frequently recurring question of whether copying something so as to replay later constitutes infringement. Fearing that time shifting would cut into their advertising revenue and reduce the

29. William S. Strong, *The Copyright Book: A Practical Guide*, 6th ed. (MIT Press, 2014), 273-4.

value of their intellectual property, Universal City Studios and Walt Disney Productions argued that Sony was liable for damages as a contributory infringer. The case is notorious for raising the issue of a corporation's liability as a contributing infringer for the illegal uses to which its users put its products.

The main precedent from the Betamax case is that "time shifting" is indeed deemed a fair use: taping something so as to watch it later is not illegal. This may seem a straightforward conclusion, but there are good arguments on both sides. Reproducing copyrighted material is, on the one hand, an explicitly forbidden act: the very first prohibition enumerated in the copyright statute is "to reproduce the copyrighted work in copies or phonorecords."[30] As Stephen Kroft, who represented Universal City Studios before the Supreme Court in this case, put it in his remarks to the court,

> This case is really very simple and straightforward. The petitioners have created a billion dollar industry based entirely on the taking of someone else's property.[31]

All things being equal, the Betamax does seem at a minimum to encourage customers to violate this basic copyright doctrine. The Betamax ad slogan, "watch whatever, whenever," almost seems to wink at customers about the device's potential dubious applications. This slogan in fact served as evidence for Universal that Sony "knew or had reason to know" that its device could and would be used for infringing purposes. A verdict in favor of Universal, then, would have meant that Sony, a manufacturer of high quality magnetic tape recorders, was held liable for the infringing activities of its customers in an international market.

That the Betamax does indeed make infringement possible, even encourages it, was never really in doubt in this case. There is no getting around the fact, after all, that it can make high quality copies of proprietary content. Instead, the case centered on whether Sony could be said to have violated the copyrights held by Universal by selling copying *equipment* to the general public.

30. 17 U.S. Code 106. Exclusive rights in copyrighted works
31. Kroft's oral argument, accessed at https://www.oyez.org/cases/1982/81-1687, June 18, 2019

Universal, essentially, found itself in the position of arguing that *anyone* who produces a device in full knowledge that it will likely be used to infringe is liable for contributory infringement.

Pursuing this argument put Universal's legal team in a position that, at the time, seemed radical. When pressed by the court about the idea of putting legal disclaimers on the device warning users not to violate copyright law (a common expedient for this kind of matter), Stephen Kroft dismisses such efforts as "disingenuous,' insisting that

> The real way for Sony to have avoided this problem would have been to cooperate with the copyright owners in devising technology which would allow the broadcaster to jam the video recorder from copying the kind of material that is owned by people who object.

Universal is committed, in other words, to the notion that any manufacturer that knowingly provides customers with a device that can be used to infringe is liable for that infringement, and furthermore that the copyright holders should have final word on what types of technological measures manufactures employ to discourage such infringement. Anything less (like warning labels) is "disingenuous" and doomed to fail. Kroft wants copyright law, something that formally attaches to music and movies, to apply at the level of Sony's factory floor. This is a difficult position to defend, at least in 1984. After a couple of questions about the degree to which a technology manufacturer can protect itself with legal disclaimers about infringement, Justice Stevens asks Kroft directly about what he thinks Xerox's liability would be in an analogous matter:

> But your view of the law is that as long as Xerox knows that theres some illegal copying going on, Xerox is a contributory infringer?

Kroft pauses for a long time, and his response, when it comes, is tellingly halting:

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

To this, Justice Stevens responds instantly: "a rather extreme position."[32] The idea that a company would be liable for its users' behavior, and the correlate argument that the rights of

32. Transcribed from audio recordings of the case, accessed at https://www.oyez.org/cases/1982/81-1687, June 18, 2019. Relevant timestamp: 32:20

copyright holders should extend into the design of the technology in question, is an extreme one, at least as of 1984. It is an argument that the court rejected then, but, as discussed below, it is essentially the bedrock doctrine of the Digital Millenium Copyright Act (DMCA) and today's copyright norms.

It is important to note that the Supreme Court did not deny that the Betamax could pose some market threat to Universal. In siding with Sony, the court simply affirmed that such financial harm, while real, was minimal. In exonerating Sony from contributory infringement, the court affirmed the broad purpose of copyright law to nourish productivity for the general public, arguing that its public benefit outweighed its private harms. The final opinion even cites a previous precedent echoing the original spirit of the law: Justice Potter Stewart's 1975 opinion in *Twentieth Century Music Corp. v. Aiken*: "the immediate effect of our copyright law is to secure a fair return for an author's creative labor. But the ultimate aim is, by this incentive, to stimulate artistic creativity for the general public good."[33] The court also considered it significant that, even though the Betamax could be used for infringing purposes, it has "substantial non infringing use," for example in the case of authorized time shifting (cases where copyright holders do not object to their viewers' time shifting. The children's television personality Mr. Rogers, for example, was a well-known copyright holder who publicly supported time shifting and users' rights.[34]

Perhaps most importantly, the court also held that even *unauthorized* time shifting is a fair use. If the copying were made for a profit, "such use would be preemptively unfair." But the majority of unauthorized time shifting is done with no commercial motive, simply so that the consumer may enjoy on their own time a work "which he had been invited to witness in its entirety free of charge." Thus the use is fair, even where the entire work has been copied and no productive changes made to it.

At stake in the case, once again, is the "tension between creative incentive and audience

33. Stewart Potter, *20th Century Music v. Aiken*, US Supreme Court, decided 1975, Justice Stewart writing majority opinion, 1975.

34. A. Perzanowski and J. Schultz, *The End of Ownership: Personal Property in the Digital Economy*, Information Society Series (MIT Press, 2016).

access that lies at the heart of copyright law."[35] In this regard the Betamax case established two important precedents. The first precedent concerns the legality of the device in question. The Betamax ruling meant that a device that admits of both fair use and infringement should be allowed if its potential for fair use, and the benefits that fair use affords the general public, outweigh its potential for infringement. The mere fact that a device allows for prohibited uses is not necessarily dispositive, nor, crucially, is it the manufacturer's legal responsibility to build the device in such a way as to discourage such uses. It is this precedent to which Napster, another manufacturer of technology largely used for illegal purposes, would primarily look in its own fair use defense.

The second precedent concerns the liability of the manufacturer. In this regard the Betamax case established that a company could not be held legally responsible for the infringing behavior of the users of its product. This ruling relied on the doctrine of fair use as codified in the recent 1976 Copyright Act, and it held that a copyright should subsist narrowly in the work in question; an extension beyond that, to something that is not the subject of copyright protection (a VTR like the Betamax, for example) would be to enlarge unduly the scope of copyright. This, too, would be a cornerstone of Napster's unsuccesful defense in 2001.

1.2.3 Audio Home Recording Act (AHRA) of 1992

The Betamax, today, is remembered mostly as the consumer video technology that lost out to VHS. This hardly seemed inevitable in 1984, especially because the Beta format was actually higher quality than its competitors. Both the VHS and Betamax, though, were analog technology; a new copyright debate was sparked with the introduction of digital reproduction technologies like Digital Audio Tape (DAT), which Sony introduced in 1987. The crucial difference between DAT and analog recording, from a copyright perspective, is not its higher quality, but rather the fact

35. Carey R. Ramos, "The Betamax Case: Accommodating Public Access and Economic Incentive in Copyright Law," *Stanford Law Review* 31, no. 2 (1979): 244.

that digital copies are lossless. With analog technologies like the Betamax, the industry's fears had been mitigated somewhat by the knowledge that quality would degrade with every successive copy; DAT devices can produce unlimited numbers of copies with virtually no degradation in quality ("serial copying"). Lossless copying represented a new kind of threat to the market for music recordings. The issue eventually crystallized into a conflict between the Recording Industry Association of America (RIAA), an industry trade group that had existed since 1958, and the Home Recording Rights Coalition (HHRC), a consumer advocacy group founded in the aftermath of the Betamax decision.[36] The debate between groups like these, and the various industry players they represented, never amounted to high profile litigation like the Betamax case. Nevertheless it was decisive in shaping U.S. copyright law, most prominently in the Audio Home Recording Act of 1992. As Blayne Haggart writes, the 1992 act should therefore be understood not as the opinion of the legislature on the correct application of copyright law to a novel technology but rather "merely the codification of agreements between the recording industry and audio equipment manufacturers."[37]

The act is in three parts. The first part is crucial: it stipulates that DAT technology must incorporate measures to prevent the proliferation of copied materials. Under this act, it becomes illegal to manufacture, import, or distribute a digital recording device that does not conform to an encoding system designed to prevent serial copying. Note that this element of the law is is more or less what Stephen Kroft called for in his arguments before the Supreme Court in the Betamax case (arguments that, it bears repeating, struck Justice Stevens as "extreme"). The protection schemes encoded in DAT, known then as the Serial Copy Management System (SCMS), are essentially an early form of what would later come to be known as Digital Rights Management (DRM), and which continue to proliferate today, embedded in digitally distributed MP3 files and Spotify's Ogg Vorbis format audio files.[38] These are legally mandated technological obstructions

36. Blayne Haggart, *Copyfight: The Global Politics of Digital Copyright Reform* (University of Toronto Press, 2014), 107.
37. Ibid., 325.
38. See the Sidify product, which removes these DRM schemes: https://www.sidify.com/guide/

designed to discourage infringing behavior. 1990s SCMS was a crude form of DRM whose only real feature was that, while it allowed a user to make unlimited copies from a single master, made it impossible to produce copies from other copies (it prevented "serial copying"). This relatively modest prevention is nevertheless the model for subsequent generations of DRM, many of which are far more insidious. Apple, for example, has instituted controls on iPhones that disable certain features when a user replaces the battery with a non-Apple battery of equivalent functionality, essentially ensuring that this common repair be done at corporate rates.[39] HP has used DRM to prevent users from using third-party printer cartridges, but also to check the status of users' HP ink subscriptions.[40] It is these kinds of DRM schemes that, for many critics, turn our digital files into "spies," silently influencing the way we interact with them and reporting back to their handlers about our behaviors.[41]

The second and third parts of the AHRA are less consequential: the second part institutes royalties on the sale of digital reproduction technology, some of which are returned to the record companies. In the third part, it explicitly prohibits copyright infringement actions against home copying; the logic seems to be that, if the RIAA is going be allowed to extend copyright protections into the design of recording devices themselves, it should forfeit its right to prosecute people who then use those devices.[42]

To understand the importance of the 1992 act, recall the logic behind the Betamax case. Part of the reason the court was unwilling to declare Sony liable for contributory infringement in 1984 is that doing so would "enlarge the scope of respondents' statutory monopolies to encompass control over an article of commerce that is not the subject of copyright protection." It would, in other words, extend the reach of copyright protections from its original provenance, music and plays and so forth, to the design of novel technologies. The latter is traditionally subject to the

remove-drm-from-spotify.html, accessed 08-18-2019

39. See "Apple is locking batteries to specific iPhones," in *Vice*, https://www.vice.com/en_us/article/59nz3k/apple-is-locking-batteries-to-specific-iphones-a-nightmare-for-diy-repair

40. See "Inkjet Dystopias," in *Boing Boing*, 2019. https://boingboing.net/2019/02/08/inkjet-dystopias.html

41. Samuelson, "The Copyright Grab."

42. Haggart, *Copyfight: The Global Politics of Digital Copyright Reform*, 325.

related but distinct field of patent law. University City Studios had sought, on the grounds of such an expanded scope, damages for contributory infringement, as well as an injunction against the manufacture of the offending device. In the Betamax case of 1984, they were granted neither. But in the legislative compromise negotiated between the major forces of the entertainment industry that is the 1992 act, the industry as a whole is essentially given both; the scope of copyright protections is extended to the design of the recording device (they have to conform to SMCS), and certain provisions are made for royalties on the sale of such devices to be directed back to the recording industry.

This act set two important precedents not explicitly spelled out the language of the law. First, it represents a victory for the individual user, whom it explicitly protects against certain kinds of infringement litigation. Second, and more importantly, it is an early example of the effort to embed systems of copyright control in the technology itself. While DRM technology is regarded by some as ineffective and retrogressive,[43] it remains an important feature of contemporary digital culture, something Tarleton Gillespie calls "the technological fix."[44] In this regard, the AHRA is an important milestone in establishing the precedent for legal home audio consumption that Spotify, as a technological solution to a legal problem, adheres to.

John Barlow, "The Economy of Ideas," 1994

John Barlow published this influential essay in *Wired* in 1994. It is perhaps the first widely read articulation of the now-familiar argument that traditional intellectual property laws are fundamentally incompatible with digital culture. A polymath and countercultural libertarian who has written on a wide range of topics, Barlow was probably better known in 1994 for his work as a lyricist for the Grateful Dead than for his writing about cyberculture. Nevertheless, via his involvement in the Electronic Frontier Foundation, Barlow had achieved a certain stature in

43. E.g. by Steve Jobs, who railed against it in 2007 in an open letter posted to Apple's website titled "Thoughts on Music"

44. Tarleton Gillespie, *Wired Shut: Copyright and the Shape of Digital Culture* (MIT Press, 2007), 1.

techno-utopian circles, and published over his career a number of influential articles in Wired. "The Economy of Ideas" is not taken seriously in the legal profession, but it does give emphatic voice to ideas that resonate with many in Barlow's generation, and which continue to have currency today: namely, the notion that copyright is fundamentally out of step with digital culture, and that nothing short of a complete overhaul of our whole notion of intellectual property will do if the legal system is ever to adjust. Barlow's ideas are mostly familiar – a central premise, for example, is Benkler's cited above, that information and physical property are fundamentally different types – but his language is always colorful:

> Digital technology is detaching information from the physical plane, where property law has always found definition. ... It's fairly paradigm warping to look at information through fresh eyes - to see how very little it is like pig iron or pork bellies, and to imagine the tottering travesties of case law we will stack up if we go on legally treating it as though it were.

In fact, some of Barlow's bemoaned case law had already been stacked up in 1994, and the steady drift of U.S. copyright law away from the interests of the public was well underway. The Clinton Administration's 1995 white paper on IP rights (discussed below) was only a year away, and the DMCA that would enshrine the principles set out therein would soon be passed. Whether or not you agree with Barlow that copyright is "dead," and that the efforts to re-animate its corpse lead to legal "travesties," he does correctly perceive the shifts taking place in legal attitudes (although he refrains from naming the relevant cases or discussing the legal issues in any detail). Not only does he pick up on and give a charismatic expression to this broader trend, but Barlow also spots its potential to return cultural production to a state of 18th century style patronage:

> Before the industrialization of creation, writers, composers, artists, and the like produced their products in the private service of patrons. Without objects to distribute in a mass market, creative people will return to a condition somewhat like this, except that they will serve many patrons, rather than one.[45]

45. John Perry Barlow, "The Economy of Ideas: A framework for patents and copyrights in the Digital Age. (Everything you know about intellectual property is wrong.)," 1994, accessed August 10, 2019, https://www.wired.com/1994/03/economy-ideas/.

This insight gives Barlow something to do besides "dancing on the grave" of copyright law. Companies in the digital age, he argues, should focus not on the delivery of products but instead on the management of "relationships" with the market. Like the Whole Earth Catalogue in general, this is an idea that mingles a libertarian screed with strategy advice from a corporate self-help guru: "The future protection of your intellectual property," writes Barlow, "will depend on your ability to control your relationship to the market - a relationship which will most likely live and grow over a period of time." Intellectual property protections should not – and, in Barlow's estimation, cannot – apply to the material itself. Instead, they should apply to the mechanisms through which companies relate "swiftly, conveniently, and interactively" with their customers.

This is a prescient insight with special relevance for the case of Spotify. Following the general trend of media companies in the 21st century, Spotify has increasingly relied upon its discovery services, rather than its provision of content alone, to remain desirable to its customers. This is, as Barlow notes, intimately connected to the lived reality of copyright protections in the 21st century; in a world where free access to 30 million tracks is no longer impressive, Spotify's greatest asset becomes its ability to help customers navigate the glut of content, to "soundtrack your life." And yet Spotify continues to hew to the traditional doctrine of intellectual property rights, compensating record labels and even ceding substantial portions of its stock to them. This contradiction – Spotify has imbibed Barlow's insights in one way but totally ignored them in another – is probably the biggest single reason why it has always failed to turn a profit.

1.2.4 1995, Working Group on Intellectual Property Rights White Paper

In 1995, Bruce Lehman, President Clinton's Commissioner of Patents and Trademarks, chaired the administration's Working Group on Intellectual Property Rights. Charged with, once again, accommodating U.S. copyright law to the technological changes that had taken place since

1976, this group released a White Paper[46] outlining the administration's general approach to the issue of copyright protections – much of which would be signed into law in the 1998 DMCA (discussed below). In general, this document recommends preserving the essence of the 1976 act, with some amendments where necessary. The language of the document is studiously innocuous, but for its critics it represents some radical changes. Both its proponents and detractors would agree, though, that it is staunchly market-oriented and, from the outset, determined to defend the principle of copyright protection from the threats originating in "cyberspace:"

> Unless the framework for legitimate commerce is preserved and adequate protection for copyrighted works is ensured, the vast communications network will not reach its full potential as a true, global marketplace. Copyright protection is not an obstacle in the way of the success of the NII (national information infrastructure); it is an essential component. Effective copyright protection is a fundamental way to promote the availability of works to the public.[47]

Note the way the document takes for granted that the "true" potential of the internet is construed *a priori* as being a "marketplace." The faith in the implicit wisdom and benevolence of the market is so deep that its place as the ultimate end for novel technologies is utterly taken for granted. The idea that the Internet would ever be something other than a market seems never to have occurred to the commission. The ways in which market fundamentalism shapes the attitude of the working group toward copyright law are beyond the scope of its argumentation, and remain latent throughout. Nevertheless the document is, at least for its critics, heavily inflected by this prejudice. For Pamela Samuelson, for example, it is "a wholesale giveaway to its supporters in the copyright industry," at the expense of the user.[48] Or, as Paul Goldstein puts it, this white paper recommended a "strict application of copyright [designed to] to bring the operations of every kind of Internet service provider...under copyright control." From this perspective, the White

46. A memo, essentially, describing a plan or strategy, a document with no legal force.

47. Bruce Lehman, "Intellectual Property and The National Information Infrastructure: The Report of The Working Group On Intellectual Property Rights," accessed via the Electronic Frontier Foundation site, 1995, 16, accessed June 24, 2019, https://www.eff.org/files/filenode/DMCA/ntia_dmca_white_paper.pdf.

48. Samuelson, "The Copyright Grab."

Paper takes a hard line position that effectively makes Internet providers direct infringers, liable for the "millions, if not billions, of signals that daily course through their facilities."[49]

The white paper's rhetorical frame, by contrast, makes its recommendations sound like minor adjustments to existing law. It is recommended, for example, that digital "transmission" fall under the traditional statute covering copying as an infringing behavior (a doctrine contested today by Spotify, unsuccesfully). It also recognizes publication to the Internet as concept with real legal weight. Taken at face value, these seem like reasonable accommodations to the digital age with no particular ideological agenda; does not my computer receive a copy of whatever is "transmitted" to me on it? Is not the Internet a primary site of publishing activity in the digital age? They seem harmless but these ideas actually have radical consequences. In classifying "transmission" as a case of "copying," the recommendation would mean that even browsing copyrighted material could be an infringing behavior – even the information stored in a computer's temporary RAM "has been found to be a sufficient fixation" to support a claim of infringement.[50] The recommendations would also deal a sizeable blow to the fair use defense, arguing that fair use is inapplicable in any case where a use could be licensed, which is a significant revision on the precedent established in the Betamax decision – a case where non-profit home use was presumptively fair, regardless of the licensing prospects the industry may have imagined for home copying.

Advancing the case for the technological implementation of infringement obstructions that we saw first in Universal's unsuccessful arguments before the Supreme Court in 1984, the 1995 White Paper also recommends the use of "copyright management information." This character of this information in the white paper is anodyne:

> The name and other identifying information of the author of a work, the name and other identifying information of the copyright owner, terms and conditions for uses of the work, and such other information as the Register of Copyrights may prescribe

49. Goldstein, *Copyright's Highway: From Gutenberg to the Celestial Jukebox*, 172.

50. Lehman, "Intellectual Property and The National Information Infrastructure: The Report of The Working Group On Intellectual Property Rights," 28.

by regulation – to provide adequate flexibility in the future.[51]

Which, on its own, does not sound particularly threatening. However, as Samuelson points out, the recommendation is actually that tampering with such information would become a criminal (not civil) offence. The actual implementation of these hidden watermarks, moreover, is likely to "have the ability to report back to the copyright owner," in a manner that amounts to a sort of digital surveillance. Drawing on the precedent of the AHRA, which had instituted the Serial Copying Management System in digital audio tape recording devices, this document advocates for a system that would mandate the prevention of any copies at all, unless permitted by the copyright holders – a significant broadening of the doctrine underlying the AHRA. The recommendation, in fact, is that the mere manufacture or distribution of devices capable of circumventing these protective systems become a criminal offence unto itself, apart from the actual copying that might take place with such devices. As Samuelson points out, this recommendation would effectively overturn the Betamax precedent, which "held that copyright holders cannot stop the distribution of a technology as long as it has a substantial noninfringing use."[52]

The White Paper would also require internet service providers (ISPs) to police their customers for potential infringement. ISPs, it argues, are in the best position to prevent copyright infringement on the part of their customers, and therefore "the best policy is to hold the service provider liable."[53] In this regard the white paper effectively ignores the privacy rights of customers, as well as the logistical burden such a policy would impose on the ISP industry. On top of all this, the recommendations include ambitious attempts to shape public opinion about intellectual property. These include a "copyright awareness campaign," and an associated educational curriculum designed to "reinforce the important role of intellectual property," in which "respect

51. Lehman, "Intellectual Property and The National Information Infrastructure: The Report of The Working Group On Intellectual Property Rights," 235.
52. Samuelson, "The Copyright Grab."
53. Lehman, "Intellectual Property and The National Information Infrastructure: The Report of The Working Group On Intellectual Property Rights," 117.

for copyright protection needs to be highlighted."[54]

The argument of the white paper, ultimately, is that without appropriate copyright protections, there will be insufficient incentive for the creation of new content in the digital culture. Tough new laws are needed to prevent the Net from devolving into a "copyright Dodge city" with rampant infringement and a resulting drought of new works.[55] This is a chaotic future that the commission hopes to avoid altogether, with a handful of aggressive measures. These measures are also preemptive, and the fears about a digital Dodge City are largely unverified as a matter of empirical fact. In advancing this agenda, the commission crafts a vision copyright law that is vastly expanded, one that Samuelson derisively terms "copyright maximalism." Whether or not we agree that this expanded version of copyright can serve the aims of copyright protections as set out in the Constitution, the interests of copyright holders are clearly favored to a greater degree than ever before. They are favored over the interests of the public, certainly, but also over the manufacturers of digital hardware (who are enjoined to encode copyright protections into their devices) and ISPs (who are forced, willing or not, into a position of surveilling and punishing their customers). The limited monopoly an author holds over performances of their works, which technically exists only for the benefit of society at large, has been expanded to protect the interests of copyright holders (who, as of 1995, were mostly corporate aggregators rather than sole authors) to such an extent that any services or devices that could conceivably pose them some financial threat, or which could intrude on some market that could conceivably come about in the future, are now required to mitigate those threats actively, preemptively and at their own expense.

54. Lehman, "Intellectual Property and The National Information Infrastructure: The Report of The Working Group On Intellectual Property Rights," 204.

55. Ibid., 15.

1.2.5 1998, Digital Millennium Copyright Act

The 1995 white paper simply outlined the Clinton Administration's intended posture on IP law; it did not itself have any actual legal force. In 1998, when Congress passed the Digital Millennium Copyright Act (DMCA) to (yet again) bring U.S. copyright law in line with the technological advances that had taken place since its last major overhaul, the majority of that philosophy became U.S. law. Once again, the language of the law was fairly innocuous; it aimed merely to bring copyright law "squarely into the digital age."[56] But the DMCA is one of the most hotly contested pieces of legislation in the history of copyright law, with many unintended consequences and countless objections from civil libertarians.

As Robert Merges points out, the passage of this law did not conform to the historical pattern set by other major reforms in copyright law. Typically, when a technological innovation upsets current paradigms, the system will grapple with this disruption over a number of years, accumulating a body of case law and occasionally commissioning formal studies upon which to base future legislation. Only after this incubation period will a new law be passed in Congress. It was in this way that the 1909 Copyright Act accommodated composers whose music was realized in piano rolls; before 1909 composers would not have been entitled to royalties on reproductions of their music in this form, since the encoded version of music (piano rolls) was not recognizable to any human as a musical composition. But piano rolls had existed since before the 20th century, and it took more than a decade to accommodate them in law. Similarly, the 1976 responded to the proliferation of audio recording equipment by introducing copyright protections for audio recordings themselves, but only after more than three decades of the recording industry. In both cases, the legislative response followed a long period of real-world engagement with technology. As Samuelson points out with respect to the 1995 white paper, the sensible thing to do has usually been to let a new technology operate for a while, "then figure out what, if any, legal fences are

56. David Nimmer, "A Riff on Fair Use in the Digital Millennium Copyright Act," *University of Pennsylvania Law Review* 148, no. 3 (2000): 680.

needed to avert market failures."[57] In passing the DMCA, Congress ignored these precedents and took a different line altogether. In the words of Merges, the DMCA was "rushed" and, moreover, answered the needs of the new media industries rather than the actual legal issues arising from the ways consumers used new technologies: as a piece of legislation it was, from the beginning, "industry backed."[58]

In adopting the recommendations of the 1995 white paper, the DMCA made two profound alterations to existing copyright law: first, it extended copyright protections to include the regulation of technological devices with potentially infringing uses. "The protection of expression," writes Merges, "is for the first time achieved through the regulation of devices."[59] We might point out that this was achieved, in a crude way, in the 1992 AHRA, but the DMCA further formalized and extended these technological protections. As David Nimmer puts it, the DMCA targets not only "bad acts" but also "bad machines" and "bad services."[60] A device or service, even just the idea of a device or service, can be inherently infringing, and thus preemptively prohibited by copyright law.

This feature of the DMCA paved the way for what Tarleton Gillespie has termed the "technical fix" to the scourge of piracy, the idea that the correct deployment of encryption technologies by the media industry can supplant traditional legal specifications about the legitimate uses of copyrighted materials. The legislative focus shifted away from acts of infringement to acts that enable infringement, and the "fix" is to aggressively compel manufacturers not to enable them in the first place. As recommended by the white paper, under the DMCA technology companies are compelled to embed copyright compliance in the devices themselves; these systems were originally crude and easily hacked, but today's content protection schemes are much more robust. These schemes have strange consequences. The enthusiastic embrace of "digital rights

57. Samuelson, "The Copyright Grab."
58. Robert P. Merges, "One Hundred Years of Solicitude: Intellectual Property Law, 1900-2000," *California Law Review* 88, no. 6 (2000): 2187–2240.
59. Ibid., 2202.
60. Nimmer, "A Riff on Fair Use in the Digital Millennium Copyright Act," 684.

management" as a solution to copyright infringement, for example, produces the anomalous result that DVD users today are legally prevented from doing what VHS users were explicitly allowed under the 1984 Betamax ruling; where the latter decision held that even unauthorized home copying was a fair use, today's DVD manufacturer is legally bound to prevent its users from exactly that kind of potential infringement. As Patry puts it, "because of the DMCA, owners of DVD players were placed in a worse position than owners of VCRs."[61] In a way the difference between VHS and DVD is bigger in legal than technological terms.

The DMCA represents not just the realization of the copyright expansions set out in the white paper, but also an unexpected realignment among the forces participating in the ongoing debate over copyright law. When copyright standards are effectively built directly into media devices, technology producers find themselves in league, willingly or not, with copyright holders in the broad effort to control mass media consumption. The DMCA draws a hard line in the sand, enacting a legal structure that effectively conscripts media companies into Edgar Bronfman's "war on customers" alluded to above. Service providers that resist this conscription will face litigation and, more than likely, the fate that Napster saw not two years after the passage of the DMCA. The ultimate legacy of the DMCA, then, may be less in its technical provisions than in the way it coerces the tech sector into allegiance with the recording industry. These are groups between whom there exists no natural allegiance; they have, in fact, usually been at odds, culturally speaking. The Betamax, for example, owes its stature in the history of copyright law to the fact that it stood in opposition to the interests of copyright holders. The DMCA effectively precludes such opposition, mandating that the interests of the copyright holders be hard wired into a device before it can legally be sold in the U.S.. It is only by reshaping the nation's copyright law that these two forces are brought into such close coordination. Spotify's close financial relationships with the major record labels is a perfect example; a company that brands itself as innovative, because of the provisions of the DMCA, finds itself not just cooperating with but in

61. Patry, *How to Fix Copyright*, 45.

fact largely owned by the parties who control the copyrights for its catalogue.

The second, and related, legal innovation of the DMCA was to create a new list of illicit activities pertaining to the circumvention of digital copy protections: “no person shall circumvent a measure that effectively controls access” to a copyrighted work. This is the infamous section 1201, making it illegal either to commit an act of circumvention, or to disseminate information or devices capable of circumventing DRM. The violation of encryption technologies, or even information about how to do so,[62] became an unlawful act unto itself, apart from the potential infringement such violation might lead to. Thus not only does the act create “bad machines,” but it makes tampering with good machines a “bad act” – that is, a violation of a copyright statute even if no copyright infringement has taken place whatsoever. Violators of section 1201, which forbids the manufacture or distribution of technology designed to circumvent “technological adjuncts to the exclusive rights granted by copyright law,” can face harsh penalties: “up to a $500,000 fine or up to five years imprisonment for a first offense, and up to a $1,000,000 fine or up to 10 years imprisonment for subsequent offenses.”[63]

1.2.6 *UMG v. MP3.com*

MP3.com was a music site launched in 1997 by the San Diego based entrepreneur Michael Robertson. Although short-lived, this site anticipated by several years many of the key functions of music sharing sites like Myspace and Napster. On MP3.com, bands had devoted pages where they could post promotional materials and share their music. The site featured a simple template for music distribution and promotion, and it quickly attracted many musicians at a time when the barriers to entry for hosting material on the Internet were much higher than they are today.

62. Edward Felton, a computer science professor at Princeton, was famously bullied about publishing research about how to ciricumvent DRM that he had conducted *at the invitation* of the industry group SDMI. See the Electronic Frontier Foundation’s list of “unintended consequences” form the DMCA, https://www.eff.org/files/2014/09/16/unintendedconsequences2014.pdf, accessed 08-19-2019

63. U.S. Copyright Office Summary of the DMCA, available at https://www.copyright.gov/legislation/dmca.pdf, accessed 06-28-2019

The site saw early successes and an extremely promising IPO in 1999, but ran into serious legal trouble almost immediately. In 1999, MP3.com introduced a "space shifting" feature marketed as "MyMP3." Combining the functionality of another Robertson venture (sideload.com) with the MP3.com site, the "MyMP3" service allowed users to upload their music to a remotely accessible server (what we would now call "the cloud"). Users could then access the content of their "locker" from any internet connected device. In order to use this service, users first had demonstrate ownership of the music in question, either by scanning a physical CD or making a legitimate digital purchase. Once they demonstrated this legitimate ownership, they could play it anywhere they had access to MP3.com.

The service, in other words, simply mimicked the ability of music owners to play their CDs on more than one device. Despite the precedent that personal space shifting is legal,[64] Universal Music Group, who owned the copyrights for many musical works being uploaded for this service, filed suit for copyright infringement. UMG's claim (made together with the RIAA organization) rested on two premises. First, the MP3.com service meant that a copy of the material in question was made from the CD owned by the user to the MP3 server; for UMG, this alone was a straightforward violation of the copyright statute. Even in cases where the service meant that MP3.com had to purchase additional copies of their own in order to provide the right user experience, at some point a copy had to be made in order for the "space shifting" to work. As this copy is neither "transformative" (involving the creative input of the copying party) nor minimal (so small as to be legally insignificant), UMG argued that it violates the copyright holder's monopoly right to a work. Secondly, UMG alleged that the "MyMP3" service caused them a market harm, another factor in the "fair use" considerations outlined in the 1976 Copyright act. The "space shifting" market upon which the "MyMP3" service depended, claimed UMG, was one that only legitimate copyright holders have a right to enter. The fact that UMG had not in fact entered it at all, along with the fact that that the balance of the music distributed

64. RIAA v. Diamond Multimedia Systems, Inc., 1999

in this manner was legally purchased is, in this view, irrelevant. The only relevant facts were that MP3.com copied the music onto its own servers, and that the right to sell a "space shifting" product predicated on UMG's intellectual property belonged to UMG alone. This was, in the 2000 opinion of Judge Rakoff, a straightforward case of copyright infringement. As he writes,

> The complex marvels of cyberspatial communication may create difficult legal issues; but not in this case. Defendant's infringement of plaintiffs' copyrights is clear. [65]

Rakoff's reasoning is simple and straightforward: is a copy made? Yes. Is there any reasonable fair use defense? Hewing narrowly to the four factor test, his answer is that there is not. Complete copies are made, for profit, with no productive alterations: open and shut case of copyright infringement. It is useful to compare this ruling with the Betamax case and the statute laid out in the AHRA of 1992. Taken together the three cases trace a series of victories for the "copyright maximalists." In the Betamax case, a device manufacturer is exonerated from the contributory infringement claim in a way that classifies "time shifting" as a fair use. In the AHRA, copyright law is construed in such a way as to require DAT manufacturers to encode infringement prevention schemes into their wares. Is the ruling against MP3.com an extension of copyright protections from hardware to software, and from "time shifting" to "space shifting?" The answer is yes and no. The case does represent an important milestone in the extension of copyright protections to digital copying in the cloud, and it does choose to treat the copying as infringement even though all the music in question is, thereotically, legally owned by the user.

And yet the comparison is also a little misleading. In the Betamax case, the fair use ruling depended explicitly on the "time shifting" being private and not for profit. MP3.com's copying practices were not private, were explicitly commercial in nature, and they were not of material that was offered for free in the first place (as broadcast television was in the Betamax case). The landmark in the expansionist agenda, in other words, is not as pronounced as the tempting comparisons might lead one to believe. Instead, the victory here is somewhat narrower,

65. *UMG Recordings, Incorporated v. MP3.com, Inc.*, case info retrieved from https://www.leagle.com/decision/200044192fsupp2d3491412, accessed 06-08-2019

and concerns the doctrine that the copyright holder holds the exclusive right to any market for his holdings, even markets which he has not yet entered or which do not yet exist. That, though, is enough of a precedent to be worth marking: if I own a copyright, I am the only one who can earn any money from it. You cannot enter into a new market space that makes use of my holdings, even if you do so with 100,000 copies of my work that you bought legally. The MP3.com case establishes the precedent that the potential market made possible by a copyright belongs to the the copyright holders, just as the copyright itself does.

1.2.7 *A&M Records, Inc. v. Napster, Inc.*

Among the technological disruptions to the music industry of the late 20th century, few did more to set the course for Spotify than Napster. Founded in 1999 by Shawn Fanning, Napster was a groundbreaking file sharing network that employed peer-to-peer technology to enable fast and easy sharing of files stored on users' computers. Napster provided a centralized database, a simple and effective search engine, and, crucially, a community environment in which to find like-minded music enthusiasts with whom to share MP3 files. Napster grew with incredible speed, amassing hundreds of thousands of users before it was abruptly driven out of business by aggressive litigation from the RIAA starting in 2000. During that time, though, the Napster phenomenon in many ways set the tone for the future of the digital music industry, defining the culture of music consumption, the ideological battle lines of music on the internet, and the contours of the digital music commodity itself. With its easy-to-use interface, its community orientation, and, of course, its price (free), Napster sounded the alarm bells for the music industry about what kind of commodity the 21st century music consumer was interested in. The industry's inflexibility in prosecuting Napster so aggressively has generally been seen as evidence that it failed to heed these alarm bells, clinging instead to the "sinking ship" of the business model that had enjoyed such prosperity in the 80s and 90s. The story, of course, is more complicated than that – certain elements at Napster had always intended to collaborate with the record industry, overtures were made and occasionally well received, and it was only through the dysfunctional leadership team at Napster that these efforts did not materialize.[66] Napster, in effect, really wanted and even planned to become legal. Whether or not its reputation for "anarcho-communist" leanings is deserved, in many ways Napster actually performed a huge service for the music industry. As Jeremy Wade Morris writes, "Napster actually helped shaped the form of the digital music commodity more than it contributed to its undoing."[67]

The nature of the Napster service was, essentially, to make the contents of one user's hard drive accessible to millions of other participating users. The Napster system in principle could be used to transmit any file, but it gained massive popularity as a music filesharing community, thanks in large part to the MP3 compression standard developed in the 1990s. Napster's underlying "MusicShare" software essentially made any digital home recording of any of its users available to all its users, without copying any of the transferred material to its own servers at any point.[68] The RIAA, however, was able to show that a majority of Napster users were using the service to get music for free illegally; in 2000, the recording industry brought suit against Napster, alleging direct, contributory and vicarious infringement. Illegal copies, they argued, were made of their copyrighted materials, in huge numbers, for no purpose except the commercial one. Napster's business model depended on the draw such illegal downloads represented for users, and its activities were a direct market harm to the copyright holders.

Arguing in part from the 1984 "Betamax" rule, Napster mounted a fair use defense; their technology, they argued, merely provided a service that, while it clearly *could* be used for nefarious purposes, also had substantial legal uses. Many musicians, for example, were happy to see their music distributed for free because the easy publicity helped their careers (the same argument Mr. Rogers had made in favor of time shifting in 1984). Napster claimed merely to

66. Trevor Merriden, *Irresistible Forces: The Business Legacy of Napster and the Growth of the Underground Internet* (Capstone Publishing Limited, 2001).

67. Jeremy Wade Morris, "Music in the Cloud," 1st ed. (University of California Press, 2015), 94.

68. The fact that Napster, unlike MP3.com, didn't make "copies" of its own was a major component in what its lawyers thought was a reasonable defense. Napster expected to claim simply to "facilitate communication." Merriden, *Irresistible Forces: The Business Legacy of Napster and the Growth of the Underground Internet*, 54

facilitate communication, for the purposes of such fair uses as sampling, space shifting, and authorized distribution. In the Betamax case, a technology capable of both fair and infringing uses had been allowed; when a device can do both, the thinking was that the interests of the public should be deferred to over the interests of the copyright holder. Napster hoped for a similar exemption.

There was also a second element to Napster's defense. Among the complex technological stipulations in the DMCA are rules governing the so-called "safe harbor" status for Online Service Providers (OSP). OSPs, provided they obey certain complex rules, are granted protections from legal actions based on the infringing activities of their users. A given service might, for example, make possible the illegal sharing of MP3 files, but if it qualifies as a safe harbor, the site cannot be held financially liable for such infringement. These conditions include that (1) the OSP informs its users of a termination policy for repeated incidents of infringement and (2) it "accommodates the technical measures that are used by copyright owners to identify or protect copyrighted works."[69] In addition to its claim of fair use, Napster sought to exempt itself from liability under this provision of the DMCA.

In both the district court and the court of appeals, all of Napster's defenses were rejected, and in 2001 the service was essentially forced to shut down under the pressure of the mandated remedies. Napster's fair use defense was rejected, and it was held liable for contributory and vicarious infringement. Critics of this decision have argued that it represents an overly narrow reading of the Betamax rule, and that it will have negative consequences for the music industry in the digital age. Lisa Zepeda, for example, points out that, although the facts do seem to indicate that the majority of Napster's users were infringing, the Betamax rule as originally construed requires only that a technology be capable of significant non-infringing use; that the balance of the usage does infringe should not be enough to hold the technology manufacturer liable. She argues, moreover, as in the case of Napster, "when new technology may be used for both legitimate and

69. Lisa M. Zepeda, "A & M Records, Inc. v. Napster, Inc.," *Berkeley Technology Law Journal* 71 (2002): 75.

infringing puroses, the balance should weigh in favor of allowing the new technology."[70]

Zepeda's position, quite clearly the one the taken by the court in the Betamax decision, is far from the mainstream today, either culturally or legally. This is not to say that there are not material differences between the Betamax and Napster. To cite just one, Napster's technological infrastructure meant that policing the activities of its subscribers, while not easy, was vastly more feasible than it would have been for Sony in 1984. This is nothing more nor less than an expression of how easy surveillance is in the digital era, but it does mean that Napster had significantly more power to know what its users were doing with its product that Sony did, and we might argue, more responsbility to ensure that its product was not being abused. For another, the materials Napster was used to distribute were never offered for free in the way that TV had been in the case of the Betamax; its potential market harm was therefore probably higher than that of the Betamax.[71] Perhaps most importantly, even if its legitimate uses are clearly real, it does seem that a much smaller portion of Napster usage was genuinely legitimate than was the case with the Betamax, something even a Napster apologist like Zepeda readily acknowledges; given that determinations of fair use are in part a matter of judicial discretion and common sense, this may have been what really did them in.

These are all, however, matters of historical contingency rather than legal doctrine or cultural attitude. If Napster represents the increased capacity of pirates to wreak havoc, its swift judicial condemnation represents the increased severity with which such havoc will be dealt in the era of digital distribution. Since the first increase is the same one that makes Spotify technically possible, down to its original P2P architecture, it is the second increase with which I have concerned myself in this chapter. Spotify came of age in a world where fair use could no longer excuse the same kind of behavior that it had excused in 1984, and where technology companies can expect to tow the line for the media industry or die.

70. Zepeda, "A & M Records, Inc. v. Napster, Inc.," 89.

71. There is reason, however, to believe that piracy accounted for much less of the music industry's downturn than is usually assumed. See Kot, *Ripped: How the Wired Generation Revolutionized Music*

1.2.8 Spotify's Obligations

Throughout this chapter, I have spoken mostly of the expansion of copyright in general, without making it clear what types of copyright licensing Spotify in particular is responsible for. Recall that U.S. Copyright law in 1909 chose to accommodate the technology of the player piano by inventing the "mechanical" royalty. This confusing moniker derives from the supposedly "mechanical" nature of musical representations in piano rolls. When the musical representation in hole punched piano rolls was at first deemed to be merely a "mechanical" part of the player piano (thus denying composers the right to be compensated for performances in them), composers sought a "mechanical right" that would entitle them to such remuneration, without needing to alter the way the courts had drawn a line between piano rolls and true musical notation.[72] Thus the mechanical right can be thought of as belonging simply to the composer of a song. This is a different legal instrument from the one consisting in the recording of a song, which has been available as a copyrightable entity since 1976 (see above). Thus a piece of music as we know it today is divided into two legal instruments, the composition and the recording.

Another difference: performances of pieces can be licensed, and copies of "master" recordings can be licensed, but the two types of authorization are legally distinct. Note that this is a separate distinction altogether from the one between a composition and its recording; the latter distinction is between types of musical property, and the former between two types of licensed activities. The question then becomes what kinds of license Spotify requires to provide streaming music – digital deliveries of audio recordings (legally termed "digital phonorecord deliveries" or DPDs) of musical compositions. The confusion arises (lots of it) because Spotify is dealing with two different types of property, in a distribution medium (streaming audio) that doesn't always conform to the practices copyright law was designed to regulate.

On one hand, Spotify behaves like radio, in that the customer does not "own" the streamed content. When Taylor Swift pulled her music from Spotify in 2014, customers lost the ability

72. White-Smith Music Publishing Company v. Apollo Company, U.S. Supreme Court Case, 1908

to listen to it there, even though their subscriptions had previously included it. On the other hand, Spotify is like digital distributions of MP3 files, in that customers can listen to any track, at any time, skipping around without restriction and searching for particular tracks. The interface is clearly modeled on the iTunes player, which plays only music the user actually owns. The way these licensing idiosyncracies are handled is a mess of legal arcana; Spotify turns out to be an "interactive digital subscription service" (as opposed to, say, a terrestrial radio broadcaster, "webcaster," or "Internet Radio" station like Sirius XM Internet Radio or Pandora Radio, which these days is different from its on-demand "Premium" tier). Since 1995, digital distributions of music files (DPDs) have triggered performance royalties.[73] In 2008, the Copyright Royalty Board determined that streamed music, by virtue of sitting on a user's cache, can trigger mechanical royalties too.[74] Thus in order to legally stream a piece of music, Spotify needs both kinds of license.

Its status as "interactive"[75] means that Spotify does not obtain these licenses statutorily, but has instead to negotiate them directly with copyright holders.[76] The means by which Spotify obtains these licenses are excruciatingly complex and have been the cause of most of its (many) legal troubles. Wixen Publishing, for example, sued Spotify for $1.6 billion the week of its IPO in 2018, alleging that Spotify had failed to make good-faith efforts to compensate songwriters (i.e. to obtain mechanical licenses) for streamed content. It may have obtained licenses for the performances, but Wixen argued that the proper procedures for locating and compensating composers and songwriters under its representation had not been followed. Two other major class action lawsuits – *Ferrick v. Spotify* and *Lowery v. Spotify,* both settled in 2017 – centered on the

73. This is the substance of the 1995 Digital Performance Right in Sound Recordings Act, largley adopted by the 1998 DMCA.

74. As published in the Federal Register, Copyright Royalty Board, Library of Congress, *Mechanical and Digital Phonorecord Delivery Rate Determination Proceeding*, 73 Fed. Reg. 57,033 (Oct. 1, 2008).

75. Pandora Radio, by contrast, has always been a "non-interactive" streaming service, which is why it limits the number of skips a user can make. This entitles it to a royalty scheme similar to that of terrestrial radio, where no mechanical royalty is triggered at all.

76. "Copyright Licensing in Music Distribution, Reproduction, and Public Performance," summary article published by the *Congressional Research Service,* accessed at https://www.everycrsreport.com/reports/RL33631.html#ifn111, Aug 19, 2019

same issue: whether Spotify obtained proper mechanical licenses.

These three cases alone have cost the company hundreds of millions of dollars. The effort to streamline that process, and to prevent more litigation, motivated the passage of the Music Modernization Act of 2018, the latest major overhaul of our nation's music copyright law. The bill's biggest contribution is to establish a "collective management organization" dedicated to distributing royalties for digital streams, something like a version of the SoundExchange organization that handles digital mechanicals instead of performance rights. Senator Orrin Hatch of Utah, the same senator who had presided over Shawn Fanning's testimony before Congress in 2001, played an active role in bringing it into law.[77] The rare example of a moment in the history of copyright law where the various stakeholders managed to agree on a piece of legislation and actually get it passed, this law has been encouraging for many industry players frustrated with the existing regime.[78] It is too early to say where exactly how the act pertains to the "copyright grab" whose history I have described above. It may be a straightforward revision of what is undoubtedly a dysfunctional way of granting mechanical licenses, or there may be other things hidden in its legal intricacies. Time will tell if it actually succeeds in simplifying the licensing process.

1.3 Spotify the Good Machine

The expansion of copyright traced in this chapter has meant, among other things, a "disciplining" of the tech sector. Over the course of years of legislation and case law, tech companies have been placed in a position of subservience to copyright law. Their products must now take into account those interests and actively discourage usages that media companies find threatening. If the last half century of copyright legislation has seen the invention of the "bad machine" as a rhetorical lever with which to shape legal argumentation, it has also seen

77. Hatch, a musician himself active in the music ministry of the Mormon Church, has made copyright legislation an important part of his political legacy.

78. "Congress may actually fix music royalties," quips Micah Singleton of the Verge. https://www.theverge.com/2018/1/26/16931966/congress-music-modernization-act-licensing-royalties, accessed 08-22-2019

the rise of "good machines" that are not mere concepts but empirical facts. Machines, that is, with copyright norms hard wired into their design. Spotify was founded as a service that would preserve the appeal of the Napster revolution – including, at first, its P2P architecture and some of its countercultural, hackerish caché – while compensating record labels in accordance with copyright law. Unless you go to great (and possibly illegal) lengths to capture the information Spotify sends to your sound card, Spotify makes space-shifting impossible – except, of course, the kind of space-shifting enabled by the Spotify client (and, we can assume, therefore sanctioned by the RIAA). Try to space-shift or time-shift beyond the confines of the platform and you have crossed the line into outright criminality – section 1201 of the DMCA promises harsh criminal penalties for messing with digital copyright protections. The audio files on Spotify bear the anti-piracy sonic watermarks mandated by many of the major labels. Perhaps most important of all, it is to these labels that the majority of Spotify's revenue still accrues, via their partial ownership of it and the arcane licensing system under which it operates. Spotify is, in other words, a quintessentially "good" machine.

The contradiction between the tech sector as, on the one hand, utopian, independent and countercultural and, on the other, the world's most profitable area of commerce, means that Silicon Valley's role in contemporary American culture is disputed. The allegiance between big tech and the RIAA that the DMCA effectively enforces adds another layer of complexity to this situation, one that any "good machine" will have to imbibe. Tech companies, including Spotify, love to market themselves as disruptive in a sort of anarchical and utopian way: to "think different" (to take the slogan of the mother of all utopic tech firms) is to flout convention, both in the literal meaning of the slogan and its blunt non-grammar. This picture of appealing, good natured anarchy has become the norm for tech companies. At the same time, Silicon Valley companies have overtaken the fossil fuel and finance industries as the biggest and most profitable forces in the world; at the time of writing, the five companies with the largest market capitalizations in the world are all tech companies (Microsoft, Amazon, Apple, Alphabet and Facebook, from biggest to smallest). The figure of the utopian anarchist and the multinational behemoth are more than a little contradictory, as are the libertarian entrepreneur, the military research lab, and the hippie. Nevertheless these are people and things that Silicon Valley in the 20th century has thrown together and, in many instances, fused.

The steady expansion of copyright legislation over the 20th century is a similar instance where unlikely parties are brought together, and Spotify can be seen as another example of such a fusion. Napster, MP3.com, and the Internet Music Underground were just three of many internet projects that, although opposed to the music industry in court, have slowly been brought to heel by it (or, failing that, stamped out and replaced with more cooperative imitations). The 20th century "copyright grab"[79] entailed determined efforts to sensationalize and vilify the moral scandal of the information "pirate," and to promote the attendant legal idea of the "bad machine" (the machine, essentially, whose mere capacity for infringing uses renders it illegitimate). The reactionary refrain about guns not killing people has, in the case of copyright, been reversed and enshrined in U.S. law: ours is a now a nation where not only do people commit copyright infringement, machines do.

By the end of the 20th century, the distribution of a device that could be used to get around digital rights management schemes was a criminal offence, punishable by fines and prison time, a notion that was still radical as recently as 1976. This idea, moreover, has permeated the culture, as evidenced by the success of Spotify and the normalization of DRM. Rarely does one hear objections to the norm that requires software systems to encode digital rights management and preclude infringement, except in rarefied legal scholarship or fringe internet activist groups.[80] The idea that our media technologies are "wired shut,"[81] like the lived reality of "surveillance capitalism,"[82] simply does not today strike many users as problematic. In successfully lobbying

79. Samuelson, "The Copyright Grab."

80. See the group, for example, "Defective by Design," which catalogues and critiques many common instances of DRM in daily life. https://www.defectivebydesign.org/

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

82. Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (PublicAffairs, 2019).

the public and the legislature with its notions of proper copyright protection, the RIAA effectively set the stage for Spotify. As I hope this chapter has shown, Spotify is neither a disruption of the existing recording industry nor a solution to its problems; instead, it is the predictable outcome of years of aggressive lobbying.

Spotify, in other words, is the natural product of years of legal maneuvering behind the whole idea of "bad machines." This maneuvering and the triumph of the "good machine," moreover, have trampled over other possibilities for digital music commerce. The ubiquity of for-profit streaming and the robustness of the RIAA's lobbying make the current arrangement seem inevitable, but in actuality it was carefully shaped for the benefit of the copyright holders. Nevertheless there have been fleeting glimpses of what an alternative music industry might have looked like. Radiohead's 2007 pay-what-you-can album *In Rainbows,* for example, was extremely successful, netting the band even more profit than it would have earned with the same sales numbers and the support of a record label. Thanks to the copyright grab, we will never know what were the possibilities for a large-scale, "open source" movement in music. Nevertheless moments like the Radiohead experiment suggest that one could have been possible. The story that begins with the 1976 act, climaxes with the crushing injunctions against Napster and Grokster, and has Spotify as its denouement, is one in which, quoting Simon Frith and Lee Marshall, "the notion of 'fair use' – once essential to the copyright attempt to balance the interests of the authors and users of a work – has been systematically marginalised."[83] The promotion of good machines has as its necessary legal correlates the evisceration of fair use and a sustained effort to reform copyright in the image of one organization's notion of how music ought to be consumed.

There is much about the music business in the era of digital information that is unknown, or unknowable: the degree to which piracy actually impacted the value of the music industry; whether Spotify has a positive or negative net effect on CD sales; how much illegal piracy has actually been displaced by legal streaming; whether a music business recognizable as such would

83. Simon Frith and Lee Marshall, "Making Sense of Copyright," in *Music and Copyright*, ed. Frith and Marshall (Routledge, 2004), 5.

be possible if we had enacted the wholesale abandonment of copyright protections called for by John Barlow. What is, clear, however, is that Spotify (and the other "good machines" like it) represents a resounding defeat for the copyright pessismists. As much as Spotify may want to be seen as the "solution" to music piracy, as a smiling cadre of benevolent anarcho-optimists with one really good idea, from a legal perspective there is basically nothing disruptive about it. Unless, that is, we understand the steady expansion of copyright's scope as a kind of disruption, in which case it is very disruptive indeed. But in the usual sense in which "disruption" is understood, as a more efficient way of doing things that upsets traditional paradigms, Spotify does not deserve the designation. The music we listen on Spotify is watermarked and surveilled, our access to it carefully controlled, and huge portions of its revenue accrue to the major labels. Most artists receive essentially nothing. In many ways consumers exercise even less autonomy and independence with Spotify than they did with CDs, although the company successfully appears to put all of music at their fingertips.

This streaming model has quickly grown to be the core of the contemporary music indusry; according to the RIAA, it accounted for 75% of the industry's 2018 commerce, a number which will probably only continue to climb. In considering the role Spotify plays in this trajectory, it is not enough to acknowledge that the difference between Spotify and Napster is that one is legal and the other not. Yes, Spotify is legal. But that which is "legal" has changed radically since 1976. In 1984, the industry was asking for an awful lot when it sought to hold Sony liable for infringement committed with the Betamax. With Spotify, they are granted everything they asked for and more.

2 Artificial Intelligence, Critical Algorithm Studies and Music

The word "algorithm" is far more common today than it was at the turn of the century. It has evolved from a specialized topic in logic and computer science to a widely used, and widely critiqued, facet of 21st century life. In their multiplicity and ubiquity, algorithms can be thought of today as a "modern myth," embracing all manner of different computational tools and technologically mediated activities. We are used to, perhaps even comforted by, the idea that they mediate everything we do on the internet, and of course nobody is surprised to see them recommending music on Spotify.[1] According to Christian Sandvig, we owe our current familiarity with the word in part to one infamous 2007 Ask.com teaser campaign featuring ominous, unexplained billboards referring cryptically to "the algorithm."[2] While it is hard to say just how much the ad actually did to familiarize the public with the term, it clearly shows that as recently as 2007, the word had an exotic quality to it. As Alex Bogusky, one of the campaign's architects, put it in a 2007 interview with the trade publication Adage.com:

> An algorithm is the central underpinning of a search engine, but it's a funny word that most people don't hear every day, if at all. [The campaign] is designed to introduce the concept of an algorithm at a high level and inject the word into the consumer

1. Solon Barocas, Sophie Hood, and Malte Ziewitz, "Governing Algorithms: A Provocation Piece," Paper prepared for the "Governing Algorithms" conference at NYU, March 29 2013.

2. See Christian Sandvig, "Seeing the sort: The aesthetic and industrial defense of "the algorithm"," *Journal of the New Media Caucus* 10, no. 3 (2014) The campaign in question also included the "chicks with swords" ads, depicting the successful operation of a web search algorithm, and, naming the algorithm as such: https://www.youtube.com/watch?v=yasBpCHHm2E, accessed 07-17-2019

> arena – we want to get people talking about the algorithm, wondering what it is, while also sparking additional interest in Ask.com and the overall concept of search.[3]

Not only was "algorithm" still a "funny word" in 2007, but our familiarity with it today is at least in part the result of deliberate marketing efforts from the tech sector. The ubiquity of the algorithm in contemporary American culture is not just a product of technological developments, especially considering just how hard a concept "algorithm" is to pinpoint.[4] Instead, it should be acknowledged that we speak of algorithms today so easily because the tech sector has always wanted us to.

And we speak of them in a wide variety of ways; the Ask.com campaign also marks the transition away from algorithms as the sole province of computer science to the commercially viable things we know by that name today. It is now common to speak of algorithms in nearly everything we do, from dating to criminal justice to news consumption. "Algorithmic literacy" is no longer something required of software engineers, but a basic skill all citizens should have to protect themselves from bad actors on the Internet. The notion of the algorithm, embracing not just logical processes (as, for example, in the Bubble Sort algorithm all computer science students learn) but also the panoply of software platforms available today, has evolved a prominent place in the popular imagination, complete with its own public relations apparatus. "Algorithm" today refers in a general way to pretty much everything we do on the Internet – which is in fact a lot of what we do. As Nicholas Diakopoulos puts it, algorithms are "the new power brokers in society."[5]

But there is a difference between "algorithm" and just "technology" in general, even if the two are often conflated. To be more precise about the former, we might suppose that many of the problems we think of "algorithms" in particular as solving involve the glut of information on the Internet. Algorithms, you might say, are technological solutions to the problems posed by technology itself. There are many contemporary problems having to do with unmanageable

3. Feature from Adage.com, https://adage.com/creativity/work/algorithm/4447, accessed 08-22-2019

4. See, e.g. Yuri Gurevich, *What is an Algorithm? (Revised)*, In Church's Thesis: Logic, Mind and Nature (eds. A. Olszewski et al.) Copernicus Center Press 2014. January 2014, discussed below.

5. Nicholas Diakopoulos, "Algorithmic accountability reporting: On the investigation of black boxes," 2014,

amounts of information, and the value of automatic sorting and recommendation tools has, as a result, risen sharply over the last decade. This trend has been attended by the rise of curation and Internet companies that sell "experiences" rather than access to information itself (of which Spotify is increasingly one); in a world where everyone has to deal with too much information, algorithms are not just branded, but are themselves a form of branding.

The rise of algorithmic culture has thus engendered rise of digital curation. In music no less than in other domains, we are constantly inundated with automated suggestions. Because the amount of information we have to sort through is so vast, moreover, these suggestions are harder and harder to second guess. The immensity of the amount of information from which Google search results are selected lurks menacingly behind every query. The psychological gravity of that vastness is hard to overstate, something that will always tend to prejudice us in favor of selections by computation. As Tarleton Gillespie points out, we are at a moment in our culture when we are constantly confronted with curated lists – lists, moreover, whose legitimacy is premised on the presumption that they have not been curated.[6]

One consequence of the popularization of the word "algorithm" has been increased scholarly discussion of it, and increased disagreement about what exactly it means. The question "what types of entities are algorithms" has currency in both the humanistic critique of algorithmic culture (see e.g. Nick Seaver (2017)[7]) and in mathematics and computer science itself (e.g. Gurevich (2014)[8]). Ultimately the question of what algorithms really are is probably undecidable, and it is this very terminological malleability that allows the word to stand-in for the opaque operations of many different types of sorting and curation functions. Judges use "algorithms" to help predict whether people will commit repeat offences[9]. Credit card companies use algorithms

6. Tarleton Gillespie, "Can an algorithm be wrong? Twitter Trends, the specter of censorship, and our faith in the algorithms around us," Online resource accessed Sept 2018, *Culture Digitally*, 2011,

7. Seaver, "Algorithms as culture: Some tactics for the ethnography of algorithmic systems."

8. Gurevich, *What is an Algorithm? (Revised)*.

9. See ProPublica's reporting on this kind of machine bias: https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing, accessed 07-17-2019

to determine a loan applicant's trustworthiness.[10] Netflix and Spotify, of course, use algorithms to recommend movies and music. Meanwhile we use the same word for all these very different operations. Thus we can think of the "algorithmic" in Alexander Galloway's 2006 *Gaming: Essays on Algorithmic Culture*[11] as referring not to any particular kind of logical operation but in a broad way to all the customs and practices of a world of constant human-computer interaction.

As algorithms have gained currency in popular conversation, there has arisen a dedicated field of scholarship to understand and critique them. As I show in this chapter, shifts in the meaning of the word "algorithm" trace a parallel shift in its corresponding critical discourse. Before personal computers were common, a first wave of critics focused on the abstract philosophical problems raised by artificial intelligence. Today's critics, on the other hand, tend to respond to actual fact of a real algorithmic culture in which they live and work. Unlike science and technology writers of the 1970s, 80s and 90s, today's critics of algorithmic culture are not engaging in abstract philosophical speculation. It is the central claim of this chapter that music ought to have a role in both kinds of conversations, but in general that it has not. Whether the subject is the metaphysics of "qualia" and their derivability from matter[12] or an algorithm's potential to replicate the bias inherent in its ground truth data,[13] the study of algorithms in culture will have important implications for the study of music in culture. It is plausible that today, more music is listened to than ever before, and it is certain that this listening happens more and more through algorithmically mediated platforms; it seems obvious that music, as both quintessentially "cultural" and increasingly "algorithmic" ought to be an important part of the discussion of algorithmic culture.

Authors frequently raise alarms about the rise of the "filter bubble" in news consumption.

10. Danielle Keats Citron and Frank Pasquale, "The Scored Society: Due Process for Automated Predictions," *Washington Law Review* 89 (2014).

11. Galloway, *Gaming: Essays on Algorithmic Culture*.

12. One of the central preoccupations in the philosophy of the mind that has been animated by the prospect of artificial intelligence. See e.g. David Chalmers, *The Conscious Mind* (Oxford University Press, 1996)

13. Perhaps the most common theme in "critical algorithm studies" today. See, e.g. S.U. Noble, *Algorithms of Oppression: How Search Engines Reinforce Racism* (NYU Press, 2018)

They discuss the potential harms of algorithmic mediation for the functioning of democracy. They point out the many ways algorithms can embed bias and produce abhorrent kinds of racial discrimination. Few remark that these issues all have clear analogues in music. Will recommendation systems lead to musical "filter bubbles" where we hear the same stuff over and over again? If so, are there toxic cultural effects one might expect to result from that narrowing? If recommendation systems are just "bad" at recognizing salient features of non-Western music, does that count as a social justice issue? These musical analogues to basic questions about algorithmic culture are unmistakable and inviting, but they are rarely addressed. Instead of taking up these questions, in fact, music is sometimes used as the paradigmatic case where a lack of algorithmic fairness *doesn't* matter:

> There is a big difference between a music recommendation service and a news recommendation service. What are the consequences of biased recommendations in a subscription-based service like Spotify? Getting a track recommended that you may not like and will skip. The consequences are small for the consumer.[14]

The consequences may indeed be small compared with the terrifying prospect of "algorithmic redlining," but on the other hand, for a serious consumer of music the stakes couldn't be higher. The limitations and biases of music recommendation, in other words, should matter to us exactly to the extent that music matters to us in the first place, and to the extent that we believe some kind of relationship obtains between music and society in general.

This is not to say that a study of music recommendation would be as urgent as, say, a critique of the "politics of search."[15] On the other hand, music could form part of such a critique, shedding light on non-musical questions in a uniquely informative way. As Hillis et al (2013) point out, for example, it is the same "logic of search" at work in Google, Amazon, Netflix and Pandora.[16] The confrontation of automated curation with the human faculty of aesthetic judgment,

14. Pierre-Nicolas Schwab, "Workshop on fairness and ethics in recommendation systems," September 18, 2018, https://www.intotheminds.com/blog/en/workshop-on-fairness-and-ethics-in-recommendation-systems/.
15. Helen Nissenbaum Lucas D. Introna, "Shaping the Web: Why the Politics of Search Engines Matters," *The Information Society* 16, no. 3 (2000): 169–185.
16. Ken Hillis, Michael Petit, and Kylie Jarrett, *Google and the Culture of Search* (Routledge, 2013), 4.

perhaps the most stubbornly "human" faculty of all, may open up discussions about that logic that conventional scholarship is unlikey to spot. These avenues could be of real value to the broadest questions facing critical algorithm studies, beyond the musical questions themselves. Automated music recommendation forces us, in other words, to consider the commensurability of the human and the computational in a way that nothing else can.

It is important to remember that there exists no "before" moment to which we can point, when music culture was completely innocent of technological meddling, when music discovery was in some way "pure."[17] Just as it is never quite clear what it would mean to isolate a "human curated playlist" today, when computer suggestions crowd in upon almost every act of musical selection, so too it is hard to know what the features of a putatively "human" music recommendation would have been before the digital age. Nevertheless there are features of automated music discovery that are undeniably different from forms of discovery that involve other people. It has been shown, moreover, that "before and after" is in fact exactly how many contemporary listeners see the advent of digital streaming.[18] These changes cannot fail to have implications for what music becomes popular, and the ways in which people relate to that music. In a culture where the majority of listening is already mediated by the same kinds of technology that have received so much attention in the domain of the news media, the criminal justice system, and the "politics of search," a critique of algorithmic culture in the musical domain is badly needed. In this chapter, I review the various literatures where one might expect such a critique, highlighting the insights I feel are most relevant to my own critique of Spotify. While showing that, for the most part, the issue of music has been neglected, I lay the philosophical groundwork for the critiques (humanistic, in Chapter Three, and statistical, in Chapter Five) to follow.

17. I owe this insight to Erin Glass.
18. Sofia Johansson et al., *Streaming Music: Practices, Media, Cultures* (Routledge, 2018), 162.

2.1 Mind and Machine: 1960s - 1980s

Forerunners of what has come to be known as Science and Technology Studies, or sometimes Critical Algorithms Studies,[19] appeared as early as the 1960s. This first wave of authors drew on the insights of the Frankfurt School about the dangers of instrumentalized reason, and sometimes pursued technical problems in the philosophy of mind that computer technology raised in new ways. They dealt with the ethics and philosophy of technology in culture, but they did so in a fundamentally different way from authors today. Even the Frankfurt School, whose ethical commitments are motivated by the lived traumas of World War Two, and who address themselves to very real social consequences, have a proleptic quality to them; when we read first-wave critiques of mechanized or computerized culture, we are, in general, being warned about the future. Critical algorithm studies today, by contrast, has the empirical fact of existent "algorithmic culture" to reckon with. In this section, I focus on the proleptic philosophical and ethical writings of early critics of machine intelligence and technology in culture, and I explain how many of their ideas remain relevant to the critique of algorithmic music recommendation today.

No sooner had the discipline of artificial intelligence been declared than it began to frighten and titillate intellectual culture in general.[20] The earliest contributors to the debates about artificial intelligence in society were probably philosophers of mind, many of whom spotted the inchoate idea of machine intelligence as a useful wedge into the mind-body problem. Hilary Putnam, for example, argued in 1960 from a provocative analogy of man and machine that the whole mind-body problem was actually of little philosophical importance.[21] The putative analogy of man and computer, in other words, is used by Putnam to deflate nothing less than Cartesian

19. For a representative sample of authors in this subfield, see the "Critical Algorithms Reading List" maintained by Microsoft Research: https://socialmediacollective.org/reading-lists/critical-algorithm-studies/, accessed 07-15-2019

20. The founding of the discipline is customarily dated to the 1956 Dartmouth Summer Research Project on Artificial Intelligence

21. Hilary Putnam, "Minds and Machines," in *Journal of Symbolic Logic*, ed. Sidney Hook (New York University Press, 1960), 57–80.

dualism itself. Putnam's is not a critique of computers but rather a mark of their growing profile in American intellectual culture and the discipline of philosophy. Putnam's goal, remarks Martin Ringle, was "not to solve the Cartesian problem but rather to dissolve it."[22] Similar projects, using the novel idea of machine consciousness as a new entry point to the mind-body problem, were undertaken by Michael Scriven[23] and Paul Ziff.[24]

Other philosophers in the 1960s took up the theoretical preoccupations and moral commitments of the Frankfurt School, which had explicitly targeted instrumentalized reason as the harbinger of consumerism and internalized authoritarianism, to raise issues related to the emerging automatization of work and culture. For many in the 1960s and 1970s, computers were simply part of the hegemonic and dehumanizing structures of corporate power.[25] Herbert Marcuse's 1964 *One Dimensional Man*, for example, sounds many of the themes of an earlier generation of Frankfurt School writers, but does so in a way that targets technological rationality as it existed 20 years after the *Dialectic of Enlightenment.* Although *One Dimensional Man* mostly targets mechanization in the guise of the mindless corporate drone, these critiques also sometimes foreshadow the technological doomsday fears that would become common in the Cold War; as early as 1966, for example, Eltin E. Morison's *Men, Machines and Modern Times* raises the question of whether man could "control the imposing system he has created for the specific purpose of enabling him to manage his natural environment."[26] Whether as an invitation to a new kind of thought experiments or a harbinger of mechanized apocalpyse, the intellectual allure of artificial intelligence is as old as computers themselves.

As computer power in particular (as opposed to industrial or mechanical power) rose in prominence in American culture, and when the intellectual fad for what John Searle would later

22. Martin Ringle, "A Brief History," in *Philosophical Perspectives in Artificial Intelligence* (Humanities Press, 1979), 3.

23. Michael Scriven, "The Mechanical Concept of Mind," *Mind* 62, no. 246 (1953): 230–240.

24. Paul Ziff, "The Feelings of Robots," *Analysis* 19, no. 3 (1959): 64–68.

25. Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*, 2.

26. E.E. Morison and L. Marx, *Men, Machines, and Modern Times*, The MIT Press (MIT Press, 1966), 16.

call "strong AI"[27] began to take hold across the intellectual spectrum, similar critiques arose that targeted artificial intelligence more specifically. The best known early critic of "first wave AI" is Hubert Dreyfus, whose 1965 residency at the RAND corporation led to the widely read pamphlet *Alchemy and AI*,[28] which in 1972 he developed into the book *What Computers Can't Do*.[29] In these projects and a handful of other subsequent works that built on them, Dreyfus picks apart the overzealous promises of AI researchers, highlights the gaps between those promises and their actual achievements, and makes an emphatic case that there are inevitable limitations to artificial intelligence – at least, as long as it restricts itself to disembodied logical symbol manipulation. Dreyfus is perhaps the first author to approach the subject of machine intelligence by citing the likes of Heidegger, Merleau-Ponty and Wittgenstein, whose systems of investigation largely reject the rationalist underpinnings of analytic philosophy – and which, so the argument goes, equally permeate (and handicap) the discipline of computer science.

For Dreyfus, intelligence is essentially linked to corporeality, so in order to be intelligent in any meaningful sense computers would need bodies, in particular the part of the body known as the brain. And as for the brain, we would need to know much more about it before any attempt to recreate it would be possible. We would need, as Dreyfus points out, a different type of computer, one whose "only prototype is the little-understood human brain."[30] The promises of AI fall short, he argues, not because researchers haven't figured out the best techniques, but because the whole project is fundamentally misguided. While some of Dreyfus's critique today feels overblown – to take just one example, his gloating over the poor performance of chess programs in 1972 has not aged well – many of his words of caution ring true, and the view of human intelligence as essentially grounded in formal symbol manipulation has indeed fallen out of favor. In particular his comments are notable for the way they remain relevant to contemporary

27. J.R. Searle, *Mind, Language and Society: Philosophy in the Real World*, MasterMinds series (Basic Books, 1998).
28. Hubert L Dreyfus, *Alchemy and Artificial Intelligence* (RAND Corporation, 1965).
29. Hubert Dreyfus, *What Computers Can't Do: A Critique of Artificial Reason* (Harper / Row Publishers, 1972).
30. Dreyfus, *Alchemy and Artificial Intelligence*, 16.

debates about embodiment and ongoing feminist critiques of positivist technoscience.[31] His gentler admonitions – for example, that “the need for a critique of artificial reason is a special case of a general need for critical caution in the behavioral sciences,”[32] or the simple idea that human intelligence may bear an inexorable relationship to the body – have been largely vindicated.

Whether or not today’s less overtly “representational” strategies for machine intelligence (neural nets, for example, which are explicitly modeled on the human brain) qualify as “more Heideggerian” and therefore less doomed to fail is an open question.[33] Nevertheless the critiques he has been making since the 1960s continue to resonate today; as Daniel Crevier notes, “time has proven the accuracy and perceptiveness of some of Dreyfus’s comments.”[34] If Dreyfus is right – if, for example, there is a basic difference between “knowing how” and “knowing that,” or if AI researchers vastly underestimate the complexity of unconscious knowledge – then such critical caution is as warranted today as it was in 1972; the “entrepreneurial haze” surrounding machine learning today is at least as thick as the one Dreyfus perceived in 1972, and the need to clear the air just as urgent.[35]

Dreyfus’s first goal always seems to be to debunk what he regards as the overly optimistic promises of AI researchers, pointing out that although analytic philosophers have leapt to the philosophical implications of machines that can think and fall in love, in point of actual fact they remained (at least as of 1970) incapable of doing all but the simplest tasks. This approach, which Dreyfus himself characterizes as “polemical,” earned him the scorn of much of the AI community (scorn that revealed, as he put it, the “unscientific character of the field”[36]). He also raises other concerns, however, connected not to computers but to people and to the philosophical

31. See, e.g. Cecilia Åsberg and Nina Lykke, *Feminist technoscience studies*, 2010 and Chikako Takeshita, “The IUD in Me: On Embodying Feminist Technoscience Studies,” *Science as Culture* 19, no. 1 (2010): 37–60

32. Dreyfus, *What Computers Can’t Do: A Critique of Artificial Reason*, xxvii.

33. Hubert L. Dreyfus, “Why Heideggerian AI Failed and How Fixing it Would Require Making it More Heideggerian,” *Philosophical Psychology* 20, no. 2 (2007): 247–268.

34. Daniel Crevier, *AI: The Tumultuous History of the Search for Artificial Intelligence* (Basic Books, 1993), 125.

35. Hubert Dreyfus and Stuart E. Dreyfus, *Mind Over Machine: The Power of Human Intuition and Expertise in the Era of the Computer* (The Free Press, 1986), xv.

36. Ibid., 8.

community's evolving conceptions of human intelligence: "what are the risks," Dreyfus asks, "of enthusiastic and ambitious attempts to redefine our intelligence in [computer terms]?"[37] For Dreyfus, the problem is not simply intellectual disingenuousness in the AI community, but the real dangers posed to *human* culture of imbibing their reckless enthusiasm. If we accept the idea of mind as a digital computer compiling facts and applying logical rules, we run the risk not only of construing (wrongly) that system as intelligence, but also (even worse) of coming to equate (wrongly) that kind of thing with true intelligence. The danger then would be that we would want to imitate computers. Since, as compilers of facts we will indeed always fall short of the computer, in endeavoring to mimic them we risk emerging genuinely less competent than "the systems [we] have been trained to imitate."[38] The result will be not only the apparent validation of the AI industry, but also the widespread degredation of real human intelligence. Dreyfus's critique, then, is as much a matter of technical philosophy of mind as it is a kind of social crusade. His willingness to blend the two is perhaps above all what set the AI community ill at ease, but there is no way to make the argument – that machine intelligence is "wrong" both intellectually and morally – without sounding at least a little hostile.

The implications for the automation of musical tasks of any sort are clear; as a form of human intelligence that is always embodied and extremely difficult to explain logically, music would seem, at a minimum, to be a good piece of evidence for Dreyfus.[39] The problem of musical creativity has, after all, survived the encroachments of machine intelligence much better than board games and other classification tasks, both of wh. Dreyfus also makes the important note that mistaking logical symbols for intelligence is not just wrong but *dangerous*, and threatens to initiate a self-reinforcing trend that will profoundly degrade humanity. Accept the equation of

37. Dreyfus and Dreyfus, *Mind Over Machine: The Power of Human Intuition and Expertise in the Era of the Computer*, xi.

38. Ibid., 206.

39. "Embodiment," in its various guises, has emerged as a common theme in contemporary music studies, from the area of "embodied music cognition" to feminist music theories that foreground and critique the corporeal situatedness of theorist; see e.g. Suzanne G. Cusick, "Feminist Theory, Music Theory, and the Mind/Body Problem," *Perspectives of New Music* 32, no. 1 (1994): 8–27 and Holly Watkins and Melina Esse, "Down with Disembodiment; or, Musicology and the Material Turn," *Women and Music: A Journal of Gender and Culture*, no. 19 (2015)

logic and intelligence and you will inevitably damage the part of yourself that made the equation wrong in the first place. The effort to explain what a musical version of this insight might look like is a major part of what this dissertation is about.

Although much of this line of argumentation is derived from the "soft" world of Continental Philosophy, in the 1970s similar critiques began to emerge from within the technological world itself. An important early example is Joseph Weizenbaum, whose influential 1976 work, *Computer Power and Human Reason*, probes the limitations of artificial intelligence and the ethics of applying them in society. Weizenbaum was an MIT mathematician who wrote the computer program ELIZA, a crude but hugely popular chat bot that simulated the behavior of a Rogerian psychotherpaist by asking open-ended questions that referred in general ways to previous elements of a recorded conversation. The program got a lot of attention, and was probably responsible for a significant part of the popular fascination with AI that the book ends up targeting. Weizenbaum combines a general history of computing (complete with instructions on how to build a Turing Machine from rocks and toilet paper) with an impassioned plea for humanistic knowledge. It may be the first attempt from within the discipline of computer science itself to question its emerging prestige and to raise moral questions about its role in society.

Weizenbaum had written ELIZA as an exercise in the emerging discipline of Natural Language Processing. It was a casual experiment that demonstrated as many limitations as it did capabilities, and it was certainly never intended as a tool with any therapeutic value. Nevertheless it was looked to by the lay public, computer scientists, and even some clinical psychologists as a true example of machine intelligence. Computer science in the 1970s, after all, was still very much taken with the prospect of thinking machines – little had changed in that regard since Herbert Simon declared in 1957 that "there are now in the world machines that think, that learn, and that create."[40] Some psychologists even believed it could eventually be used in clinical practice.[41] Weizenbaum, whose love for psychology is constantly apparent throughout, was

40. Cited in Dreyfus, *Alchemy and Artificial Intelligence*, 3

41. Kenneth Mark Colby, James B Watt, and John P Gilbert, "A computer method of psychotherapy: Preliminary

horrified by the idea that anyone would want to substitute the empathy and compassion of a human psychologist with a computer program. For Weizenbaum, these human capacities are a task that, even if we could mimic them convincingly (which we couldn't then and cannot now), should never be delegated to computers.

It is important to note that Weizenbaum, as a critic of AI from within the ranks of its researchers, represented a distinct minority. A view more representative of the mainstream in 1970s AI would be Roger Schank, who regards the discipline's philosophical dimensions as basically irrelevant: "to ask whether [computers] really understand is beside the point."[42] Among its many other virtues, Weizenbaum's book is an instructive reminder of just how many people, like Schank, found the promises of "strong AI" compelling in the 1970s, and the degree to which the bald functionalism of the "Turing Test"[43] had penetrated discussions of intelligence generally. This kind of stubborn functionalism is something Roger Schank continues to push for as a philosopher of education today, from, among other places, the platform of Trump University.[44] From the vantage point of today's intellectual and technological climate, it is startling to think that AI of the 1970s, in all its crudeness, had already "set as its goal the building of machines whose range of thought is to be co-extensive with that of humanity itself."[45] And yet it really had; the power of the computer to do certain difficult things easily seems to have imbued the Turing Test with a certain unwarranted scientific objectivity, and convinced many people that human intelligence really was a matter of computer programming.[46] Today the Turing Test itself seems to have fallen away from the debate over what is intelligence; Searle's (1980) refutation has done

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communication," *The Journal of Nervous and Mental Disease* 142, no. 2 (1966): 148–152.

42. Roger Schank, "Natural Language, Philosophy and AI," in *Philosophical Perspectives in Artificial Intelligence* (Humanities Press, 1979), 222.

43. The notion, proposed by Alan Turing, that a computer whose behavior is not distinguishable from human behavior is, ipso facto, intelligent.

44. Schank says Trump University really wasn't all that bad: https://www.linkedin.com/pulse/trump-university-i-state-accreditation-issue-roger-schank, accessed 10-10-2019.

45. Joseph Weizenbaum, *Computer Power and Human Reason: From Judgment to Calculation* (W. H. Freeman / Company, 1976), 197.

46. As mathematicians constantly have to remind us, the widely known Turing Test exists on a totally different scientific plane from the idea of the Turing Machine. The first is essentially a speculative thought experiment, while the second refers to a true mathematical proof.

battle with it amidst 20 years of heated debate, while Chomsky has over the years deflated it in much simpler terms.[47] But the prevailing attitudes about machine intelligence in the 1970s seem to be a fusion of Skinnerian behaviorism and a dogmatic optimism; thus a 1974 publication of writings on machine intelligence is able simply to assume that "humans are programmed from various sources – genetics, parents, teachers, etc, in exactly the same way as machines,"[48] which is the very notion Chomsky's famous 1959 review of Skinner's *Verbal Behavior* is usually thought to debunk.[49]

Ultimately Weizenbaum's work is a heartfelt lament against instrumentalized reason, one that sounds Adornian themes without ever citing him. It is an extended exhortation to draw a line between human and machine intelligence, on both technical and ethical grounds. "The question," he writes, "is whether or not every aspect of human thought is reducible to a logical formalism, or, to put it into the modern idiom, whether or not human thought is entirely computable."[50] Ultimately this is the very same question raised by automated recommendation, and for Weizenbaum the answer is emphatically no: "There are some human functions for which computers ought not to be substituted. It has nothing to do with what computers can or cannot be made to do."[51] From the perspective of at least one person who actually built the tools that the public had come to regard as proof that machines could think, the line between human mental states and their machine simulacra was a hard one.

In some ways the book is written against the same wave of enthusiastic "strong AI" partisans targeted by John Searle's famous 1980 essay, "Minds, Brains and Programs," where the "Chinese Room" thought experiment is first laid out.[52] Briefly stated, the Chinese Room thought experiment shows that it is possible to conceive of behaviors that seem as intelligent as you like

47. As he often points out, asking whether computers can think is about as meaningful as asking whether submarines can swim; if you want to call that swimming, then yes, they can.

48. F.H. George and J.D. Humphries, eds., *The Robots are Coming* (National Computing Centre, Ltd. Publications, 1974), 19.

49. Chomsky, "A Review of B. F. Skinner's *Verbal Behavior*."

50. Weizenbaum, *Computer Power and Human Reason: From Judgment to Calculation*, 12.

51. Ibid., 270.

52. John Searle, "Minds, brains, and programs," *Behavioral and Brain Sciences* 3, no. 3, 417–457.

by simple means of formal syntactical symbol manipulations: a person with infinite time for computation, the correct instruction booklets, but no knowledge of Chinese, can use formal logic to produce outputs indistinguishable from idiomatic Chinese. But these manipulations would remain purely syntactic, and would bear no necessary relationship to semantics (the meanings of things); the person cannot be said to know the meaning of the output. In the same way, computers, logical manipulators and nothing more, cannot be said to have intelligence in the human sense (which depends on meaning). The Chinese Room targets, that is, people with grandiose conceptions of AI – grandiose not in the sense of believing AI capable of doing things it cannot, but rather in interpreting the mere execution of tasks as equivalent to intelligence itself. As Searle puts it, he is writing against the notion that "the appropriately programmed computer really is a mind, in the sense that computers given the right programs can be literally said to understand and have other cognitive states."[53] As strange as it may seem today, for the lay public in 1980, awed by the still-new machines, as well as an intellectual community inheriting the attitudes of the Behaviorist consensus, this was still a common position. For Searle, part of the problem is a "residual behaviorism or operationalism" apparently lingering in 1980s intellectual culture. This is attended by a lingering Dualism as well, another problem Searle refers to in the 1980 paper.

There are different emotional charges at work in Weizenbaum and Searle; AI inspires ethical revulsion in Weizenbaum, who denounces it as "obscene" and "immoral." Searle assumes typical analytic remove, arguing from the non-identity of syntax and semantics, but in many ways Weizenbaum's work (1976) actually anticipates Searle's (1980). In spite of this, Searle actually takes aim at Weizenbaum's ELIZA, perhaps unfairly aligning it with Roger Schank's quest to model human understanding in general, or the "general problem solver" research undertaken by Newell, Simon and Shaw for the RAND corporation.[54] Although in actuality Weizenbaum did not

53. Searle, "Minds, brains, and programs," 417.

54. Researchers developing early AI software designed to model the decision making processes of "generals, industrial planners and public policy makers." See Dreyfus and Dreyfus, *Mind Over Machine: The Power of Human Intuition and Expertise in the Era of the Computer*, 8. See also Roger C. Schank and Robert P. Abelson, *Scripts,*

consider his chat bot to have achieved any intelligence worthy of the name, ELIZA was familiar enough material to stand in for predominant ideas about the nature of machine intelligence, and it serves as part of Searle's punching bag. Where Searle's refutation of "strong AI" rests primarily on the difference between syntax and semantics – and the claim that a system of formal symbol manipulation can never approach the latter, no matter how impressive its dexterity with the former – Weizenbaum's is more deeply felt and personal, while at the same time having a firmer footing in the technical foundations of computer science.

In 1986, Terry Winograd, a prominent early computer science researcher best known for his experiments in language parsing, along with the philosopher Fernando Flores, wrote a book about machine intelligence that incorporated a systematic critique of the tradition of rationalist philosophy entitled *Understanding Computers and Cognition.* This book took up many of the themes introduced by Dreyfus, but, as the co-authored product of a philosopher and computer scientist, joined them to the technical literature in a way Dreyfus could not. The world of computer science, the authors point out, is completely dominated by that rationalist tradition, and perhaps owing to the prestige and success of modern science, this tradition has crystallized into "the very paradigm of what it means to think and be intelligent."[55] The rationalist tradition, by virtue of the impressiveness of modern scientific achievements, has displaced all other forms of intelligence to such an extent that their existence is barely acknowledged at all anymore. A primary aim of this work is to demonstrate the "non-obviousness" of these rationalist assumptions that so dominate the culture of computer science research and our culture more generally. In arguing that "computers do not exist outside of language," this work attempts to extend to computer science the movement in the cognitive sciences away from traditional notions of rationalism, correspondence and representation. As Eleanaor Rosch was demonstrating that the mind seems not to categorize according to necessary and sufficient conditions, but rather exhibits

Plans, Goals and Understanding: an Inquiry into Human Knowledge Structures (Hillsdale, NJ: L. Erlbaum, 1977)

55. Terry Winograd and Fernando Flores, *Understanding Computers and Cognition* (Addison Wesley Publishing Company, 1986), 16.

"prototype effects" wherein some members of a group tend to be more characteristic than other members of the same group, questions about the viability of the computational model of the mind made it int othe computer sciences.[56] The authors do not go so far as to extend this critique to the domain of ideology (that sort of thing comes later) but the work registers an important objection the emerging field of AI, one more technically grounded than Dreyfus.

In discussing the history of critiques of artificial intelligence, it is important to mention the organization Computer Professionals for Social Responsibility, a little-known forerunner to today's movement for "fairness" in machine learning. Before the publication of *Understanding Computers and Cognition*, Terry Winograd was active in this group, which began to meet in 1981 and formally incorporated as a 501(c)(3) in 1983. Although initially concerned with critiquing the use of AI in warfare, the organization eventually took on a wide range of issues in the ethics of computing, organizing conferences and releasing a quarterly journal. They never published on issues of aesthetics directly, but they did address the related issue of intellectual property law in the digital era. The question of copyright law's commensurability with algorithmic culture is, as I show in Chapter One, a central concern for any study of streaming music in the 21st century. Although the CPSR never approached the issue of music directly, they were one of the first groups to spot it as an important area in need of legal and scholarly revision.

2.2 Living with Machine Intelligence: 1990s - present

Not all writing on algorithmic culture originates in analytic philosophy and computer science. With the rise of the personal computer and growing profile of the tech sector in the global economy, more and more disciplines took an interest in them. Perhaps most prominent among these new critics of technology in culture is Donna Haraway, whose wide ranging work

56. See Eleanor Rosch et al., "Human categorization," *Studies in cross-cultural psychology* 1 (1977): 1–49 and George Lakoff, *Women, Fire and Dangerous Things: What Categories Reveal about the Mind* (University of Chicago Press, 1987)

manages to tie the futility of the Star Wars missile defense program to a feminist critique of positivistic knowledge and various flavors of post-humanism. While her work remains enormously influential in all manner of studies of technology in culture, it is Haraway's readers who tend to critique the relationship of computers to culture more specifically – Haraway's deployment of the cyborg concept, if anything, almost seems to assume a certain frictionless compatibility between machines and people, a compatibility that is mobilized in service of a broader feminist project.[57]

A telling example of Haraway's legacy, but where people and computers are kept at odds rather than brought together, is Gilles Deleuze's 1992 "Postscript on the Societies of Control," which applies a postmodernist lens to a problem that, so far, we have seen only analytic approaches to.[58] Here, Deleuze argues that Foucault's "society of disciplinarity" has, in the age of the personal computer, given way to a society of "control." If disciplinarity was bad, control is even worse: Deleuze calls it the "new monster" and exhorts readers to "look for new weapons." This monster is connected specifically to computers, which have replaced the traditional tools of the 19th century ("levers, pulleys, clocks" – presumably the tools of Foucault's "disciplinary" paradigm) and which usher in a new pernicious form of capitalism. In a post-disciplinary, computerized society, all production is relegated to the third world, while the wealthy engage in financial trade wholly abstracted from material goods. Deleuze's engagement with computer science is of a general nature – its claims in that regard are vague enough to have been made as reasonably about 1970s and 1990s technology, and the relationship between personal computing and economic trends that he mentions are simply general features of economic globalization – but the article does mark a new kind of pessimism in humanistic writing about technology that is not found in early critiques. Where Weizenbaum, for example, is merely confronting the alarming prospect of man's transformation into a "clock-work" (and hoping to forestall it), Deleuze regards the transformation as a fait accompli. He does not call for any specific action, which in his voice

57. "People are nowhere near so fluid," she writes. Whereas "cyborgs are ether, quintessence."Donna Haraway, "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century," in *The Postmodern Turn: New Perspectives on Social Theory*, ed. S. Seidman (Cambridge University Press, 1994), 89

58. Gilles Deleuze, "Postscript on the Societies of Control," *October* 59 (1992): 3–7.

would probably sound rhetorically naive, but he gives a charismatic expression to a grim diagnosis of the emerging digital culture, one that prefigures the fatalism of many contemporary critics of "techno-optimism."[59]

With the rise of personal computing and the first cycle of dot com boom and bust, this kind of pessimism has only increased. Daniel Crevier, in his 1993 *AI: The Tumultuous History of the Search for Artificial Intelligence*, surveys some many of the emerging concerns about the future of artificial intelligence. In a concluding chapter called "The Silicon Challengers in Our Future," he discusses the grim prospect of a military takeover by the machines, their potential to facilitate mass surveillance, and the unemployment crisis that could follow the advent of artificially intelligent robots.[60] Yet he also leaves room for what he calls "the blissful scenario," where "AI could act as an instrument to further democracy," and "the advent of [the] personal librarian and intelligent database browsing programs [will] help maintain an informed citizenry."[61] In this striking passage, what Crevier holds out as the best hope for computer technology – that the personal librarian will lead to a better functioning democracy – turns out to be the very thing that is most frequently indicated as technology's most deleterious effect; many commentators argue that it is precisely this kind of technology – usually termed "personalization" today – that has led to the media "filter bubble"[62] and the decay of the democracy in the United States. Although the book predicts, in general, "mostly beneficial effects," it also sees AI as "immensely threatening," and even predicts that the "main battles of the 21st century" will be about who – us or the machines – will control the future of the earth.[63]

In the first two decades of the 21st century, as critical algorithms studies has matured into an interdisciplinary research area, the focus has shifted from the philosophical dimensions of AI to its practical consequences. In the 1970s, 80s and 90s, writing about the intersection of

59. Samuel Alexander, "A critique of techno-optimism: Efficiency without sufficiency is lost," *Melbourne Sustainable Society Institute, Working Paper (WP)* 1 (2014): 14.
60. Crevier, *AI: The Tumultuous History of the Search for Artificial Intelligence*, 312-334.
61. Ibid., 337.
62. Eli Pariser, *The Filter Bubble: What the Internet is Hiding from You* (The Penguin Press, 2011).
63. Crevier, *AI: The Tumultuous History of the Search for Artificial Intelligence*, 341.

technology and society had, in one way or another, flowed from the philosophical issues raised by the prospect of artificial intelligence. Even Joseph Weizenbaum's impassioned admonitions not to let technology supplant human interaction were basically rooted in abstract intellectual commitments about the limitations of computation; normative though they undoubtedly were, they were still essentially philosophical. Critical algorithm studies today, by contrast, is more interested in ethical and social implications per se; the question is no longer what technology is capable of, nor is it the proper definition of "intelligence." Even less is the discipline interested in what insights AI might yield to us about the actual function of the mind (the essence of the kind of AI that, in different ways, Searle and Schank had actually endorsed). For a diverse range of scholars confronting the lived reality of an algorithmically mediated world, the primary task is simply to understand that world and critique it where it produces unjust outcomes – which it turns out to do frequently.

A number of the major titles in this area have targeted a general audience. Eli Pariser's widely read *The Filter Bubble* (2011), for example, highlights the ways in which our present media culture, monopolized by a handful of corporations and optimized for user retention, poses a threat to democracy. In the era of "personalization" (which Pariser dates to 2009), instead of the free flow of opposing ideas envisioned by the Internet's early adopters, we are instead "more and more enclosed in our own bubbles."[64] Pariser argues, moreover, that the same technology that makes the vast reach of the 21st century Internet manageable – namely, personalization – also prevents it from realizing that emancipatory potential; OK Cupid's recommendation algorithms (or, for that matter, Spotify's) and Cambridge Analytica are, in a sense, two sides of the same coin. Christopher Steiner's 2012 *Automate This: How Algorithms Took Over Our Markets, Our Jobs, and the World* is a catalogue of the various professions threatened by the algorithmic revolution.[65] Jacob Silverman's 2015 *Terms of Service* is a consummate tirade against the social

64. Pariser, *The Filter Bubble: What the Internet is Hiding from You*, 5.
65. C. Steiner, *Automate This: How Algorithms Took Over Our Markets, Our Jobs, and the World* (Penguin Publishing Group, 2012).

ills of networked society – "I shared therefore I am," he quips, satirizing the corrosive way our digital personas have supplanted real human interaction.[66] Frank Pasquale's 2016 *The Black Box Society* shows how financial institutions frequently embed self-serving and reckless behavior in their decision making algorithms, hiding the same old strategies of ruthless capitalism beneath the apparently neutral veneer of algorithmic technology.[67] Many of these same themes are taken up in Cathy O'Neil's 2019 *Weapons of Math Destruction*, which focuses on how big data, and the apparently neutral idea of a mathematical model, can be wielded against the consumer in concerning ways.[68] Safiya Umoja Noble's 2018 *Algorithmic Oppression* focuses specifically on the negative impact algorithmic mediation can have for racial justice, a development for which Noble coins the widely adopted phrase "technological redlining."[69] Shoshana Zuboff's 2019 *The Age of Surveillance Capitalism* is an extended critique of the covert sale of surveilled user data, a practice that accounts for a large portion of all Internet commerce. The era of "surveillance capitalism," Zuboff argues, is one in which the surveillance apparatuses of the world's major corporations already exceed those of the worst totalitarian states in history. They are, moreover, already leveraged to control our offline behaviors, often in ways we do not perceive: "surveillance capitalism preys on dependent populations who are neither its consumers nor its employees and are largely ignorant of its procedures." Similar themes are sounded in Kate Crawford's frequently cited article for the Harvard Business Review, "The Hidden Bias in Big Data."[70]

There are also many critical works for academic and technical audiences. The possibility of machine bias, defined as "unfair discrimination against certain individuals or groups of individuals," was spotted in 1996, years before it became a popular subject, by Batya Friedman

66. Jacob Silverman, *Terms of Service: Social Media and the Price of Constant Connection* (Harper Collins, 2015), ix.

67. Frank Pasquale, *The Black Box Society: The Secret Algorithms That Control Money and Information* (Harvard University Press, 2015).

68. Cathy O'Neil, *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* (Crown Publishing Group, 2016).

69. Noble, *Algorithms of Oppression: How Search Engines Reinforce Racism*.

70. Kate Crawford, "The Hidden Biases in Big Data," 2013, accessed August 10, 2019.

and Helena Nissenbaum.[71] Elizabeth Van Couvering's 2007 anthropological study of high ranking employees of various search companies reveals that the "schemas" according to which search engines are designed are thoroughly market-oriented and stand distinctly at odds with the values of "objectivity, fairness, diversity, and representation."[72] Kate Crawford highlights the incongruence between the logic of the algorithm, which, she says, will tend to select a clear winner, and the logic of "agonistic pluralism" (a term borrowed from Chantal Mouffe[73]), which she proposes as a new design ideal for engineers.[74] Jenna Burrell in 2016 proposed a subtle taxonomy of algorithmic opacity: opacity can refer to corporate secrecy, consumer illiteracy, or, more subtly, as the mismatch between mathematical and human logic.[75] Burrell also makes the important point that many academic studies of algorithmic culture, even where they ask the right questions, fail to address the actual facts of the systems in question. Nick Seaver (2017) sounds this same theme, while resuming the scuffles from the discipline of math and logic over what should constitute an algorithm; too much debate takes place over algorithms, he claims, without any real consensus about the subject under consideration. Seaver raises this issue in a way that connects it to his training as an anthropologist, drawing on interviews and participant-observer sessions with the actual designers of various recommendation engines. He concludes that more important than the ontological dimension of algorithms is the cultural one; algorithms should be studied not only in culture, but *as* culture. They should be thought of "as heterogeneous and diffuse sociotechnical systems, with entanglements beyond the boundaries of proprietary software."[76]

David Berry (2019) takes Seaver's idea seriously, calling for a general "critical theory

71. Helena Nissenbaum and Batya Friedman, "Bias in Computer Systems," *ACM Transactions on Information Systems* 14, no. 3 (1996).

72. Elizabeth Van Couvering, "Is Relevance Relevant? Market, Science, and War: Discourses of Search Engine Quality," *Journal of Computer-Mediated Communication* 12, no. 3 (April 2007): 866–887.

73. Chantal Mouffe, "Deliberative Democracy or Agonistic Pluralism?," *Social Research* 66, no. 3 (1999): 745–758.

74. Kate Crawford, "Can an Algorithm be Agonistic? Ten Scenes from Life in Calculated Publics," *Science, Technology, and Human Values* 41, no. 1 (2016).

75. Jenna Burrell, "How the machine 'thinks': Understanding opacity in machine learning algorithms," *Big Data and Society* 3, no. 1 (2016).

76. Seaver, "Algorithms as culture: Some tactics for the ethnography of algorithmic systems," 10.

of algorithms," to combat the "cult of data-ism," which has in certain cases militated against theorizing itself, including the type of theorizing that is the scientific method.[77] Berry argues that the best way to counter the "data-ism" trend is to look at particular cases where algorithms operate unjustly and examine them in detail; his examples relate primarily to Amazon's "Mechanical Turk" service, which enables companies to hire very low wage workers to handle menial tasks that are nevertheless still impossible (or not cost-effective) to automate. As Berry notes, Amazon conceives of the Mechanical Turk program as a modular part of a larger computational system. This renders the human employees as essentially a subset of the computer program, reversing the traditional way in which we conceive of automation in the workforce. Where for most of the history of computation, the problem has been to get computers to behave like people, here the business model is explicitly predicated on getting it the other way around, and paying the humans almost nothing.[78] Berry sees this as a strategy for keeping the system's inherent injustices invisible. It is only by exposing this kind of structure, by "contesting the invisibility of algorithmic infrastructure," that the badly needed critical theory of algorithms is possible.[79]

Critical Algorithms Studies and Music

While these critiques have grown in number and intensity over the 21st century, they continue not to spot music as a viable area of critique or even a useful case study. Authors from critical algorithms, science and the digital humanities all seem to come close but never quite take up the subject of music. Especially because these areas often intersect with the scholarly world of Sound Studies, the absence of much critical work on streaming audio is especially surprising. As a place where machine learning, recommendation (which was originally part of

77. David M. Berry, "Against Infrasomatization: Towards a Critical Theory of Algorithms," in *Data Politics: Worlds, Subjects, Rights*, ed. Didier Bigo, Engin Isin, and Evelyn Ruppert (Routledge, 2019).

78. On the appalling wages of Mechanical Turk, TaskRabbit and the gig economy generally, see the outstanding reporting of Sarah Kessler in "Pixel and Dimed": https://www.fastcompany.com/3027355/pixel-and-dimed-on-not-getting-by-in-the-gig-economy, accessed 10-10-2019

79. Berry, "Against Infrasomatization: Towards a Critical Theory of Algorithms," 61.

library science), classification and digital signal processing are all brought together with the plainly humanistic domain of musical aesthetics, Spotify seems a natural object of study here. But the Digital Humanities, for the most part, seems to prefer to remain outside the objects it studies. As Jonathan Sterne puts it, "a lot of the best digital humanities work in sound studies is pretty low-tech."[80] As a result, the field gestures at some of the issues that *would* be central to a critique of Spotify, but consistently shies away from the technical dimension that would deepen them. In the edited volume *Digital Sound Studies*, for example, Jonathan Stearne speaks of the "tyranny" of the audio player. He gestures at music recommendation but only as an example of something with which digital humanities is *not* particularly concerned.[81]

What comes closest to a study of streaming technology from the world of digital sound studies is probably Jonathan Sterne's 2012 work on the MP3 format, *MP3: The Meaning of a Format*.[82] This book is both a history of the MP3 compression format and an essay into its meaning as a cultural artifact. Because the MP3 compression standard played such a role in the development of the digital commodity, this book inevitably raises issues related to Spotify today. Stearne shows that the MP3, like the telephone, depends upon the psychoacoustics task of reducing an audio signal as much as possible while preserving its musical recognizability. Sterne argues that the MP3 therefore bears the "traces" of telephony and other related electronic DSP techniques. And so it should be studied alongside these other media. The digital format, no less than the more visibly physical technologies, has informed the"dimensions of twentieth century sound history."[83] This book is, in other words, an exploration into meaning of a now ubiquitous music technology: exactly what I am calling for with respect to Spotify today. The very technology in question, moreover, is directly adjacent to the rise of streaming audio; such was the cultural force of the MP3 that debates about music culture in the early days of the Internet

80. Jonathan Sterne et al., "Demands of Duration: The Futures of Digital Sound Scholarship," in *Digital Sound Studies*, ed. Mary Caton Lingold, Darren Mueller, and Whitney Trettien (Duke University Press, 2018), 268.
81. Ibid., 277.
82. Jonathan Sterne, *MP3: The Meaning of a Format* (Duke University Press, 2012).
83. Ibid., 9.

were simply debates about the MP3.[84] The revolution that we now associate with streaming digital music was originally conceived of as the "MP3 revolution."[85] Sterne may be the first author to realize that not only are data and politics inseparable – a familiar enough theme among critics of digital culture – but so are data and culture itself.

Of the scholarship that addresses music streaming itself, the majority is from a business perspective. Among this number are not only many popular histories of Napster[86] but also scholarly works on the future of the music business in the digital era.[87] Some of these business and copyright oriented works raise the broader issue of what the consequences of digital culture will be for the nature of musical meaning; Jeremy Wade Morris, for example, makes passing mention of the "changing relationship people have with their music or the changing role of music in the contemporary moment."[88] The second question refers to way music services tend to relate music to observed user behavior (hence, e.g. the Spotify "work-out" and "study" and "sleep" genres). The first question is more complex, and is not something Morris really approaches. It requires a full length study of its own, which is in many ways the project undertaken from an empirical perspective in Sofia Johansson et al., *Streaming Music: Practices, Media, Cultures* (Routledge, 2018) (discussed below). Many other writers address the precise nature of the supposed "recovery" for the music industry inaugurated by Spotify. While these are important questions that do bear some relationship to my central question, I regard them as mostly outside the purview of this chapter.

There do exist a few works that address the question of streaming music in culture directly. There are two recent books that take the issue up in the context of broader conversations

84. Matthew David, *Sharing: Crime Against Capitalism* (Polity Press, 2017).

85. See M. McCandless, "The MP3 revolution," *IEEE Intelligent Systems and their Applications* 14, no. 3 (1999): 8–9. Spotify, however, uses the Ogg Vorbis compression format today, which is higher fidelity than MP3.

86. E.g. Merriden, *Irresistible Forces: The Business Legacy of Napster and the Growth of the Underground Internet* and Joseph Menn, *All the Rave: The Rise and Fall of Shawn Fanning's Napster* (Crown Business Publishing Group, 2003)

87. E.g. Kot, *Ripped: How the Wired Generation Revolutionized Music* and Patrik Wikstrom, *The Music Industry: Digtal Media and Society Series* (Polity Press, 2013)

88. Morris, "Music in the Cloud," 191.

about the nature of taste: Tom Vanderbilt, *You May Also Like: Taste in an Age of Endless Choice* (Knopf Doubleday Publishing Group, 2016), alongside discussions of taste in food and colors, visits the headquarters of the Echo Nest and interviews Brian Whitman (see Chapter Three). There, Whitman outlines his company's strategy for modeling user taste in a sort of conversational way, but Vanderbilt's critical discussion of that strategy is minimal. Nolan Gasser, *Why You Like It: The Science and Culture of Musical Taste* (Flatiron Books, 2019), on the other hand, is written by a former Pandora "musicologist" (their word for the employees in charge of creating their meticulous database of labeled music) who also happens to be an accredited academic Musicologist. Gasser's project is really an extended analysis and tabulation of different areas of musical taste, informed by his first hand experience working to profile and predict it at Pandora. The conceit of a "genotype," defined as "a metaphoric expression signifying the boundaries, characteristics and content of one's musical taste," is, as far as I can tell, ultimately indistinguishable from the corporate concept of a "taste profile," and the book simply surveys a handful of these at great length. There are chapters on, for example, the "hip hop genotype" and the "jazz genotype," which try to discern what musical features would be important to listeners of those genres.[89] The book is essentially a list of the ways and reasons people can and do like music; no attempt is made to consider the commensurability of that list with automated recommendation, or the appropriateness of the automated discovery paradigm in general.

There are some important exceptions to the prevailing absence of attention that this issue has been given. In 2016 the journal *Popular Communication* published a special issue on Music Discovery. The contributing authors, while consistently addressing automated music discovery itself, also steer clear of technical issues. Ingvar Kjus, for example, looks at the qualitative experience of streaming services, highlighting the disparity between their promise and what they

89. Comparisons of those features with the "salient" features derived quantitatively in Chapter Five of this dissertation are interesting – see Appendix II

deliver.[90] Raphael Nowak concentrates on the idea of "discovery" as a sort of affective puzzle.[91] Gavin Carfoot's essay on the power relations inherent in contemporary acts of musical discovery, and the way they tend to resume patterns from the colonial era, is highly relevant to a critical discussion of Spotify, but that is not a connection he actually makes.[92] Anja Hagen attempts such a connection, but her data on Spotify is all hand-collected and feels somewhat anecdotal.[93]

There are two recent books that actually do approach the question, with serious attention to both music and recommendation. The first is Johansson et al's 2018 *Streaming Music: Practices, Media, Cultures*. This work is a portrait of the transition from fixed media to streaming (what Eriksson et al will call "music as experience"). Its general objective is to "shed light on what these transformations in music culture mean for music listeners."[94] This is, for the authors, a question of the "meaning of music as it settles online," and as such the discussion focuses on theorizing the empirical practices of streaming customers. Drawing on interviews with young streaming music customers in Sweden and Moscow, conducted over three years, the authors try to understand how the advent of streaming audio has actually changed the way people relate to music. The results are illuminating. The Spotify platform is one among a handful the study takes on, and one of their findings is that consumers mimic with striking fidelity the image Spotify tried to cultivate; Spotify's music is a way to "structure the everyday."[95] This finding agrees with my analysis of the Echo Nest engine (Chapter Three), as well as the marketing strategy Spotify has taken in recent years (consistently advertising its ability to create musical "soundtracks" for everyday life. Spotify is, moreover, widely regarded by informants as having a homogenizing effect; it depends,

90. Yngvar Kjus, "Musical exploration via streaming services: The Norwegian experience," *Popular Communication* 14, no. 3 (2016): 127–136.
91. Raphael Nowak, "When is a discovery? The affective dimensions of discovery in music consumption," *Popular Communication* 14, no. 3 (2016): 137–145.
92. Gavin Carfoot, "Musical discovery, colonialism, and the possibilities of intercultural communication through music," *Popular Communication* 14, no. 3 (2016): 178–186.
93. Anja Nylund Hagen, "The Playlist Experience: Personal Playlists in Music Streaming Services," *Popular Music and Society* 38, no. 5 (2015): 625–645.
94. Johansson et al., *Streaming Music: Practices, Media, Cultures*, 1.
95. Ibid., 93.

so say the authors, on a paradigm of "providing more of the same."[96] The authors argue that this seems to privilege "closed" musical experiences, a theme that other others (including me) will take up. This is a rigorous sociological subtantiation of the anecdotally common idea about Spotify, and this alone is valuable. But the precise nature of that musical sameness – whether having to do with genre, spectral profile, subjective user feedback, etc – is never specified. The authors demonstrate that many music consumers have a "before and after" perspective on the advent of music streaming; although they listen to far more music now than before, they do so with less dedicated focus.[97] Live concerts and hard physical media are conceived by many young listeners as similar kinds of "interruption" to the constant stream now available to them. The work demonstrates the ubiquity both of the streaming services, and of user dissatisfaction with them.

These are valuable insights into the function of streaming music in contemporary digital culture, but the authors, like so many, don't try to connect them to any aspect of the Spotify system itself. Spotify is shown to be perceived to give us more of the same, but whether or not that is really the case, or what it would mean for that impression to be rendered falsifiable, is not part of their discussion. The best work on Spotify, on the other hand, addresses these questions exactly. It comes from a group of Swedish writers who have integrated humanistic critique and serious quantitative literacy, and brought that interdisciplinary critique to bear on Spotify itself for a number of years. This research group has published many articles, and have developed those findings into the first serious critical study of Spotify, Maria Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music* (The MIT Press, 2019). I review two of the articles first, before discussing the book below.

Maria Erikssonn's article, "Close Reading Big Data," looks carefully at the treatment of metadata by the music intelligence company the Echo Nest (acquired by Spotify in 2014), showing that their system will tend to place "trivial, mundane, and sometimes far-fetched source material

96. Johansson et al., *Streaming Music: Practices, Media, Cultures*, 101.
97. Ibid., 162.

at the foundation of musical analysis."[98] It is, essentially, a very intelligent way of pointing out some of the ridiculous shortcomings of the Echo Nest's "music intelligence." Taking an even more technologically sophisticated route, Pelle Snickars shows that, contrary to Nick Seaver's skepticism about the limited "knowability" of recommendation algorithms (or the usefulness of such knowledge), it is in fact possible to measure the size and repetitiveness of the "loops" in Spotify recommended content. Snickars concludes that recommended content is indeed fairly repetitive: "music recommendation algorithms do not take advantage of the archival infinity at Spotify" and that the algorithms are therefore a "disappointment," at least if what is desired is the promised "personalisation." User behavior, moreover ("likes," skips and so forth) are shown unambiguously not to have any appreciable impact on the recommended songs. Snickars characterizes the various Spotify pronouncements about its Radio product as essentially dishonest, showing that recommendations are repetitive and simply do not respond to user behavior as advertised.[99]

Spotify Teardown

The book length study of Spotify, Maria Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music* (The MIT Press, 2019), builds on this body of research in fascinating ways. With the support of the Swedish Research Council since 2013, this research group has marshalled a number of strategies to render the alluring intuitive questions we all have about Spotify – does it narrow my listening experience? does it collude with the labels? does it exploit independent stake holders? – susceptible to scientific inquiry. Or, at least, it tries to do that, and is honest about where those investigations break down – which, predictably, they do most often touching matters of aesthetic form and taste. At the broadest level, the authors seek to ask "how people's practices and approaches toward cultural forms such as songs, books or films...are transformed under the

98. Maria Eriksson, "Close reading big data: The Echo Nest and the production of (rotten) music metadata," *First Monday* 21, no. 7 (2016).
99. Snickars, "More of the Same–On Spotify Radio."

shift from commodity ownership to commodity experience."[100] "Experience" here indicates that the authors are situating their work in the new culture of streaming, which by now has pretty thoroughly displaced the culture of owning; *Spotify Teardown* asks in what ways this change has engendered other changes in the contemporary culture and business of music.

The book is divided into primary investigative chapters and interstitial "interventions." The former are valuable concrete essays on Spotify the company; chapter one gives a narrative history of its evolution, highlighting the important moments in its 24 rounds of venture capital funding (e.g. the appointment a high-ranking Napster and Facebook employee to its board). Chapter two is an overview of its various revenue strategies that focuses on its ongoing financial losses, and discussing the difficulties it will inevitably face in becoming profitable. Chapter three analyzes the evolution of its marketing strategies, showing in particular how one of Spotify's very first marketing efforts, the #backaspotify Twitter campaign, was connected to a center-right political effort to reform the business climate of Sweden. Chapter four situates Spotify in the history of "free culture" on the Internet, comparing its public image with the legacy of Napster and other free movements. The "interventions" are playful, open-ended experiments that often cut against the grain of the intended use of the Spotify service. One of them, for example, opens with a cease and desist letter the researchers got from Spotify alleging that they had violated the company's terms of service. Others are more hackerish, deploying bots to compare content recommended to different age groups and genders, or launching a dummy record label and uploading dummy music to Spotify. Sometimes the results lead to convincing conclusions, sometimes not, but they are always thought provoking. The project of critiquing automated recommendation is as difficult as the project of understanding music itself, and the authors inevitably run into argumentative dead ends. The book as a whole is most valuable as a thorough and rigorous critical portrait of the Spotify company, combining historical context with quantitative probes. As for its central guiding question – how people's practices are transformed as a result of the rise of streaming music – the

100. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 1.

book admits to raising more questions than it answers, which is perhaps the inevitable fate for such a project (it is also essentially the conclusion of this one).[101] Nevertheless it represents the best attempt to apply the humanistic concerns animating the field of critical algorithm studies to the subject of music steaming, and to do so while grounding them in serious quantitative studies.

2.3 Music is Philosophical and Empirical

Eriksson et al are the exception that proves the rule; such efforts to combine humanistic and quantitative thinking, and to do so with music streaming as a focal point, are exceedingly rare. As I have shown in the above survey, critical studies of algorithmic culture have tended to be *either* philosophical or empirical. The debate over the role of computers in human life has steadily shifted, moreover, from one to the other, with the majority of today's writing devoted to the important social justice questions raised by the present ubiquity of machine learning. Even though many of the issues raised by both types of inquiry have exciting applications in the musical domain, little attention has been paid to the issue of music in the critical algorithms research area. This is unfortunate not just because machine learning will matter enormously for music consumption in the future, but also because music is one area where the two threads – the philosophical and the empirical – can actually come into conversation with eachother. It makes sense to consider music in both ways, perhaps more than any other topic in algorithmic culture. Music thus represents both a lacuna unto itself, in that it hasn't been studied enough from this perspective, and a chance to bring together different types of critique already present in the discourse. Music is, in some ways, almost scientific in its rationality. In other ways, it's not rational at all. This dual nature is probably above all what makes it so difficult for computers to get it right. This is also what makes it a particularly good subject for critics of machine learning and digital culture; that is to say, music is both a philosophical subject and an empirical one.

101. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 190.

While there are recently emerging dedicated studies of music in algorithmic culture, the most exciting research areas, joining these two avenues, remain basically untouched.

In particular, there is almost no attention paid to what is, in my view, the biggest question of all: how do we decide if a music recommendation engine is working well? For Spotify, the answer is really simple: it's working well when user retention is high and revenue is up. "Serendipity" – Spotify's word for recommendations that you didn't already know you like but which you turn out, in fact, to like – is just one part of the broader strategy to keep customers engaged. In fact, it might not be a very big part of that strategy at all. It is the nature of "platform capitalism" to maximize user retention above everything else, and we have no reason to believe that Spotify differs significantly from this general trend.[102] But user retention is not a measure for success that any human listener would recognize. Is a recommender system successful, then, when a customer simply *reports* satisfaction? Would that then imply the design of systems that simply give listeners "more of the same," which is exactly the outcome so emphatically lamented in Snickars (2017) (that our worst fears about Spotify are true; that it does just recommend the same stuff again and again)? Snickars seems to assume, reasonably, that this represents a failure, but the question of what a recommendation algorithm *should* do, if not that, is not one he takes up. This is more than just a question about Spotify but a true problem in applied aesthetic philosophy, resuming once again the difference between what Kant might call a judgment of "taste" and a judgment of "beauty." One is merely pleasing, while the other engages some deeper, hard-to-define human faculty. Automated music recommendation is a 21st century problem, but one that we cannot contemplate without revisiting this centuries old conundrum.

But what if there is no coherent measure of success for an automated recommendation? What if the very act of automation has already evacuated whatever meaning a piece of music can be said to have? The social dimension of music is, of course, universally acknowledged, even, in a way, by Spotify itself. But Spotify, with its community playlists and its embedded Facebook

102. Srnicek, *Platform Capitalism*.

code, is an even paler imitation of musical sociality than Facebook is of human friendship or Tinder is of human courtship. If it is true that musical meaning is fundamentally predicated on human connections – as many do indeed believe – then it may be that there really is no such thing as a good recommendation algorithm. It may be that the whole idea is a category error. It may be, in other words, that a good music recommendation, by definition, is something passed from one person to another, and that it bears a much smaller relationship to the audio signal than is often supposed (even by the people who suppose that it doesn't matter). If so, the rise of automated streaming may herald a collective shift not just in where and what we listen, but *how* we listen, and how we conceive of musical affection.

There is also unexplored territory on the practical side of the music recommendation question. In fact, one of the difficulties in approaching this topic quantitatively is that there are so many potential research questions that it is hard to know where to begin. One pressing issue, however, seems to be the question of homogeneity. Many of the complaints about Spotify center on its potential to keep unknown artists from getting popular, on its incentives to recommend the same music over and over, on the way it supposedly encourages passive listening.[103] Eriksson et al (2019) have designed listening bots to probe this kind of behavior in various ways, often with fruitful results. Homogeneity, however, can mean more than one thing. So far, in every case that I know of it has meant repetition; either repetition of the same songs in a playlist, the restriction of recommendations to top promoted content, or the repetition of the same artist. Given the design of Spotify's system, however, it makes sense to think about aesthetic homogeneity as well. In other words, you might be recommended 100 songs that all sound the same, or that look the same to Spotify's automated feature extraction methods, but that playlist might not repeat a single track or artist. Such a playlist, however, could be said to be aesthetically homogeneous. Whether that would be a good or bad thing, or whether it would be categorically different from how music

103. See Damien McCafferey, "The Narrowing Gyre of Music Recommendation," in *This is the Sound of Irony: Music, Politics and Popular Culture*, ed. Katherine L. Turner, Ashgate Popular and Folk Music Series (Taylor & Francis, 2016), for a musicological example, or Snickars (2017), cited above, or many others from the music blog world that sound the same themes.

recommendation has always happened, would be require a different kind of inquiry.

A study of music recommendation that joins the philosophical mode with the empirical one would be the correct type to substantiate these intuitions, and this is what is undertaken in the remainder of this dissertation: the philosophical question, about the possibility of evaluating recommendation quality, is addressed in Chapter Three, which is an extended essay on Spotify's notion of musical meaning. The empirical question, about content homogeneity in Spotify recommendations, is pursued in Chapter Five, which conducts quantitative experiments using large scale queries via the publicly available API. A concluding section brings these two discussions together.

3 What Does Music Mean to Spotify?

One overlooked feature of Spotify's software is that its user experience tends not to discriminate among traditional musical types. Its search box, for example, accepts virtually anything as valid input. Users can enter particular artists, albums, and songs, but they can also enter genres, moods, or other kinds of musical keywords. The resulting recommended materials are equally heterogeneous. Whether we take the "lean in" or "lean back" approach,[1] we are confronted with a mixture of genres, moods, playlists or other kinds of "hubs" (Spotify's umbrella term for these variegated musical departure points) as search results. Above all of this diverse suggested material hovers the same inviting "play" button; a hub for "black history is now" is clickable in the exactly same way as a "radio" station seeded by Parliament. So is the "artist" Parliament, as is their 1978 track, "Flashlight."

This is an important feature of Spotify's software design. This array of clickable options nurtures an impulse for instant gratification and is probably a strategy to maximize user retention.[2] It also makes Spotify not simply a place to go to hear the music you want, but a place to learn about what you want, to browse a library of cute icons that respond to clicks with various kinds of sonic offerings. In other words, Spotify is a music discovery service, not just a place to stream music.

1. Industry jargon referring to different styles of music streaming software that assumes an active ("lean-in") or passive ("lean-back") approach to what music is played.

2. See Nick Seaver, "Captivating Algorithms: Recommender Systems as Traps," *Fortchoming, pre-print*, 2018, for a discussion of how recommendation algorithms increasingly optimize retention over more traditional metrics for recommendation quality.

Spotify's gradual transition from a streaming service to a discovery service is discussed in detail below, but the trend is easily visible just by looking at its recent string of acquisitions. Most importantly, Spotify acquired The Echo Nest in 2014, whose recommendation technology was already powering Spotify and much of its competition at the time. Less well known are Spotify's acquisition of the curation-focused data science firms Niland, Sonalytic and MediaTv (all three in 2017). Even if we are kept mostly in the dark about how Spotify makes its recommendations, the turn toward algorithmic curation is unmistakable. And even if we can never know exactly how much of the Echo Nest technology is being used in Spotify recommendations, it is clear that machine learning plays a "crucial role" in Spotify's recommendations.[3]

As a place where you go essentially to explore rather than simply consume, Spotify communicates a certain seamless intimacy with the user. Spotify is not a machine that delivers requested goods for a fee; it seeks to give users an open-ended, benevolent and exploratory experience in which it is assumed that the data surveilled from your behavior can only enrich your relationship with the company and improve the quality of your recommended content. It is only natural for a profit-driven enterprise to want to project this benevolence – and, in the contemporary culture of what Shoshana Zuboff calls "surveillance capitalism,"[4] Spotify's practice of surveilling user behavior is an unremarkable example of what has become the dominant business model for tech companies. But it is worth pointing out that music consumption in the digital age was not always this way. Napster and MP3.com, for example, were revolutionary simply for how much music they made freely available, not for the ingenuity with which they helped users discover new music. Today, when putting 30 million songs within reach is no longer impressive on its own, and (related) when the glut of material is harder than ever to make sense of, music streaming services have, increasingly, needed to become music discovery services.

It is impossible to know exactly how Spotify's music discovery engine works. This is true,

3. As Tony Jebara, Spotify's head of Machine Learning, puts it. https://newsroom.spotify.com/2019-10-24/6-questions-and-answers-with-tony-jebara-vp-of-machine-learning/, accessed 01-15-2019

4. Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*.

first of all, because the system does not work in any one way at any one time for any one user.[5] Even if it were not subject to constant mutation, moreover, the actual algorithm is a carefully guarded trade secret. In spite of the limitations on what we can know about it, it nevertheless seems straightforwardly true that, no matter how Spotify's recommendations are actually made, the system must in some way be predicated on a notion, explicit or not, of musical meaning. This notion is obscured from the user but it is there somewhere. Insofar as any recommendation, by a human or by a machine, depends on ideas of musical salience and similarity, we can say that Spotify's recommendation service represents a tacit "theory" of musical meaning.[6]

In this chapter, I probe and critique that theory. After narrating the history of the Spotify brand and tracing its transition to a music discovery service, I make some tentative claims about what, I believe, must be the essential contours of that theory (always acknowledging that the Spotify system is hidden and constantly evolving). A close reading of the Spotify technology and its relationship to the humanistic tradition of aesthetic philosophy reveals that, although the Spotify technology is based on a dissertation that promises nothing less than the meaning of music itself, the applicable theory turns out to be a rather conventional notion about the fundamental predictability of human behavior, and its derivability from large amounts of data. In fact, this is not a theory at all, at least not in the traditional sense of having some explanatory power. Spotify is therefore an exemplary case of the way machine learning, in its tolerance of opacity and prediction rather than explanation, has blurred the line between science and engineering, producing a sort of "qausi-theory" of musical meaning. At its heart this chapter is an attempt to look closely at that theory and situate it alongside more traditional theories that have approached the same topic.

5. See Nick Seaver, "Knowing Algorithms," Unpublished draft available on nickseaver.com, 2013, accessed July 15, 2019 for an instructive reminder to remain humble about the "knowability" of recommendation algorithms.

6. It is important to remember that although it is best known for its "data-driven" approach to music information and its automated personalized recommendations, Spotify actually continues to employ human curators. See Reggie Ugwu, "Inside the Playlist Factory: The Unsung Heroes of the Music Streaming Boom," Published by Buzzfeed Media, accessed January 8, 2019, https://www.buzzfeed.com/reggieugwu/the-unsung-heroes-of-the-music-streaming-boom

For good reasons, Spotify's system does not encourage this kind of critical thinking. Questions about the system's implicit theory of musical meaning can only serve to remind users that its theory is just one of many – and therefore not necessarily the one most worth paying for. The success of the Spotify model depends on communicating that its catalog is both complete and effectively managed – that it has achieved a unique balance of "scale" and "care," to use the words of one of the designers of its recommendation technology.[7] Relativizing the theory of meaning upon which the system depends represents a disconcerting imperfection. If the technology populating my playlist relies on just one way to construe musical significance, who knows what gems it might be missing or how it might be guiding my consumption habits. Or, to follow the line of argumentation pursued by Tia DeNora in a more sinister direction, how it might be manipulating my moods, or shaping my personal identity.

Spotify may not go out of its way to highlight this idea, but the notion that the system is in fact predicated on a theory of musical meaning can be traced back to one of the first places where Spotify's recommendation technology was set out: the 2005 doctoral dissertation of Brian Whitman at the MIT Media Lab.[8] Although it was published three years before Spotify officially launched, Whitman's "Learning the Meaning of Music" introduced the basic outline of the software that would eventually power a hugely successful music intelligence company, The Echo Nest, which Spotify acquired in 2014. As I argue below, some aspects of this technology almost certainly continue to operate in present-day Spotify. And so Whitman's doctoral dissertation forms a useful, if partial, entry point to Spotify's black box.

As is clear from the title, Whitman proposes this technology while engaging explicitly with the question of musical meaning. He promises that he will be "Learning the Meaning of Music." "Learning" is probably intended half tongue in cheek, as a nod to the "machine learning" that takes place in the dissertation. But it's only half tongue in cheek; as always with

7. Brian Whitman, "How Music Recommendation Works – And Doesn't Work," 2012, accessed July 1, 2019, https://notes.variogr.am/2012/12/11/how-music-recommendation-works-and-doesnt-work/.

8. Brian Whitman, "Learning the Meaning of Music" (PhD diss., Massachussets Institute of Technology, 2005).

questions of machine learning, the question of exactly what kind of learning is happening is an open one. Indifference to the opacity of the system compounds with a certain faith in the inherent predictability of human behavior to make the concept of "learning" difficult to construe. The system produces output, but in what sense exactly has it "learned" anything, really? What, moroever, about meaning? In what sense is the word intended, and what is the actual content learned about it?

To echo Hilary Putnam, one of the few humanistic sources to which Whitman refers, what is the "meaning of meaning" in that title?[9] Regardless of how much of this technology ends up going into a given recommendation task for Spotify in 2019 (which is unknowable), a theory of musical meaning gleaned from Whitman's dissertation can be part of a broader effort to think critically about what music "means" to Spotify. More generally, this can offer a basis for thinking critically about the consequences for music of the rise of automated curation in general.

As noted in Chapter Two, this issue is analogous to questions pursued in the discipline of "critical algorithm studies." The idea of embedded bias, for example – the prospect that ostensibly objective algorithmic tools will silently encode certain assumptions – is a major theme in this field. As is the related issue of "fairness," which focuses on the real-world consequences of applied machine learning, especially concerning social justice and inequality. Although the natural temptation is to expose the bias and rectify the unfairness, the very impulse to "fix" artificial intelligence in this way actually represents a concession to its viability and inevitability.[10] If all we do is point out that, say, Spotify's system is better equipped to recommend Taylor Swift than Julius Eastman, we run the risk of reinforcing the assumptions beneath Spotify and the inevitability of the curated streaming model itself. Quibbling with a machine learning system's performance alone, even if we do it very cleverly, avoids the fundamental questions about its

9. Hillary Putnam, "The Meaning of 'Meaning'," *Minnesota Studies in the Philosophy of Science* 7 (1975): 131–193.

10. Julia Powles and Helena Nissenbaum, "The Seductive Diversion of 'Solving' Bias in Artificial Intelligence," accessed April 1, 2019, https://medium.com/s/story/the-seductive-diversion-of-solving-bias-in-artificial-intelligence-890df5e5ef53.

appropriateness and can even serve to reinforce its claims on our future.

The correct object of interrogation, then, is not so much the empirical facts of Spotify's recommendation engine as it is the whole idea of automatic recommendation in the first place. For this reason, this chapter will remain at a relatively "high" level, discussing details of Spotify (for example, where it is likely to preserve elements of the Echo Nest technology) only where those details are relevant to broader considerations of automated curation. At issue, ultimately, is the general appropriateness of data-driven approaches to the human phenomenon of musical meaning. This chapter therefore addresses Spotify's assumptions about music, but also the more fundamental assumptions of data science generally – assumptions that Tal Zarsky captures succinctly:

> Any institutional decision that applies or allows algorithms to automatically sort, govern, and decide issues related to human actions makes two crucial assumptions: that human conduct is consistent and that with sufficient data human behavior becomes predictable.[11]

If Whitman's dissertation has really accomplished what it promises, then at some level the assumptions in this quotation have to be valid; and if they're not valid, it's a critique than granular quibbles with Spotify's performance will probably never capture. Learning the meaning of music really *would* be special – it would mark the resolution of a stubborn problem that has dogged aesthetic philosophy forever. It would, moreover, be something far more precise and interesting than what is promised in the quotation above; it is one thing to simply assume, as all data science must, that things are basically predictable, given enough good data. It is quite another to crack the code of human affection for music. The rhetoric of Whitman's dissertation, and Spotify's promotional materials, present a sleight of hand that makes it hard to pull these two things apart, even though they definitely aren't the same thing. In this chapter, I attempt to do that by looking as closely as possible at the notion of musical meaning at work in Spotify. I also ask whether this

11. Tal Zarsky, "The Trouble with Algorithmic Decisions: An Analytic Road Map to Examine Efficiency and Fairness in Automated and Opaque Decision Making," *Science, Technology, and Human Values* 41, no. 1 (2016): 118–132.

notion is a good one, and what is lost and what gained in the transition to a culture of listening in which automated curation is the norm – a transition which, for better or worse, we are definitely making.

The discussion proceeds in three sections:

- First, I sketch a history of Spotify's development, dispelling some commonly held beliefs about it and showing how and why it transformed from a streaming company to a discovery company. Here, I argue that automated music recommendation services must necessarily rely on some notion of musical meaning.

- Second, I make a case for why Spotify almost certainly continues to employ some of the techniques Whitman develops in his 2005 dissertation. This involves some forensic work comparing various technical documents issues by various parties in Spotify and the MIT Media Lab.

- Finally, I attempt to discern Spotify's theory of musical meaning itself. I do this, first, via a close reading of the behavior of the Spotify graphical user interface (GUI) and, second, via Whitman's 2005 dissertation. In the latter case, I argue that the techniques outlined are novel and probably effective, but that there are interesting gray areas where Whitman addresses the question of musical meaning. In particular, I highlight some of what I feel are interesting deficiencies in his work as a theory of musical "meaning." In the end I neither condemn nor endorse Spotify's system. Instead, I merely hope to show that a system like Spotify's inevitably relies upon a theory of meaning, and that as users of that system we will benefit from paying close attention to what that theory is.

3.1 Spotify and the "Curatorial Turn" (2008-2018)

There is a widely held belief that when Spotify was launched in 2008, it was as a response to a music industry imperiled by the growing practice of music piracy.[12] It is true that by the time Daniel Ek and Martin Lorentzon created the startup that would eventually mature into a publicly traded corporation worth more than $20 billion, the recording industry had contracted enormously from its peak at the end of the 20th century. According to Greg Kot, revenues from recorded music in America plunged from their all-time peak of $14.6 billion in 1999 to $12.6 billion in 2002, a decline of 13.7 percent.[13] The familiar narrative casts Spotify as a reaction to and, perhaps, a solution for the industry's financial crisis. And indeed this sometimes seems fair: according to the International Federation of the Phonographic Industry (IFPI), for example, industry revenue in 2018 had recovered to 68.4% of that peak value, largely on the strength of a 45% growth in paid subscription streaming.[14] As Spotify is by far the largest such subscription service, with some 200 million active users today (87 million of which are paying for their subscriptions),[15] Spotify can appear from this perspective to be an important driver of the industry's recovery, vindicating the altruistic posture the company occasionally projects.[16] The major record labels are frequently castigated for their repeated failures to develop viable systems of electronic distribution in the digital age. Spotify, as a kind of commercial imitation of illegal file sharing, can be seen as the music industry's belated, but successful, effort to rectify that mistake. Heralded as the "solution to music piracy," Spotify will restore value to the industry, connecting listeners with the music they want to hear, artists with interested audiences, and seeing that all parties be compensated fairly.

12. See for example, "Newsbeat" BBC News, Online Resource, https://www.bbc.com/news/newsbeat-43240886, Accessed Jan 27, 2019, 2018, which casts Spotify as a "response to the growing piracy problem," or Marsha Silva, "Spotify, the "Solution to Music Piracy," Is Getting Pirated by 2 Million People," accessed February 4, 2019, https://www.digitalmusicnews.com/2018/03/26/spotify-piracy-hacked/, or many others that echo this idea.
13. Kot, *Ripped: How the Wired Generation Revolutionized Music*, 31.
14. IFPI, https://gmr.ifpi.org/state-of-the-industry, Accessed Jan 27, 2019, 2018.
15. Apple music, though, is gaining on Spotify, with 56 million users as of time of writing (see Yoo 2019).
16. As it does, for example, in Brian Whitman's lengthy 2012 blog post, "How Music Recommendation Works–and doesn't work," discussed at length below.

This narrative, however, obscures some important facts about Spotify in particular and the relationship of music streaming to the music industry in general. First of all, it ignores the fact that Spotify has yet to turn a profit. In fact, Spotify's annual operating losses have increased sharply every single year, from €98 million in 2013 to €378 million in 2017.[17] In 2018 and 2019, Spotify's losses have decreased, but the company definitely remains unprofitable. This doesn't seem to trouble anyone. Spotify's 2019 press release for investors, for example, is jubilant about its first quarter earnings, while predicting another loss of €180-340 million.[18]

These kinds of consistent losses are not unheard of the present investor climate; Pandora, for example, also reguarly posts losses in the hundreds of millions. In general, moreover, traditional notions of value have changed radically across the economy, such that huge losses are no longer an indicator of low stock value. As hedge fund manager David Einhorn puts it, "the market has adopted an alternative paradigm for calculating equity value."[19] Profitability has taken a back seat to 21st-century measures of shareholder value, like scale, market share, and potentially monetizable data sources.

Nevertheless, Spotify's financial profile should still give pause to those who want to see it as the music industry's savior. Howeover much the investor climate has changed, Spotify will, after all, eventually have to turn a profit or fold. Perhaps more importantly, these losses are not due to a lack of revenue or a reliable customer base, but instead point to the same old problem the music industry has always faced in the digital age: they are due primarily to the licensing costs Spotify pays out to the major labels, which represent its biggest operating expense by far. The inevitable fact is that customers are unwilling to pay what they used to pay for music, while major record labels remain committed to intellectual property paradigms that only work with 20th century revenue streams. This has been the problem facing music sellers for the last two decades,

17. Felix Richter, "Spotify's Losses Widen as Royalty Costs Pile Up," 2018, accessed March 20, 2019, https://www.statista.com/chart/4894/spotify-revenue-vs-costs/.

18. See Spotify's publicly available financial disclosures: "Spotify Financial Disclosures," accessed July 24, 2019, https://investors.spotify.com/financials/default.aspx

19. Quoted at https://www.cnbc.com/2017/10/24/david-einhorn-value-investing-may-be-dead-and-amazon-and-tesla-killed-it.html, accessed 07-22-2019

and to judge from its earnings reports, Spotify's solution is no more viable than Napster's.

If Spotify is responding to an industry beleaguered by widespread piracy, its response in fact fails precisely where Napster's did. Napster was driven out of business through aggressive litigation from the Recording Industry Association of American (RIAA), while Spotify is kept from turning a profit as it funnels most of its revenue (and shares of its stock) to the major labels. The money is channelled differently this time around, but in a basic sense, the RIAA has bankrupted both companies.

The fact that this can be said of the streaming industry's biggest player, moreover, raises important questions about the financial viability of the streaming model itself; if Spotify can't make it work, one wonders, who can? Spotify has over the years shifted between various strategies for earning revenue: early on it looked to advertising, before attempting to monetize its integration with Facebook, and now sees subscription as its principal revenue stream. These are responses to changes in the tech economy in general, and some have even been successful. But it would be more accurate to say that Spotify's true source of revenue has always been venture capital, which it has attracted with extraordinary success, gaining more and more over 24 funding rounds even in the face of large losses. If Spotify succeeds only in raising venture capital, growing quickly, and collecting potentially monetizable user data, it no more represents a solution for the music industry than does, say, Uber or any other tech company (not necessarily a music company) whose rise has followed this template.

This familiar narrative about Spotify, in which it is lumped together with other "disruptive" tech firms like Uber and Airbnb, also obscures another important fact: that, although it is marketed as a novel and innovative firm, it is in fact largely owned by the traditional music industry forces. Since Spotify cannot afford a market rate for the licensing fees its service requires, it has been forced to compensate the major labels in part with company equity rather than cash. As a result, Peter Tschmuck reports, major labels today own as much as 20% of Spotify.[20] This is perhaps

20. Peter Tschmuck, *The Economics of Music* (Agenda Publishing, 2017), 179.

the cause of the widespread concern in the music industry about so-called "playola," a word that refers to the influence major labels supposedly wield over the content of Spotify's curated playlists (not to be confused with the familiar "payola," which denotes a similar practice from radio broadcasting).[21] It is also a possible cause for the often reported homogeneity of Spotify's automated recommendations, an effect which, if authentic, would give the lie to Spotify's stated aims as a music discovery service.[22] In any case, it is important to remember that, although Spotify is often said to have "disrupted" or "saved" the industry, in actuality it is largely owned by the major record labels, and it is to them that the majority of its revenue accrues.

The familiar narrative also overstates the relationship between Spotify and the industry as a whole. If we believe that Spotify has the potential to "rescue" the industry from the scourge of piracy, we must believe that it has a marked effect on the market itself. Yet this may not be true at all. While Pandora has commissioned studies showing that Internet radio has positive effects on music consumption in general, there is little consensus on this point and other scholars have found quite the opposite result. Or it may be that Spotify has no net effect on the music industry whatsoever. Aguiar and Waldfogel, for example, find that while Spotify does displace some lost revenue due to piracy, the new revenue is "roughly offset by revenue reductions from the sale of permanent downloads."[23] Spotify stimulates the market in some ways while depressing it in others, and it seems impossible to know exactly how to gauge its impact on the industry as a whole. It is not necessarily reasonable to assume that Spotify has either "rescued" or depressed the market.

Nor is it even certain that the industry's crisis in 2006 (the problems to which streaming is often seen as a solution) were due to piracy in the first place. While it is true that by 2006 revenues

21. For a representative complaint about playola, see, e.g. Glenn Peoples, *How 'Playola' Is Infiltrating Streaming Services: Pay for Play Is 'Definitely Happening'*, https://www.billboard.com/articles/business/6670475/playola-promotion-streaming-services, Published at billboard.com, accessed 01-09-2019, 2015

22. Spotify's app blurb on the Google app store, for example, promises "the right music for every moment" (and, moreover, for every individual user) – not just what the major labels want to promote. This claim has been dismissed as "mendacious" by Snickars, "More of the Same–On Spotify Radio"

23. Luis Aguiar and Joel Waldfogel, "Streaming reaches flood stage: does Spotify Stiumlate or Depress Music Sales?," *National Bureau of Economic Research* Working Paper 21653 (2015): 22.

had seen a sharp decline from their peak in the 1990s, the golden years the record industry had enjoyed in the 1990s were not necessarily the norm. Instead, some have seen them as anomalous, a period of growth artificially stimulated by the advent of the CD and, therefore, inherently short-lived. Revenues had in fact been declining for a long time before the arrival of the CD, which gave the industry a lift largely thanks to its new ability to sell consumers CD versions of music they already owned on vinyl and tape. From this perspective, it is only reasonable to expect that this lift would be temporary – and perhaps, therefore, inaccurate to blame the downturn on internet piracy and file sharing. The idea that piracy is responsible for the industry's downturn, though repeated constantly by the RIAA and industry insiders, is not necessarily accurate. As Greg Kot notes,

> It was disingenuous of the industry to blame its slump on file sharing without acknowledging the role played by rising CD prices. The average retail price of CDs had increased more than 19 percent from 1998 to 2002. Peak price was $18.99, with middlemen getting the vast majority of the split.[24]

If this picture is accurate – if the industry's pains at the turn of the century were a natural market adjustment rather than the result of disruptive new technologies or cultural shifts – then the whole idea of Spotify as the industry's savior, "restoring value" to a business sector struggling to accommodate new technological paradigms, is an oversimplification. Despite aligning itself with the rhetoric of disruptive innovation popular in the tech industry, in actuality Spotify is probably neither the industry's savior nor its destroyer, and in many ways it continues the patterns and promotes the interests of the major record labels who are among its largest shareholders. From a business perspective, Spotify is much less exceptional than it seems.

3.2 Meaning and the "Curatorial Turn"

Although Spotify may not be the driving force behind a sudden shift in the music industry, it certainly marks one. How (or whether) the streaming industry is to become self-sustaining

24. Kot, *Ripped: How the Wired Generation Revolutionized Music*, 42.

remains a mystery; nevertheless, it is hard to imagine a future in which the music business does not have streaming music at its center. Over the last 11 years, Spotify has evolved from a music streaming company that in many ways inherited the mantle of Napster, Gnutella and Limewire, seeking merely to provide legal access to a large catalogue of music, to a music discovery company whose most valuable properties are its recommendation engines. In this section, I trace that history.

In the only academic history of Spotify, Maria Eriksson et al. (2019) divide its evolution into seven periods:[25]

- "Beta" Period (2007-2008). Spotify released to a small circle of personal acquaintances.
- Period A (2008-2009). First public version launched in October 2008 in eight European countries. Spotify removes unlicensed music from its service. Spotify begins to sell advertising, launches ad-free Spotify Premium.
- Period B (late 2009). Global financial crisis eats into advertising revenue and venture capital. Doubts about viability of ad-supported model leads to increased emphasis on subscription services.
- Period C (2010-2011). Spotify as *platform*, emphasis on "social" features. Linking of Spotify and Facebook, increased practice of data extraction from users. "Related artists" function added. Spotify opens in USA.
- Period D (2011-2012). Valuation reaches $10 billion. Increased "platformization." Competition with Internet radio in USA (Pandora) leads to increased importance of recommendation and discovery.
- Period E (2013). Spotify begins to address "the abundance of choice" as a primary problem. Solution is no longer primarily social, but increasingly algorithmic. Spotify positions itself

25. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 43-67.

as a discovery company. Spotify acquires music recommendation company Tunigo (May 2013), which recommends music based on social activities and moods.

- Period F (2013-2015). Spotify dismantles the P2P network it had inherited from Napster, opting instead to use its own servers. Spotify acquires The Echo Nest (2014), an important music information company, for $100 million.

- Period G (2015-2016). In competition with Apple Music, Spotify emphasizes its ability to create musical *experiences* tailored for the moment. Curation strategy combines expertise of two acquired companies: Tunigo (expert human curation) and Echo Nest (scalable algorithmic curation). Also acquires Seed Scientific, a data science company. Summer 2015, Spotify introduces various personalized weekly playlists, such as “discover weekly.”

As this timeline shows, since its founding Spotify has nimbly adjusted to shifting market priorities and trends in startup culture, making at times dramatic adjustments to its marketing strategy and business model to accommodate these shifts. Not long after the collapse of Napster, Spotify began as a peer-to-peer sharing service that not only copied parts of Napster’s technical architecture, but actually permitted the sharing of unlicensed music. When Spotify launched its first publicly available version in 2008, it removed the unlicensed music but preserved much of the P2P architecture and kept the disruptive caché of Napster as part of its marketing strategy. After the global financial crisis cast widespread doubt on the viability of advertising for all Internet companies, Spotify recast its free tier as a marketing strategy for its subscription service, which was now to be its primary revenue stream. In the wake of Facebook’s monumental growth around 2010, Spotify partnered with Facebook and integrated itself with the social network giant.

Among these various adjustments, the most important one for the purposes of this chapter is the so-called “curatorial turn”: the shift toward music curation as a central element in Spotify’s service. Largely because of its arrival in the US market in 2012, where it had to compete with Pandora and other Internet radio services, Spotify has increasingly positioned itself as a “music discovery service" rather than simply a music streaming service – and this remains largely the form Spotify takes today. Even a cursory look at Spotify's service today reveals how central recommendations are in its service; recommendations of all kinds confront the user at every turn, from its "radio" button to its "discover weekly" playlist, to all the hubs under the "browse" tab. This shift can also be seen by looking at the contrast between two versions of Spotify's promotional materials, one from 2006 and one from Spotify's "about" section in 2019:

In 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.[26]

And in 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.[27]

The difference in tone is subtle but illustrative. In 2006, Spotify is a service that, ultimately, delivers "your choice," even if that choice can optionally be mediated by the service's recommendations (recommendations which, at the time, were probably mostly curated by humans rather than machines). The leading line promises "the music you want," clearly foregrounding the volition of the user. This blurb also promises the user "speed and control," two features that an informed, self-directed user might value. This blurb clearly targets a user that takes an active role in her media consumption, what the industry terms a "lean-in" strategy.

Although it probably holds appeal for aficionados and professionals, this posture eventually became a liability. In 2011, for example, Billboard published an article characterizing Spotify as "just a huge database of songs."[28] In response to this shift in customer priorities, Spotify had

26. Accessed via the Internet Archive, at https://web.archive.org/web/20061127231638/http://www.spotify.com/, accessed May 20, 201
27. Spotify Home Page, "About Us,"https://www.spotify.com/us/about-us/contact/, accessed May 20, 2019
28. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 59.

to change its approach. And this meant designing software that, for the first time, had something to say about musical quality, about music *qua* music. That is why, by 2019, what matters is not the music you *want*, but the music that is appropriate for "every moment." The value the user might find in having control over the tool is replaced by its power to "soundtrack your life," that is, to find music for you that matches whatever non-musical activity you happen to be engaged in. There is a notable shift to a "lean-back" approach, a shift which has taken place with respect to the media industry in general over this decade.[29] This shift engenders an adjustment in Spotify's attitude toward music itself; as we lean back, it seems, music's value comes to reside primarily in its relationship to things outside of itself rather than our relationship to it. A peculiar feature of the rise of curation is that the value of music is in how it "goes with" other things rather than what it sounds like.

More than the size of the catalogue or the quality of the sound,[30] Spotify's selling point, today, is its discovery product. And although Spotify does continue to employ human curators,[31] to a greater degree than any of its competitors, this product is automated. Spotify's promise is to help customers find the right music for a given moment, to "soundtrack your life." On the face of it, this slogan makes a pretty bold statement: that the millions of tracks in Spotify's catalogue are soundtrack music. It is only made obliquely, so it is easy to miss, but the treatment of all music as background music is a real consequence of the curatorial turn, and a central component of the "theory" of musical meaning this chapter is examining.

Here Spotify is part of a broader trend in digital culture from content acquisition to content experience and curation. This is a trend that Nicholas Negroponte of the MIT Media Lab noticed as early as 1994.[32] This is perhaps the first citation connecting the issue of machine learning

29. For work on the rise of curation in general, see, e.g. Silverman, *Terms of Service: Social Media and the Price of Constant Connection* and Gillespie, "Can an algorithm be wrong? Twitter Trends, the specter of censorship, and our faith in the algorithms around us"

30. Even the sonic watermarks imposed by many of Spotify's music industry partners (which are noticeable) seem not to deter customers at all. See Matt Montag's blog (https://www.mattmontag.com/music/universals-audible-watermark) for a useful demonstration of those watermarks. Accessed 7-24-2019.

31. See Ugwu, "Inside the Playlist Factory: The Unsung Heroes of the Music Streaming Boom"

32. Nicholas Negroponte, "Less is More: Interface Agents as Digital Butlers," accessed July 12, 2019, https:

to the cultural problem of data glut. Too often, Negroponte points out, Silicon Valley assumes that, with respect to technology and information, more is always better. In reality, he predicts, what Internet customers really want is *less* data – but more relevance: "I am willing to project an enormous new industry based on a service that helps navigate through massive amounts of data." This is a turn that has has only intensified since then. As Peter Wikstrom puts it,

> In a world where information is abundant, people may not be willing to pay a premium for basic access to that information, but they are most likely willing to pay for services which help them navigate through the vast amounts of information.[33]

Spotify is not alone, in other words, in turning toward automated curation; it belongs to the same world of information glut as Facebook and Google, and has adapted to it with similar strategies. It is important to note, though, that doing so engenders a related shift in the company's notion of musical meaning, something that Google never had to contend with. The remainder of this chapter is an attempt to precisify and analyze that notion of musical meaning.

3.3 Is Spotify Using the Echo Nest?

The rise in demand for curation services was an engineering problem that Spotify has approached in more than one way. Following the broader trend of social networking after 2010, Spotify's first solution was, to use the industry's word, "social." In 2010, Spotify received $16 million in venture capital from Sean Parker, the co-founder of Napster. After Napster, Parker had gone on to become the founding president of Facebook. With his investment in Spotify, he earned a spot on its board of directors and ensured that the two companies could integrate their products smoothly. With an integrated Spotify and Facebook, a "social" model of music discovery became possible: the listening habits of one's friends could be distilled and transformed into music recommendations. This strategy has the advantage of requiring relatively little engineering

//www.wired.com/1994/06/negroponte-5/.

33. Wikstrom, *The Music Industry: Digtal Media and Society Series*, 7.

(and virtually no DSP), and it is predicated on the intuitively reasonable assumption that people share musical tastes with their social groups. There are a number of ways in which this strategy is less useful, though: first, it will never be a reliable way to expose users to music that is not already popular. Second, like all "context based" recommendation systems, it bears no formal relationship to musical content itself. Third, it still demands the active engagement of the user, the "lean-in" attitude Spotify had traditionally envisioned for its customers.

Automated recommendations could potentially address these shortcomings. Facing these issues, as well as competition from American Internet radio stations like Pandora, Spotify in 2012 began to develop its automated recommendation engine more aggressively. It began to foreground its recommendation services, adjust its marketing strategy, and, above all, it acquired prominent companies in the music intelligence and recommendation space.

Probably the most important such acquisition was The Echo Nest, which Spotify bought in 2014 for $100 million.[34] Founded in 2005 by two graduates of the MIT Media Lab (Tristan Jehan and Brian Whitman), the company had quickly grown into one of the biggest players in the music recommendation space. By 2014, its API powered the music recommendation services of major companies like MTV, Rdio, and Spotify (before the latter bought it). The technology employed by The Echo Nest is described in the academic writing of its founders (especially Whitman's dissertation), and below I will be using those texts to make some deductions about Spotify's current software.

But is it at all reasonable to assume that Spotify today is actually using the technology it acquired in 2014? It is widely acknowledged, after all, that Silicon Valley companies regularly acquire technology without ever putting any of it to use. Moreover, 2005 was a long time ago and the technology Whitman proposed in his dissertation may well be out of date today.

There is, however, good reason to believe that Spotify does in fact use Echo Nest technology today – or at least that with respect to its attitude toward musical meaning, Spotify in

34. Ingrid Lunded, "Spotify Acquired Music Tech Company The Echo Nest In A $100M Deal," 2014, https://techcrunch.com/2014/03/07/spotify-echo-nest-100m/.

2019 shares crucial features with what Whitman developed in 2005. This can be seen by reading three documents closely: (1) Brian Whitman's 2005 dissertation at MIT, (2) a blog post he made detailing the Echo Nest's service in 2012, and (3) the current official documentation of Spotify's API. The similarities among these three documents, which together trace a timeline as long as Spotify's own, make a compelling case that Spotify's contemporary recommendation engine shares at least some features with the software originally designed by Brian Whitman in 2005. This is important, of course, because the dissertation is in the public domain and can be read in detail. Bearing in mind the important qualifications raised by Nick Seaver,[35] and being careful about the scope of our argumentation, we can ground certain claims about Spotify and automated recommendation in a close reading of the dissertation.

In 2012 (two years before the Spotify acquisition), Brian Whitman made a blog post (Whitman 2012) outlining the Echo Nest's general approach to music information, and his own opinions on the industry as a whole. This post explicitly links the technology of the Echo Nest to the research activities of himself and Tristan Jehan at the MIT Media Lab, and most of the features he describes in it also appear in his doctoral dissertation. For example, in the blog post, Whitman expresses his deeply held conviction that musical similarity derives from "cultural" meaning, not simply the audio signal:

> We've shown over the years that people's expectation of "similar" – either in a playlist or a list of artists or songs – trends heavily towards the cultural side, something that no computer can get at simply by analyzing a signal.[36]

This idea – that musical meaning resides outside of the audio signal – is the central conceptual frame for Whitman's doctoral dissertation from 2005. There, Whitman positions his software unambiguously against an "absolutist" theory of musical meaning deriving "from the signal alone." Instead, music's meaning is constantly characterized as "cultural" and "relational." It is not an overstatement, in fact, to say that this is the main idea of the dissertation. When

35. Seaver, "Knowing Algorithms."
36. Whitman, "How Music Recommendation Works – And Doesn't Work."

Whitman promises to "learn" the "meaning" of music, what he is promising above all is to capture, and render legible to machines, the difficult and unruly "cultural" information that relates to the audio signal, and then to combine the two information streams into a single classification system into which any music can then be fed. The dissertation and the post are seven years apart, but they share a single animating idea: that musical meaning is not in the signal alone. There is, therefore, a clear conceptual link between the technology behind the Echo Nest in the year 2005 and the thinking of Whitman around the time when Spotify acquired it.

In this same post, Whitman also refers to the Echo Nest's "Audio Analysis Engine," and even provides a link to Echo Nest official documentation of this product, prepared by co-founder Tristan Jehan. This document explains how the Echo Nest's machine listening works. How, that is, their system deals with the audio signal itself (as distinct from the extra-signal "cultural metadata" so central to Whitman's intervention).

The Audio Analysis engine detailed in 2012 bears unmistakable similarities to the one Spotify makes available today. The 2012 document, for example, takes in an audio signal and rates it in various ways. It can evaluate it in conventional musical ways, according to its *key, mode*, and *tempo.* These are standard music information retrieval tasks. The 2012 document also contains more idiosyncratic measures, however, such as the abstract musical categories of *valence, danceability* and *speechiness.*

Crucially, all these same categories are available today in Spotify's "Get Audio Features" API endpoint.[37] Exactly as in the Echo Nest circa 2012, Spotify today evaluates tracks for their *key, mode, tempo*, as well as their *valence, speechiness* and *danceability*. Moreover, in most cases the language of the the contemporary API documentation echoes verbatim the language of Tristan Jehan and Whitman in 2012. Here is Whitman characterizing The Echo Nest's machine listening tool in 2012:

> We emit song attributes such as danceability, energy, key, liveness, and speechiness,

37. Accessed 04-01-2019 at https://developer.spotify.com/documentation/web-api/reference/tracks/get-audio-features/

which aim to represent the aboutness of the song in single floating point scalars.[38]

Each of these idiosyncratic metrics (danceability, energy, etc) is also outlined in the contemporary Spotify API documentation, with each one still represented as a single floating point scalar. For more commonalities, we can look at the way these fields are defined. Here, for example, is Jehan defining *mode* in the 2012 documentation:

> Mode indicates the modality (major or minor) of a track, the type of scale from which its melodic content is derived.[39]

And here is Spotify defining *mode* in the contemporary API documentation:

> Mode indicates the modality (major or minor) of a track, the type of scale from which its melodic content is derived. Major is represented by 1 and minor is 0.[40]

Similarly, in 2012, Jehan defines the *key* output of the Echo Nest's audio analysis tool as

> The estimated overall key of a track. The key identifies the tonic triad, the chord, major or minor, which represents the final point of rest of a piece.[41]

Which has been somewhat refined in Spotify's 2019 documentation:

> The estimated overall key of the track. Integers map to pitches using standard Pitch Class notation. E.g. 0 = C, 1 = C#/Db, 2 = D, and so on. If no key was detected, the value is -1.

The rest of the fields exhibit the same parallelism. Clearly, whoever is generating today's Spotify API documentation is working with the same raw materials as Jehan and Whitman were in 2012 – materials which are, in turn, unambiguously connected to the 2005 dissertation. The grounding idea of Whitman's dissertation, moreover – the one that represents its latent philosophical content and is the true object of this inquiry – is a prominent theme in his 2012 blog post.

38. Whitman, "How Music Recommendation Works – And Doesn't Work."

39. Tristan Jehan, "Analyzer Documentation," 2014, accessed January 4, 2019, http://docs.echonest.com.s3-website-us-east-1.amazonaws.com/_static/AnalyzeDocumentation.pdf.

40. See "Get Audio Features" endpoint in the Spotify API, https://developer.spotify.com/documentation/web-api/reference/tracks/get-audio-features/

41. Jehan, "Analyzer Documentation."

Reasoning from these commonalities, I take it that Spotify in 2019 is still using at least some key features elaborated in 2005 by Whitman and that it is therefore likely that the "theory of musical meaning" elaborated in the one is roughly operational in the other. There is undeniably some license in this inference, and some readers may want to reject all or part of this assumption. I hope that even the most skeptical reader, however, will nevertheless find the following discussion worthwhile.

3.4 What does music mean to Spotify?

The theory of musical meaning I ascribe to Spotify will be principally derived from its underlying technology, which I examine mainly in the guise of Whitman (2005). Before doing that, though, it is worth taking a moment to look at Spotify's graphical user interface (GUI) and examining the notion of musical meaning implied there. Even a cursory examination of its front-end reveals some key assumptions Spotify makes about how music is meaningful to its users.

3.4.1 Spotify GUI

Music is grouped for Spotify users not primarily by genre or style (and certainly not by album, a concept that has grown increasingly outdated in the post-Napster world) but rather by mood, activity, and what might be termed "musical keywords." Under the "browse" section, the user is confronted with various buttons that will lead to musical options. These are termed "hubs" in the Spotify lexicon, and they are represented by clickable square thumbnails. Hubs are distinct from the more traditional "genre" marker in that they can refer to various different kinds of musical reference. There are hubs pointing to traditional genres ("country" and "folk"), but also activities ("party" and "chill") as well as politically-oriented themes ("black history now"), sponsored content ("Spotify singles"), and, curiously, a single hub dedicated to Ellen

DeGeneres (“Ellen”). Hubs appear as clickable thumbnail images with crude artwork evoking a given hub’s theme (a raised first, for example, for “black history now,” a dove for “christian,” and a representation of African tribal garb for the “Afro” hub). These thumbnails rework the traditional idea of an “album cover,” turning it into a generic index for a given mood, more or less in the way emojis caricature human affective states. Examples of the clickable thumbnails “Ellen” and “Afro” are shown in figure 3.1.[42]

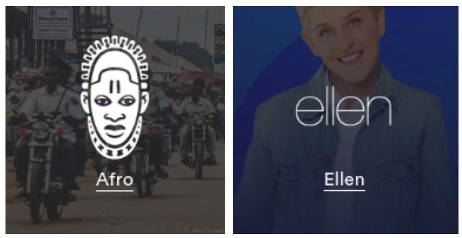

Figure 3.1: Spotify “Hubs” for “Afro” and “Ellen”

Although the selection of “Ellen” as a hub alongside “Afro” may seem inscrutable, the heterogeneity of the Hub themes illustrates an important feature of the kind of musical meaning the Spotify GUI seems to assume: in the curatorial phase of music streaming, music’s meaning resides in its relationship to other activities or feelings. The traditional idea of *genre* is that there are certain musical properties shared among all members. The reference for a genre is, as Whitman would put it, “the signal itself.” This is not true of “hubs,” which are instead significant for their extra-musical references (as in the hubs “study,” “sleep,” “Ellen,” etc). Considered as a “hub,” even the word “reggae” (apparently a *genre* word) works differently from “reggae” as a *genre.* Put “reggae” next to “Ellen” and you change the status of the word subtly. A “reggae” *genre* refers to the sound of the music, whereas a “reggae” *hub* is a broadly construed, fungible cultural index. Like “Ellen,” it doesn’t refer to a type of music so much as a musical-cultural vector.

In this way the Spotify GUI is perfectly in line with Whitman’s dissertation, which insists

42. Screenshots taken from Spotify desktop app on May 20, 2019

again and again that true musical meaning is informed by "culture," that it is not in the audio signal alone. Of course, few people today would countenance the outmoded idea that real listening can or should take place in a mode of idealized contemplation, divorced entirely from extra-musical factors. Nevertheless, it is important to note that Spotify seems to have landed at the other extreme – all music becomes "soundtrack." Listening in Spotify is not about attending to music but using it to evoke a desired feeling or achieve some other secondary effect. As Ellen herself puts it on a promotional web page for the "Ellen" hub,

> I'm so excited to partner with Spotify on my very own music hub because music truly makes everything better. Well, music and salt.[43]

Like salt, music in the Spotify universe makes things better; presumably it also shares with salt the property of not being much good on its own. Instead, music in the Spotify universe is just one ingredient among others, one more good to consume in the effort to lead as full and happy a life as possible – something the reggae *hub* will help you do in a way that the reggae *genre* can't.

As theories of musical meaning go, this one is not crazy. The opposite extreme, at any rate, where musical meaning is inherent in the abstract formal properties of a composition, is no less objectionable. It is interesting to note, however, that this is a posture Spotify has arrived at mainly because it found itself having to help people to discover new music; the idea of music as functional, or "relational," as Whitman sometimes puts it, is in part a byproduct of the need to make music discovery systematic and programmable, a need which has its origin in the market. It is a music-philosophical statement arrived at via the effort to accommodate a capricious market. Spotify's traditional "lean-in" posture, in which users are trusted to know what they want to hear and relied upon to seek it actively, does not rely upon any such position. If users are finding their own music, Spotify itself is able to remain agnostic on the question of music's purpose. Users who know what they like don't need "hubs." It is only when market trends demand a

43. Spotify 2019 promotional materials, available at https://newsroom.spotify.com/2018-12-10/exploring-spotifys-creative-content-partnership-with-ellen-degeneres/, accessed 3-27-2019

recommendation engine, in the years around 2008, that Spotify has had to make choices about these questions. Their answers are visible in part in the user interface.

3.4.2 Reading Whitman, "Learning the Meaning of Music" (2005)

As Nick Seaver points out, knowing how an algorithm works is never a simple matter. Drawing specifically on his fieldwork in the music recommendation space, Seaver notes that, according to one interlocutor,

> There is not one playlisting algorithm, but five, and depending on how a user interacts with the system, her radio station is assigned to one of the five master algorithms, each of which uses a different logic to select music.[44]

When it comes to algorithms "in the wild," Seaver holds, it is never the case they are simply a black box waiting to be opened by the right investigator. The whole idea of the algorithmic black box, in fact, is a red herring, a tempting fiction that tends to nourish the worst fears about algorithmic mediation. If there is a single secret code at work rather than a constantly changing and unspecifiable one, it is all too easy to assume the worst about it. The reality, though, is that recommendation algorithms are far too intimately personalized, too frequently updated, and too complex for those fears to either right or wrong in any straightforward way. This is not to say that suspicions about them are never justified, nor that the logic of a system can never be divined, but simply to remember that we must bear in mind always that our conclusions are almost always based on incomplete and possibly outdated information.

What this means in practice when it comes to Spotify is that some types of claim are going to be more reasonable than others. We may never know how a given playlist was curated, nor, say, what are the precise proportions of "content-based" and "context-based" considerations at work in Spotify's recommendations. But we can make empirical observations about logged recommendations, and we can think critically about the fact that every recommendation does

44. Seaver, "Knowing Algorithms," 5.

combine the two types of signal in some way. With these considerations in mind, one good way to approach this question is to do a close reading of Whitman's dissertation. The technology outlined therein is distinguished above all by its ability to join two disparate subsets of music information retrieval: on the one hand, sophisticated "content-based" machine listening methods (methods that draw on the techniques alluded to above), and, on the other, "context-based" information culled from web crawling and other kinds of natural language processing. These two types of signal are combined into a machine learning model that, in turn, can be used to classify as-yet-unheard musical material.

Crucially, this is an approach that Whitman specifically positions against the kinds of music information retrieval techniques, apparently dominant in 2005, that derive musical meaning from the audio signal alone. As Whitman puts it, systems that rely on the signal alone are "doomed," since they miss the essential element of human reaction. As noted above, the idea that musical meaning isn't "in the signal" is Whitman's most important theoretical commitment.

One interesting thing about Whitman's dissertation is the fact that, although it would eventually power a major corporation (Spotify) that many artists see as an exploitative shill for the major labels,[45] it is really an extended plea for a more nuanced treatment of musical meaning. At its heart it is the kind of argument you might expect to hear from a musician: that musical meaning is hugely complex, variable, unpredictable and contingent.[46] Whitman's language about music is, at times, quite personal:

> Our driving force behind this work is that fundamentally, the current approaches anger us: they don't seem right. Music is a personal force that resists 'processing,' 'packing' or 'understanding.'[47]

It is striking that Whitman would refer to his anger here. "Current approaches" in the

45. See, e.g. Daniel Sanchez, "What Streaming Music Services Pay (Updated for 2018)," 2018, accessed February 5, 2019, https://www.digitalmusicnews.com/2018/01/16/streaming-music-services-pay-2018/, who ranks Spotify near the bottom as one of the lowest-paying streaming services for artists, at $0.00397 per stream

46. This is possibly because Whitman himself has performed as an avant-garde noise musician, under the stage name Blitter. According to Whitman's LinkedIn profile, Blitter's career ended in 2002. Careful not to confuse Whitman's stage name with the social network of the same name.

47. Whitman, "Learning the Meaning of Music," 91.

above are those that take a signal-only approach (or, even worse, a context-only approach) to musical meaning. Either one, on its own, inevitably does violence to the true complexity of musical meaning; anger at that violence is something that many musicians can probably relate to. So far, Whitman's argument is one that probably few musicians would quarrel with. On the contrary, it sounds like the kinds of complaint musicians frequently make of recommendation services (including Spotify): they just don't get it.

But Whitman takes this complaint in a strange direction. Musical meaning may evade digital signal processing, but Whitman argues that, simply by mixing it with "context," and doing so at an enormous scale, one can actually come close to the true essence of musical meaning, the same thing that traditional system had so lamentably failed to capture. In a basic sense, if we believe that The Echo Nest is a good system, we must agree with Whitman that this strategy has in some non-trivial way managed to do what his title has promised: to "learn" the meaning of music. And to do so would mean having a kind of theory of musical meaning, which I term a "quasi-theory."

In summary, there are four main points about Whitman's system to bear in mind, which together outline this "quasi-theory" of musical meaning:

1. That its basic elements seem to be operational in 2019 Spotify.

2. That it works by learning a statistical relationship between "cultural metadata" and the audio signal, yielding a model which can then be used to classify as-yet-unheard music.

3. That the above relationship is defined as the "meaning of music."

4. That this philosophy of "relationality" is both remarkably well suited to the market needs facing Spotify the time of the acquisition, and that it is clearly evidenced in the GUI as well. It is also a coherent musical extension of Hilary Putnam, as Whitman points out in the dissertation.

3.4.3 *Newton v. Diamond* and the question of musical meaning

With that rough sketch of Spotify's theory of musical meaning in mind, we can look more closely at how the question of meaning is treated in the 2005 dissertation. It begins by going over the well known legal dispute between James M. Newton and the Beastie Boys over their usage of a sample from his 1978 release, *Choir.* The Beastie Boys legally licensed a few seconds of solo flute playing and looped it for their 1992 song, "Pass the Mic." The legality of the audio sample is not in dispute. Nevertheless, Newton sued for copyright infringement, arguing that the sample in question infringes upon the musical composition itself in a way not provided for by the negotiated license. What this accomplishes for Whitman is to establish the central frame for his entire thesis. That is to say, for Whitman this case proves that the true significance of music resides outside the audio signal itself:

> When the Beastie Boys sampled his recording they took far more than the signal, even if the signal was all they took. Where can we find the rest?[48]

Having used this case to establish his thesis's main intervention, Whitman leaves the legal questions alone; it is enough for him that the case appears to demonstrate the non-signal nature of musical meaning. However, it is worth paying more attention to the actual facts of the case in question. One crucial thing Whitman ignores is that the court immediately sided with the Beastie Boys. While James Newton would presumably agree with Whitman's central premise (that the Beastie Boys took more than the signal, even if it was all they took), the law does not. Strictly speaking, the only thing the case demonstrates is that James Newton *alleged* that they took more than the signal, a feeling he shares with his fellow musician Brian Whitman. Whomever we side with in the legal matter, the case does not really argue one way or another on the question of where musical meaning lives (which is Whitman's real question). The central frame for Whitman's "meaning," in other words, is almost off-topic.

48. Whitman, "Learning the Meaning of Music," 17.

Moreover, this case raises the issue of the "meaning" of music in a relatively straightforward way, the same way in which almost any intellectual property dispute in music would: it points to the fact that reasonable people can sometimes disagree on what should constitute copyrightable musical property. As for the question of whether musical meaning can be convincingly derived from amalgamated reviews, Google searches, and machine learning, or whether it should be derived exclusively from the audio signal – the question to which Whitman's thesis actually addresses itself – the Newton v. Diamond case bears no special relationship to it.

It is interesting to note that the case *does* hinge on a question of musical meaning, but it is a different one from Whitman's question. As Whitman acknowledges, the legality of the sample is not in question; the Beastie Boys obtained rights to use it from ECM for $1000. But Newton also copyrighted the "Choir" composition, and it is this holding upon which he argues infringement has occurred. The judge ruled on the narrow question of whether the legal instrument of a "composition" had been infringed upon by a sample deployed in a particular musical context. At issue, therefore, is the relationship between a sound recording and a composition (rather than, say, a listener/customer and a piece of music). More specifically, at issue is whether or not six seconds of sampled flute performance can constitute a vital part of the musical composition "Choir." The court upheld the verdict that, not only does the sample not constitute a vital part of the "Choir" composition, but that even if it did, the Beastie Boys usage of it is "de minimis," that is, too insignificant to be legally actionable. In her opinion, Chief Judge Mary Schroeder writes that "the dispositive question is whether the similarity goes to trivial or substantial elements."

In other words, the dispositive question in the legal case is *not* the one Whitman says it is. Whether the meaning can be derived from the musical stimulus is a totally different problem from whether or not a small sample can infringe meaningfully upon the legal instrument of the "composition." The latter is what the court case is about; the former is what Whitman's dissertation is about.

The two issues are not particularly related to each other. The legal case has nothing to do with the meaning of music in the broad, contextual way that Whitman will eventually construe it, that is, the sense in which music can be meaningful to a potential customer base. Much less does it relate to the question of how or whether that meaning can be leveraged into an effective recommendation engine. The legal case is much narrower than that, and all the argumentation connected to it remains firmly in the domain of musical form, explicitly excluding the "cultural metadata" so central to Whitman's work. The frame is an interesting entry to Whitman's real work, but it does little to elucidate the nature of the musical "meaning" we are going to be "learning."

3.4.4 Whitman and Leonard B. Meyer

Although the Beastie Boys case centers on a different issue from his research topic, it is rhetorically effective for Whitman. It is an alluring way to introduce the concept of musical meaning and effectively sets the stage for his project. But it is only an introductory framing device, and Whitman quickly moves on from it, proceeding to the explanation of his automated recommendation engine. For Whitman, the central problem most recommendation services face is that they tend to ignore human reactions to music; his contribution is to join signal processing techniques with language processing techniques to form a more robust picture of musical "meaning" that can be used to make more intelligent recommendations.

More specifically, his system combines context-based (amalgamated human reactions to music) and content-based information (signal-derived) to "learn" a model of musical "meaning" that can, in turn, be used to evaluate as-yet unheard audio signals. In sophisticated and often musically nuanced ways, ground truth data denoting the relationship of audio signal to semantic content is used to train classifiers that can determine membership of a given audio frame in a given semantic category.

At the heart of Whitman's system, then, are machines that listen to music and, in ways informed by actual human reactions to music, determine its membership in categories that will be useful for making recommendations. If we have done this, we have ipso facto "learned" the "meaning" of music. Note that Whitman is quite clear on this point, although it is sometimes possible to discern some trepidation behind his shudder quotes:

> A model of the contextual information given a signal allows us to accurately 'understand' music (extract semantic features of link to the outside world) that hasn't even been heard yet. So what we call meaning throughout this thesis is defined as *the relationship between a signal and its interpretation.* In our work we create predicted 'machines' that analyze audio signals and extract projected community and personal reactions: these are 'meaning classifiers.' . . . What we attempt to do here is computationally understand this extra-signal information and link it to the signal in such a way that it can be predicted for future audio.[49]

As noted above, Whitman positions himself against the dominant intellectual trends in music information retrieval. His will be the first piece of research in the MIR space to really capture "meaning" in this way; other systems just get it wrong. Musical meaning is something he cares deeply about, and his faith in computational understanding as a path to it appears to be sincere. The question of musical meaning is, of course, also dealt with in the disciplines of musicology and aesthetic philosophy, and Whitman situates his thesis in this intellectual tradition as well. Throughout the entire thesis, however, Whitman cites but one musicological source: Leonard Meyer's influential 1956 *Emotion and Meaning in Music.*[50]

While this text does, in a manner of speaking, approach the same subject as Whitman, its actual role in the dissertation is simply to serve as a humanistic counterexample to his own work. Meyer represents what Whitman terms the "absolutist view" of musical meaning, and as such stands in for the entire discipline of musicology itself:

> At the outset we should make it clear that our definition of meaning above is mostly *referential*, that is, it exists as the connection between two representations. This contrasts with the purely *absolutist* view discussed by Meyer, in which the meaning is encompassed purely within the composition or signal. Our approach considers both with an emphasis on referential types of meaning. Many musicologists study the absolutist view of musical meaning simply because there is no formal mechanism

49. Whitman, "Learning the Meaning of Music," 19.
50. Leonard B. Meyer, *Emotion and Meaning In Music* (University of Chicago Press, 1956).

> of analyzing the contextual information. What this thesis presents are ways of computationally representing both signal-derived and contextual music information and then ways of learning a model to link the two.[51]

Whitman's system combines digital signal processing techniques (content-based) with natural language processing techniques (context-based) to produce "meaning classifiers" – algorithms, trained on those two data sources, that can predict more "extra-signal information" for new, as-yet-unheard audio signals. It is a system for producing descriptions of music that incorporate both audio processing and large amounts of empirical, human-generated musical description.

Throughout this thesis, this system is associated the words "meaning" and "understanding." Suppose that the system Whitman distills, a system that predicts "extra-signal information" about musical signals, is a good one. Whitman opposes it to Meyer, but how much distance does he really gain? In what follows I argue that the answer is not much – that is, that in spite of explicitly positioning himself against "absolutism" as encountered in his reading of Meyer, Whitman's approach actually aligns with Meyer's in most of the relevant ways.

Leonard Meyer in fact serves Whiman in a similar way to the legal case discussed above. Which is to say that it is a framing conceit used to clarify his central intervention, but which upon closer inspection does not really do what he intends it to do. For Whitman, Meyer exemplifies an approach to the question of musical meaning that attempts to derive it from the "signal" (from audio signal or representations in score, which, for Whitman, seem to be philosophically equivalent). "Many musicologists," Whitman tells us, take Meyer's approach, and they do so because "there is no formal mechanism of analyzing the contextual information." In other words, musicologists do not incorporate empirical human reactions into their theories of musical meaning because they lack any rigorous method for aggregating and processing them at scale. Whitman, of course, provides such a mechanism, and making this distinction is the beginning and the end of his engagement with Meyer and with the rest of the intellectual tradition for which he stands in.

51. Whitman, "Learning the Meaning of Music," 19.

Whitman's system, however, in spite of its engagement with extra-signal materials ("cultural metadata") preserves the same basic contour as Meyer's. Both address themselves to a scenario in which a signal is audited as the sole stimulus in a musical event. Meyer, availing himself of then-popular trends in psychology, seeks to understand how that stimulus acts on human beings; that is his notion of what an inquiry into musical meaning looks like. Meyer characterizes music as a system of delayed gratification; music sets us up to expect certain things and manipulates our innate desire to see those expectations fulfilled, in ways that stimulate complex affective responses. The famous comparison from Meyer is that of the cigarette smoker whose emotions are piqued when he, craving a smoke, reaches into his pocket to find that he's out of cigarettes. Music, according to Meyer, triggers a similar affective response via a similar physiological mechanism.[52]

The inevitable fact of human listening is that a signal acts upon a listener; Meyer regards the discussion of musical "meaning" to be about how that strange alchemy works. Whitman, as we have seen, is not really concerned with that question. As a software engineer, he simply approaches the issue in a different way (or, rather, approaches a different issue). But in spite of his protestations against "absolutism," his approach does not privilege the audio signal any less. Whitman produces a system that hears music and evaluates it, predicated on sophisticated audio- and language-processing techniques. Meyer sees musical affect as one case of a broader system of human affect, Whitman as a data science problem. Yet both authors see the process of musical meaning making as one in which the signal acts upon the listener (machine or human). Considered in this light, both authors actually agree on the signal as the primary source of musical significance.

Whitman's whole claim is that Meyer (and, it bears repeating, the entire discipline he stands for) fails to take contextual information into his account of musical meaning. But the truth is that Meyer actually does address it. Throughout his work, he is perfectly aware of the role that

52. Meyer, *Emotion and Meaning In Music*, 14.

extra-signal information can play in the excitement of affect and construction of meaning. It is just that he regards this kind of information as outside his purview:

> We have found that the subjective data available, taken by themselves, provide no definite and unequivocal information about the musical stimulus, the affective response, or the relation between them.[53]

Elsewhere, even more directly:

> Listeners and the objective data gathered from the observation of behavior and the study of the physiological responses to musical stimuli did not yield reliable information about the musical stimulus or the affective responses made to it.[54]

By "subjective data" (and, in a terminologically confusing choice, "listeners and the objective data gathered from [them]"), I take Meyer to be referring to listeners' reported affective states – the empirical responses of actual people reporting actual experiences to music. Meyer is referring, in other words, to more or less the thing that Whitman terms "context" and "cultural metadata." For Meyer, this kind of "context" cannot tell us anything about the nature of the affective response itself, which is the essential substrate of musical meaning. Instead, this data is relevant to a conversation about musical meaning only in light of a *general* theory of affect, which is what Meyer hopes to explicate. He calls for:

> A general hypothesis as to the nature of affective experience and the process by which musical stimuli might arouse such experience.[55]

First, Meyer says, you should postulate a general hypothesis about how meaning and affect arise. Then and and only then can Whitman's "cultural metadata" figure meaningfully into a discussion of musical "meaning." Whitman is wrong that Meyer ignores human reaction because it's too difficult to integrate at scale. He just regards it as of secondary importance for a discussion of musical meaning. For Meyer, such a discussion seeks to answer "how does music

53. Meyer, *Emotion and Meaning In Music*, 12.
54. Ibid., 22.
55. Ibid., 12.

work?" – not just "how has music worked for many people, and how best to use that information to synthesize future human reactions?" The latter question, of course, is Whitman's.

In a part of Meyer's book that Whitman seems to have ignored altogether, this allows Meyer to imagine listening situations where context and conditioning do in fact play a large role in the construction of musical meaning. In this regard Meyer leaves much more space for extra-signal information that Whitman gives him credit for:

> Often music arouses affect through the mediation of conscious connotation or unconscious image process. A sight, a sound, or a fragrance evokes half-forgotten thoughts...These imaginings...are the stimuli to which the affective response is really made. In short, music may give rise to images and trains of thought which, because of their relation to the inner life of the particular individual, may eventually culminate in affect.[56]

These internal musings can form an important part of the human affective response, but they do not belong to the "musical stimulus." Instead, they form a new stimulus of their own, "activated" by the primary stimulus of the audio signal but different from it in kind:

> The real stimulus is not the progressive unfolding of the musical structure but the subjective content of the listener's mind. Yet...it seems probable that conscious or unconscious image processes play a role of great importance in the musical affective experience of many listeners.[57]

Secondary effects are part of loving music. Meyer acknowledges quite explicitly their role in musical experience. This is not necessarily an idea you would expect from the "absolutist" perspective of which Whitman makes Meyer an exemplar. Far from being the opposite of Whitman, what Meyer voices here is something very close to the intuition animating the whole of Whitman's project. The two authors share much more than Whitman would lead you to believe.

Whitman has created, essentially, a system for processing audio. It is one that is informed in creative ways by empirical human affective responses, but it is still a system for processing audio – that is, a system that grants the audio signal ultimate primacy. A signal goes in, a

56. Meyer, *Emotion and Meaning In Music*, 256.
57. Ibid., 258.

classifier does its work, and an output of some kind comes out; audio frame X, say, is evaluated as belonging or not belonging to category Y. What is positioned as a novel intervention, locating meaning in the "relation" of the mind to the world, really just recasts it as a kind of "mind-mind problem."[58]

The nature of the outputs the system deals with has certainly changed over the years, but the fundamental architecture of the system (audio in, evaluation out) is most likely the same. And insofar as that fundamental architecture remains in place, Whitman has gained no philosophical distance from Meyer, who also addresses the question of how a signal operates on a person.[59] Whitman is correct that his approach, incorporating real human responses, really is different from MIR techniques that derive from the audio signal alone. The intellectual intervention and technical innovation legitimate (and, to judge from the success of the Echo Nest, practically effective); nevertheless, it would be wrong to locate Meyer and Whitman at opposite ends of the music-philosophical spectrum.

The real difference between the two authors, of course, is that Meyer is trying to understand how people relate to music and Whitman is building a machine that *emulates* how people relate to music. The machine's listening experience is qualitatively different from the human one; it is impossible for a machine to have the experience of Meyer's "subjective content of the listener's mind," to have the music call to mind a long forgotten experience which triggers a cascade of memories and affective states, or to listen in the company of friends. The machine "listens" in silence and isolation, without any subjective experience.[60] In addressing itself to a scenario where there exists no interiority or intersubjectivity or even real vibrations of the air, there is a sense in which Whitman's system is infinitely more "absolutist" than Meyer's.

58. See Cusick, "Feminist Theory, Music Theory, and the Mind/Body Problem" and Amy Marie Cimini, "Music Theory, Feminism, the Body: Mediation's Plural Work," *Contemporary Music Review* 37, nos. 5-6 (2018): 666–683

59. There are other conceivable theories of musical meaning that truly do de-center the signal. Chapter Four of this dissertation surveys musicological theories of musical meaning beyond Meyer to give a sense of the varied texture of humanistic thinking on this subject, much of which genuinely does not privilege the audio signal.

60. Assuming that Whitman does not believe, in "strong AI" fashion, that because his system simulates these affective states, it actually has them.

Although both these authors use the word “meaning,” they are for the most part not on the same topic. Where their topics do overlap, moreover, they basically agree (they’re equally “absolutist”). Whitman is not wrong that Meyer needs musical meaning to depend on the “signal,” or, as Meyer calls it, the “stimulus.” That is indeed the relationship under investigation for Meyer. Where Whitman is wrong is in claiming that this is not true of his own notion of musical meaning. For all his talk of musical meaning, on the mysterious relationship between signal and response Whitman is basically silent – and therefore gains no philosophical distance from Meyer. He simply writes about a different subject, namely how best to synthesize that response for the purposes of a commercial application. The essential, causal relationship between signal and response – the only question Meyer really targets, and a problem for countless other thinkers besides Meyer – is at once implicitly taken for granted and totally ignored in Whitman’s project.

3.5 The Meaning of Meaning

What, then, is the “theory of musical meaning” employed by Spotify? Above I have sketched part of an answer: that music’s meaning is functional rather than intrinsic, and that the mysterious ways in which music causes people to feel things – whatever they are (and Whitman definitely doesn’t try to answer that) – will necessarily appear in a meaningful way *somewhere,* provided we gather enough data. In short, the “theory” of musical meaning is nothing more than an expression of the assumptions grounding the fields of machine learning and pattern recognition.

The fact that Whitman’s system is able use words like “learn” and “meaning” while essentially skirting the kinds of thinking that traditionally attach to them is part of a broader trend. In the rhetoric of machine learning, it is almost as if with enough data, theory itself becomes obsolete.[61] Data, if the quantity and quality are high enough, can seem to supplant

61. Chris Anderson, “The End of Theory: the Data Deluge Makes the Scientific Method Obsolete,” 2008, accessed July 25, 2019, https://www.wired.com/2008/06/pb-theory/.

theory. Predicting supplants understanding and explaining. That, at least, is what is happening here with respect to music. As Zarsky puts it, quoted above, this is the assumption:

> That human conduct is consistent and that with sufficient data human behavior becomes predictable.[62]

Turning back to the musical domain, though, is that a "theory" at all? You might answer "no," and you might be right. But what, then, do we make of Whitman's claim to have "learned the meaning of music?" If we do not have a notion in place of what musical meaning is, what is it exactly that we have learned? And what, then, do we make of Spotify's claim to be worth $10 a month? Are not Whitman's dissertation and Spotify's pitch equally grounded, on some level, on the idea that they're at some level *right* about what music means? And is being basically right about musical meaning not *ipso facto* a kind of theorizing?

Whether we approach recommendation through Spotify's GUI or Whitman's dissertation, it seems clear that *some* kind of theory is at work; there's no other way to "learn the meaning of music." And yet the theories there, such as they are, have no real explanatory power; they're theories of data aggregation and prediction. The recommendation problem, then, resumes the familiar problem from the critique of AI in culture: whether machine intelligence can be evaluated behavioralistically or not. It resumes it, but it doesn't do anything to resolve it. This can be seen as a flaw in its design, or it can be a simple expression of the fact that it's a product, not a piece of knowledge. In other words, there's a parry available to Spotify's apologists here: very well, you might say, Spotify is wrong about meaning. So what? It's not a form of scientific knowledge, but just a collection of engineers trying to solve a problem and earn some money. But, as Pelillo et al (2015) argue, the era of machine learning has changed the way we should think about this traditional distinction:

> The scientist's occupation is seen today more modestly as a kind of problem-solving activity not dissimilar conceptually to that of the engineer, whereas on the other hand

62. Zarsky, "The Trouble with Algorithmic Decisions: An Analytic Road Map to Examine Efficiency and Fairness in Automated and Opaque Decision Making."

> the work of the engineer is thought to produce a form of knowledge which is on a par with that produced by the scientist.[63]

Whitman himself echoes this idea; without giving a full throated endorsement of "strong AI," he does seem to suggest that insights about man and insights about machine don't necessary stand at odds with each other:

> You call it algorithms but it's a lot more than that. We are obviously doing a ton of computer stuff but it's all based on what people are saying and choosing and that stuff. We hate this stupid man versus machine dichotomy.[64]

If the man-vs-machine dichotomy is stupid, it should follow that the programmatically derived "meaning" is not just an engineering expedient, but some kind of true statement about how music works. If Spotify is worth paying for, it should also follow that Whitman's technology – culling meaning from aggregated human activity and linking that to the audio signal – should have really captured musical meaning. It's implicit in saying that you've learned the meaning of something that you have some explanation of how it works, that you've cracked some kind of code. But when you actually look at Spotify's recommendation engine, what you have is, on one hand, an expression of the reducibility of human conduct to statistical predicition (nothing more than an axiom underlying all of machine learning) and, on the other, a theoretically feeble "relationality," which isn't even all that different from what we find in Leonard Meyer (1956).

Whitman sidesteps, in other words, the question that should matter to him most (what does music mean?), even as he postulates a cryptic kind of answer. Compounding matters is the fact that, in the case of Spotify, that cryptic answer is itself never divulged to the consumer in any way. Still, we can say one thing for certain about what that theory is: that if we collect enough data, musical meaning, whatever that may be, will inevitably, somehow, be captured by

63. Marcello Pelillo, Teresa Scantamburlo, and Viola Schiaffonati, "Pattern recognition between science and engineering: A red herring?," Philosophical Aspects of Pattern Recognition, *Pattern Recognition Letters* 64 (2015): 3–10.

64. Emily White, "The Echo Nest CTO Brian Whitman on Spotify Deal, Man Vs. Machine, Why Pandora 'Freaks' Him Out (Q&A)", Billboard interview in 2014, https://www.billboard.com/biz/articles/news/digital-and-mobile/5944950/the-echo-nest-cto-brian-whitman-on-spotify-deal-man-vs, accessed May 20 2019

the system. As for the nature of that meaning, Whitman takes a peculiar approach: he cites a single source (Meyer) as representative of countless humanistic authors who have thought about the issue, gives that source a cursory reading (it's "absolutist"), and declares his own system to be an improvement upon it. To the criticism that the system tramples over the nuance of true musical experience, or to the tradition of aesthetic philosophy, Whitman will always have the ready defense that this doesn't matter since that the real task is software design rather than philosophy.

Ignoring basic questions like this is a kind of privilege, the same one enjoyed by Roger Schank when he disavowed philosophizing about technology decades earlier (see Chapter Two). The prestige and monetary value of the tools under development by Schank and Whitman drown out the simple questions we might want to ask about them: does this really stuff work? And, if so, how? That these questions are hard to hear over the din of excitement surrounding machine learning today does not mean that they shouldn't matter to the software designer; what this chapter argues, more than anything else, is that they do matter.

A close look at Spotify's treatment of the problem of musical meaning shows that the advent of big data approaches does not magically make that problem disappear; that even the one philosophical source Whitman cites is actually aware of it in very much the same terms as Whitman, and that, above all, it remains as obstinate a problem as it has been throughout its long history in aesthetic philosophy. It is as thorny a problem as the financial crisis confronting the music industry in the 21st century, to name another problem Spotify hasn't solved.

. . .

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4 Typology of Musical Meaning in the 20th Century

In the previous chapter, I argue that Spotify's automated recommendation system is predicated on a tacit theory of musical meaning. I also discern its basic contours by reading Whitman's dissertation against the Spotify GUI. Part of that argument was also to take issue with Whitman's treatment of his sole reference for humanistic theories of musical meaning, namely Leonard Meyer (1956).[1] In Whitman's reading of Meyer, the two authors sit at opposite ends of a crude ideological polarity; "absolutist" and "relational," as Whitman terms them. I show that this is a misreading of Meyer, a misreading that points to the inherent vagaries of Whitman's notion of musical meaning, taken on its own terms.

Not only does Whitman misread Meyer, but the whole idea of using Meyer as a stand in for all of musicological thinking on the subject does that discipline a huge disservice; Whitman does not, in fact, really situate his technologically derived "meaning" into meaningful conversation with humanistic discourses on this subject. In order to do that, one would first have to survey the history of humanistic thinking about what constitutes "musical meaning." In this chapter, I do just that, creating a typology of theories of musical meaning against which to examine what we have already looked at in Whitman's dissertation – which, again, is assumed to operate, in

1. For a more recent psychological theory of musical emotion that accounts for "aesthetic judgement" as an experimentally verifiable category, see Patrik N Juslin, "From everyday emotions to aesthetic emotions: Towards a unified theory of musical emotions," *Physics of life reviews* 10, no. 3 (2013): 235–266

at least the broad outlines, in Spotify today. This typology is of course not exhaustive, and it is necessarily reductive. Nevertheless, it provides a sense of the diverse texture of musicological thinking on this subject and is a valuable counterpoint to the one-dimensional picture one gets from Whitman's dissertation.

One of Whitman's humanistic sources is the philosopher Hilary Putnam. Whitman cites a famous aphorism associated with Putnam: "meaning just ain't in the head." This aphorism refers to the "Twin Earth" thought experiment and the associated theory of semantic "externalism." Imagine two worlds, each with something called "water," but which differ subtly in chemical composition. A person from one world will say "water" and mean H20, while his twin on Twin Earth will say "water" and mean XYZ. Their internal mental representations could be identical, while clearly referring to two different things; thus, argues Putnam, meaning isn't in the head. The idea of semantic externalism is that "meaning" cannot refer to purely internal mental states. Instead, mental content depends partially, but necessarily, upon external influences. "Meaning," then, is not just a matter of internal states or ideas. You can't know the meaning of any given word, for example, simply by describing the neural activity of the person who happens to be using it. As Putnam writes, "the psychological state of the speaker does not determine the extension (or the "meaning," speaking preanalytically) of the word."[2]

Whitman extends this idea into the musical domain in a way that may at first seem counterintuitive: just as semantic meaning "ain't in the head," so musical meaning is not in the audio signal. In a way, it's an odd move, because the "signal" already isn't in the head; there is a strange intellectual non-parallelism in aligning "head" and "signal." But it makes a little more sense if you think of Whitman's broader aims: where Putnam seeks to locate meaning in something like a person's interactions with the world, so Whitman wants musical meaning to be about humans' reported reactions to musical information (signal). Just as a person without expertise in identifying trees can obtain the same internal state when using the word "Elm" and

2. Putnam, "The Meaning of 'Meaning'," 143.

"Beech" (Putnam's example), so a music listener (and, modeling that, Whitman's computerized "meaning recognizer") constantly updates its model of a given music term, producing a kind of meaning that inherits the contingency and externalism of its linguistic cousin. Thus the "meaning" of that term is construed in a manner intended to be analogous to Putnam's: as Whitman writes, "this places the meaning of music far outside the head."[3]

This is the essence of what Whitman means when he characterizes his notion of musical meaning as "relational." Just as linguistic meaning does not reside in the mind of the language user, but rather depends on her interactions with the world (it depends on a "linguistic division of labor"[4]), so, for Whitman, the meaning of music resides fundamentally outside of the audio stimulus. The meaning of music is "the connection between the music and other music," and between music and non-musical "cultural metadata."[5]

This puts Whitman in a funny position, philosophically: it requires that web crawls and surveilled internet activity stand in for the world-human interactions imagined by Putnam for his notion of meaning – a translation that Putnam would probably never countenance. The idea that information about how humans react to music *only online* is a robust enough representation of human-music "relationality" upon which to base a theory of musical meaning is a major flaw in Whitman's thinking. The experiment, so to speak, bears thin resemblance to the real-world phenomenon it seeks to explain.[6] We might expect something like this if Whitman were imagining a genuine post-human listening world, where everything takes place online. But he actually is a rather traditional listener in that regard; his indignation at existing systems is explicitly that they miss the essential human elements of musical meaning. He's angry that most MIR research has reduced music to its sonic fingerprint alone. And yet when it comes to reducing human reactions to music and interactions with each other, supposedly so central to true musical meaning, to their

3. Whitman, "Learning the Meaning of Music," 29.
4. Putnam, "The Meaning of 'Meaning'," 144.
5. Whitman, "Learning the Meaning of Music," 21.
6. This is one of the core critiques Chomsky makes of B. F. Skinner, whose experimental approach to language use is hopelessly artificial. See Chomsky, "A Review of B. F. Skinner's *Verbal Behavior*"

mere digital representations, Whitman seems perfectly comfortable.

There are other, more complicated objections. Since Whitman invokes Putnam and the externalist theory of meaning as analogous to his project, it makes sense to consider what the musical analogue would be of a prominent opponent of externalism: Noam Chomsky, whose "internalist" program is often cast in opposition to Putnam. For Chomsky, the whole idea of defining "meaning" in the way Putnam attempts to do ("pre-theoretically") is incoherent and pointless. To attempt to render a "theory of meaning" itself in Putnam's fashion, one that exists apart from its power to explain the nature of the language faculty or to account for anything beyond its own terminological manipulations, is not real science. It is a matter of definitions rather than true reasoning. To ask "what is meaning?" in this way is, for Chomsky, something like asking "how do things work?" Which is to say, while it can be an effective spur to true scientific work, it is not in itself scientific at all. At best, it is a "guide to possible topics of inquiry." At worst, simply incoherent.[7]

Words, for Chomsky, don't have "meanings" in the sense in which the Twin Earth experiment requires them to have. "Meaning," in fact, thusly construed, is an empty concept. Instead, "lexical items provide us with a certain perspective for viewing what we take to be the things in the world; they are like filters or lenses, providing a certain way of looking at things."[8] Words, a term Chomsky seems reluctant to use, probably for the way it continually reifies the commonsense notion of lexical discreteness and significance, don't "mean" anything. They're more like lenses, which don't have "meanings" upon which people depend for communicating with each other. The quest for "shared meanings in a public language" is as pointless as the quest for shared shapes among noses; "establishing shared entities has no more explanatory value than the postulation of shared shapes."[9] Of course meaning isn't in the head, for Chomsky; it isn't anywhere. "Meaning is something that words have in sentences, or maybe even in whole belief

7. D.M. Johnson et al., eds., "Language from an Internalist Perspective," in *The Future of the Cognitive Revolution* (Oxford University Press, 1997), 120.
8. Ibid., 123.
9. Ibid., 126.

systems. We should, so it seems, abandon the quest for a theory of meaning as quixotic."[10]

Let us return to the quest for musical meaning, bearing Chomsky's position in mind. Recall that Whitman allies himself with Putnam's sense of meaning; it's not in the head, and not in the signal. It is relational, something that consists in the relationship between music and other music, or between music and people – in fact, among all those things, processed and made legible to the computer in a complex fashion derived from Whitman's training in natural language processing. Music has meaning that can be expressed in words; how and in what way is a mystery whose solution resides somewhere in those relations. But actually we do not need to know anything about how or why with this kind of machine learning task; a model's interpretability can be pretty low if our faith in the data is strong enough.

Nevertheless the system's notion of meaning is strangely specifiable. For example, the system can not only classify a given audio frame X as belonging or not belonging to musical category Y, but it can "visualize the spectral fingerprint" for a given musical term – that is, it has an opinion on what the musical meaning of "sad" is, in addition to being able to input music and evaluate it as sad or not:[11]

Setting aside the question of whether or not the relations used here (internet intercourse) are a reasonable substitute for what Putnam had in mind, insofar as Whitman assumes the possibility of a pre-theoretical notion of meaning, he does indeed align with Putnam. The "musical meaning" of a word may shift over time, updated by repeated consultations with the field of human reactions. It may, today, operate with a more sophisticated form of machine learning. Nevertheless this is a system that does depend on there being such a thing as a "meaning" for a musical word, one that can be deduced, isolated, and even visualized. The first quadrant in Figure 4.1 really *is* supposed to be the musical meaning of "quiet," a notion that definitely externalises musical meaning.

Let us carry Chomsky's internalist hypothesis into the musical domain. To do so would,

10. Johnson et al., "Language from an Internalist Perspective," 128.
11. Whitman, "Learning the Meaning of Music," 70.

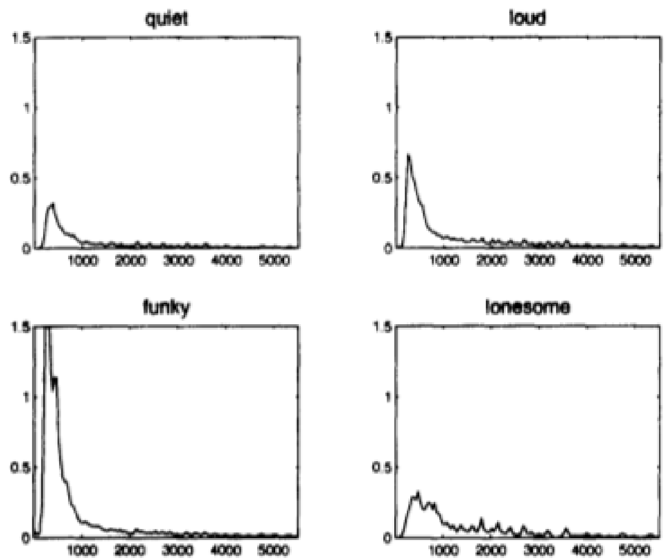

Figure 4.1: Spectral characteristics of musical terms from Whitman (2005)

as we saw above, would be to conclude that the whole question of musical meaning is usually pointless. Musical meaning would be, like linguistic meaning, a matter of definition rather than investigation; you can define it so that it's in the head, or so that it's not. Either way, our sense of "meaning" is stipulative and technical, can do whatever work we want it to do. The whole discussion, in other words, is not really scientific. Discussions of musical meaning in this pre-theoretical way are basically harmless, but have no true explanatory power. Whitman's notion of musical meaning, for example, can tell us nothing about why or how people respond to music – which is in fact exactly what Meyer's theory of musical meaning tried to do, and which constitutes the real difference between him and Whitman (see Chapter Three). Traditional music theory, Schenkerian analysis for example, at least gives us *some* explanation of how music works, some logic that answers real questions we have about music: why do people enjoy listening to music? If there is a natural human instinct for following the fundamental descent from 5 to 1, as Schenker hypothesizes, then we have an answer, a principle with some explanatory power. Whether or not they are true "scientific" statements of objective validity, the logic of tonicization and Schenker's *Urlinie* do create a framework for making what Milton Babbitt, ever the crusader to make music genuinely scientific, has called "testable statements about musical compositions."[12] To say that musical meaning "is" anywhere or "is" anything, on the other hand, has no such explanatory force. Whether you're right or wrong about musical meaning being in the head, it doesn't tell you much about why people enjoy it. There is no statement about music that Whitman's theory validates or disproves.

Complicating matters, Whitman's system deals with both words and music at once, even returning values for the degree of evaluated "musicality" of given terms (some words carry more musical-semantic weight than others).[13] There's a strange circularity in the fact that the system has no choice but to define one semantically nebulous entity (music) in terms of another (language). Of course, that's nothing more than the traditional problem of talking about music ("dancing

12. Milton Babbitt, "The Structure and Function of Musical Theory: I," *College Music Symposium* 5 (1965): 49.
13. Whitman, "Learning the Meaning of Music," 86.

about architecture") but given that the unsolved puzzle of semantic meaning, without music to muddy the waters, was already the thing to which Putnam addressed himself, it is worth noting here; we don't even know what meaning is in language, apart from its utility to define music. What, for example, if music shares with language the property of being something like Chomsky's "lens?" What if it is merely a way of seeing the world whose meaning, if such a locution is ever sensible, exists only singularly and considered against "whole belief systems?" Then then the whole idea of musical meaning in words becomes incoherent or vague to the point of uselessness, much more so than is captured in the "dancing about architecture" quip. Musical meaning would not be, in this sort of Chomskian perspective, a sensible object of philosophical inquiry. Asking about musical meaning would be like asking "how do things work?" An interesting provocation, perhaps, even a guide to future inquiry, but not acceptable itself as a real philosophical question.

4.1 Theories of Musical Meaning

Of course, there does exist a rich tradition of musicological and philosophical thought on this very subject, far beyond the single author whom Whitman cites. Indeed, one of the interesting quirks of Whitmans thesis is that it uses machine learning to rehearse an argument over musical meaning that dates literally to the beginning of Western thought. It is, moreover, probably the most familiar and notoriously ideological polemic in all the history of Western music: the question of whether or not music can (or should) refer beyond itself. It was essentially Whitman's theoretical preoccupation that the "battle of the Romantics was fought over, with Wagner and the Hegelians on one side and Brahms and the musical "absolutists" on the other. In terms almost identical to Whitman's, the issue of musical meaning, especially whether it is inherent or contingent, has been the field upon which the most notorious battles over Western music have always been waged; it is not, in other words, a small omission on the part of Whitman. This question is of such decisive importance for Western music that, for Lawrence Kramer, it is not really about music so much as a necessary condition for its existence: arguments over music's relationship to things other than itself is the "condition of intelligibility for most modern Western music."[14]

It is a question that admits of many different kinds of answer. In this chapter, I survey the history of these answers and attempt to produce a rough typology of them. This typology is, of course, incomplete, but it does give a sense of the breadth and diversity of thinking about musical meaning over the last hundred years. Having established this typology, I revisit the issue of Spotify to situate its theory of meaning (as derived in Chapter Three) on the spectrum this typology describes. The meanings of musical "meaning" have been varied and diverse; in this chapter, I ask, what do we make of Spotify in light of this fact?

4.1.1 Musical meaning is an incoherent concept or a category error

As is often noted, there are theories of musical meaning in Plato and Aristotle. Even some of their ideas are familiar from more recent debates – Plato's infamous anecdotes about certain modes' morally corrosive power, or Aristotle's about music as a kind of *mimesis* are not, after all, so different from various 20th century intellectual and political battles.[15] It was the 19th century, however, that really gave the subject of musical meaning the contours that largely persist today: when we talk of musical meaning these days, we typically argue over whether or not music can refer to something besides itself, more or less the question Whitman addresses himself to.

In this regard Whitman is on very firm musicological footing, raising a question that has dogged the discipline for as long as it has been around. The battle between Hanslick and Wagner, Jenefer Robinson writes, "may stand as exemplary of two very different attitudes toward music that have vied for dominion in the history of Western music from Plato to the present day."[16]

14. Lawrence Kramer, *Musical Meaning: Toward a Critical History* (University of California Press, 2002), 2.
15. The 1990s battles over whether or not to censor gangsta rap, for example, continue to this very day. See the recent supreme court case, Elonis v. United States (2015).
16. Jenefer Robinson, "Introduction: New Ways of Thinking about Musical Meaning," chap. 1, ed. Jenefer Robinson, vol. Music and Meaning (Cornell University Press, 1997), 2.

We can imagine discourse on this subject, then, roughly as spectrum between these two poles: people who think music expresses nothing are on one end, and people who think of it as a kind of "language" are on the other.[17] Often, the analytic philosopher Peter Kivy will occupy the formalist extreme, with the music semiotics of Jean-Jacques Nattiez at the other. This typology proceeds more or less from one end to the other.

For Kivy, the whole idea of musical meaning is fundamentally misguided. It is what he terms a "category error," applying the analytic philosophical slur for a claim that is so off that it cannot even rise to the level of being wrong. Thus the question "is music meaningful?" cannot, for Kivy, even be answered in the negative. This is because Kivy considers meaning in a strict semantic sense, as being propositional in exactly the way that language is: meaning for Kivy is "the meaning that attaches to human artifacts such as language, written and spoken, and artworks."[18] As such it makes no sense to discuss it in connection with music, which, lacking any truly propositional content is for Kivy plainly not such an artifact.

Kivy's major quarrel is with Anirudh Patel, who argues for a "broader" conception of what meaning is: for Patel, "meaning exists when perception of an object/event brings something to mind other than the object/even itself."[19] For Patel, this means that there exist *degrees* of semantic-ness, with music occupying a sort of middle ground between language and, say, the genuinely insignificant hum of a helicopter. Since music can indeed call to mind other things than itself, it is ipso facto meaningful in some way. The problem here, says Kivy, is that this is already a stipulative definition of meaning, one that merely changes the subject from something interesting to something trivial. If you define meaning this way, you avoid everything that made the question of musical meaning worth asking. "It is meaning in the *echt*, semantic, propositional sense that the argument was all about in the first place.".[20] It is, of course, okay to define "meaning" in

17. This polarity, in fact, is the very approach taken in Anirudh Patel's survey of the subject, some of which is repeated in this typology. Anirudh Patel, *Music, Language and the Brain* (Oxford University Press, 2008), 300-351
18. Peter Kivy, *Sounding Off: Eleven Essays in the Philosophy of Music* (Oxford University Press, 2012), 166.
19. Patel, *Music, Language and the Brain*, 304.
20. Kivy, *Sounding Off: Eleven Essays in the Philosophy of Music*, 185.

this stipulative way, but the logical error occurs when the original, semantic, sense of the word is smuggled in under the less precise, temporarily stipulated, one.

For Kivy, music is therefore not meaningful (semantic) but rather formal (syntactic). It has rules that govern it but contains no genuinely referential material of its own. To this category in the typology, then, we might add Lerdahl and Jackendoff's *Generative Theory of Tonal Music*, which offers a theory of music perception that is absolutely silent on questions of affect or semantic reference.[21] Possibly as a consequence of its derivation from Chomsky's theory of Universal Grammar, the GTTM does not address itself to the question of whether or not music can signify beyond itself. It is a theory of how music works in human psychology – a topic that has some potential to explain how something in the world really works (the human musical faculty). The question of "meaning," its possibility, or the difference between it and syntax, and so on – these are questions that simply never enter into the discussion. Instead, the GTTM offers a theory of how the mind processes musical signals, a formal description of a hypothesized innate human music faculty. The theory is analogous to, but by no means necessarily related to, the biological endowment of language. It is a scientific description of the formal rules governing a hypothesized musical organ somewhere in human biology; the question of music's "meaning" or lack thereof is irrelevant, even though the discussion proceeds with language as an obvious analogue.

For obvious reasons, the question of musical meaning often looks to language in this way. But not everyone in music studies has taken to the idea that linguistic models will necessarily be so instructive. In a broad critique of the whole enterprise, Steven Feld derides it as both faddish and overly given to a retrograde kind of musical formalism.[22] Feld argues that a theory's viability is predicated on its explanatory power alone: "we are led to seriously question whether linguistic models, confined to sound structure, constitute adequate explanations of ethnomusicological facts."[23] We look to language for the simple reason that it is there that we are most accustomed to

21. Fred Lerdahl and Ray Jackendoff, "An Overview of Hierarchical Structure in Music," *Music Perception: An Interdisciplinary Journal* 1, no. 2 (1983): 229–252.

22. Steven Feld, "Linguistic Models in Ethnomusicology," *Ethnomusicology* 18, no. 2 (1974): 197–217.

23. Ibid., 207.

find what we term meanings; in empirical language, we routinely consult dictionaries to discover the "meanings" of words. But this has no analogy for the kinds of "ethnomusicological facts" Feld is concerned with.[24] Music and language might not, in other words, be as similar as they appear, and scholarly efforts to use one to illuminate the other are seldom as fruitful as we want them to be. Writing along similar lines, Kofi Agawu notes the tendency of the linguistic model to point back in the direction of formalism (which, by the 21st century, has been largely repudiated in musicology), even for scholars openly hostile to the traditional formalist program. As Agawu puts it, for some scholars writing about music and language, "the music itself remains a treasured concept even when it is being vigorously attacked."[25] Musical meaning, for these authors, might not be a "category error," but the analogy with language nevertheless leads down the wrong path.

4.1.2 Musical meaning resides in emotion (either the expression or the experience of)

Even though he is usually located on the "formalist" end of the spectrum, Leonard Meyer actually commits himself to a version of musical meaning more ambitious than Peter Kivy. Meyer briefly takes up the question of whether music can have propositional meaning in Kivy's narrow, propositional sense – he calls such meaning "designative" and its concomitant theory of meaning "heteronomist." But Meyer brings up this kind of meaning only to dismiss it; whether or not music has some kind of propositional content is not his concern at all. Instead, the musical meaning he will theorize is connected to affect and the "psychological theory of emotions." What is under consideration for Meyer is indeed meaning, but meaning construed as "that which is most vital and essential in emotional experience: the feeling-tone accompanying emotional experience, that is, the affect."[26] A theory of emotion and meaning in music (the two terms in his title), moreover,

24. Some musical cultures studied by 20th century ethnomusicologists, of course, had the language analogy as an explicit element in their theories of music. See e.g. John Miller Chernoff, *African Rhythm and African Sensibility: Hauptwerk*, Originally published 1979 (University of Chicago Press, 1986)

25. Kofi Agawu, *Music as Discourse: Semiotic Adventures in Romantic Music* (Oxford University Press, 2009), 5.

26. Meyer, *Emotion and Meaning In Music*, 12.

would need to address the question of *how* music arouses this affect; thus meaning is, essentially, a theory of arousal. In this particular theory, affect is aroused when expectations are disappointed. The human affective response is akin to a nicotine addict reaching for the notorious missing pack of cigarettes, piqued to find her pocket empty.[27] Although the two are often taken as paradigmatic of the "absolutist" or "formalist" perspective, it is important to note that Meyer actually points to a kind of affective musical "meaning" that Kivy would never refer to by that word.

Another theory of musical meaning as essentially emotional comes from Stephen Davies. Davies agrees with Meyer that music's meaning resides in its relationship to emotion, but instead of seeing it as arousing an undifferentiated *affect* that is subsequently experienced as an actual emotion (as Meyer does), Davies sees music as capable of iconically representing a handful of basic emotions. In exactly the manner in which a cartoon in its general "carriage" is able to communicate an emotional state without either embodying it nor engendering it in viewers, so music can "represent" a limited range of emotions with its sonic "carriage." Where authors like Meyer and Cooke[28] ascribe to music a pseudo-propositional affective content, Davies argues that the emotional content of music is best understood as a sonic icon, a representation of emotion rather than any kind of true communication.[29]

For Davies, music is meaningful as the site of these emotional "appearances." When we speak of a piece of music being, say, "sad," argues Davies, we use the word without any reference to actual feelings. Davies's theory of musical meaning dismisses the commonsense notion of "sad." The music does not itself "feel sad. The composer's experience of sadness is philosophically irrelevant, as is that of the audience. Nor do we necessarily mean that the music causes *us* to feel sad, nor again should we hypothesize an imaginary "persona" (as some philosophers have wanted to do) onto whom we project the experience of sadness. Instead, we understand the music to be putting on the *appearance* of sadness, which it can do only within a

27. Meyer, *Emotion and Meaning In Music*, 14.
28. Deryck Cooke, *The Language of Music* (Oxford University Press, 1959).
29. Stephen Davies, *Themes in the Philosophy of Music* (Oxford University Press, 2003), 123.

proscribed phenomenal range. Music "wears" sadness the way a clown wears a mask or a cartoon wears an outlandish grin, indicating emotion without experiencing or actually eliciting it. It is in the iconographic representations of this finite phenomenal range that music's meaning resides.

4.1.3 Music has semiotic or pseudo-semantic properties

If Kivy represents the extreme of musical non-meaningfulness, the philosopher Jean-Jacques Nattiez usually stands in for the opposite extreme, for the position that music is in fact a kind of semiotic system. Nattiez takes it for granted that music is "meaningful" in this way, and in his influential 1990 book, *Music and Discourse*, he seeks only to explain, diagram and meditate on the discursive system through which this meaning is disseminated. He arrives at a system of musical semiotics in which the musical sign has three faces: "the essence of a musical work is at once its genesis, its organization, and the way it is perceived."[30] In breaking up the notion of musical significance into these three components, Nattiez achieves some kind of compromise with Kivy, who would insist that something either is or is not semantic; a sign, the object of semiotic inquiry, need not satisfy Kivy's narrow criteria in order for some kind of significance to take place. Thus musical semiotics represents a theory of musical significance that can preserve a kind of meaning without needing musical figures to have straightforward propositional semantics.

Efforts to construe music as pseudo-propositional in this way sometimes contain seeds of discomfort. We know that music is, at a minimum, *important*, but why and how it can be so without having any real referential force is a stubborn mystery that puts musicologists, even those inclined toward semiotic analysis, in an uncomfortable position. As Harold Powers writes, "most musicologists...are a little embarrassed by the notion that music is a language whose message is something other than itself."[31] These authors, then, tend to ignore the semantic problem that Kivy harps on (music isn't semantic) and focus on the more digestible semiotic issue: they theorize

30. Jean-Jacques Nattiez, *Music and Discourse: Toward a Semiology of Music* (Princeton University Press, 1990), ix.
31. Harold S. Powers, "Language Models and Musical Analysis," *Ethnomusicology* 24, no. 1 (1980): 2.

instead the means by which this meaning, whatever it may be, can be communicated to the listener, given that the signal contains no propositional content of the familiar variety. As Eero Tarasti writes, "music as a sign provides an ideal case of something meaningful and communicative, and thus of something *semiotical* par excellence."[32] Music is simply assumed to be meaningful; the question is not how is that possible but how does that work. Following the work of Charles Peirce, Roland Barthes and Algirdas Julien Greimas (among others), the theory of musical semiotics is designed to yield paradigms for the analysis of music that can account for longer units of musical analysis ("utterances" rather than "phonemes") and the existence of a broader lattice of semiotic possibility (a "semiosphere") as the necessary background through which musical signifying can happen.

There are also theories in this vein that try to strike a middle ground, giving music true pseudo-semantic qualities. If Kivy focuses on the "what" of musical meaning and Nattiez the "how," these authors try to get at a little of both. The most influential example is probably Leonard Ratner's theory of musical *topoi*. In this theory, via a long historical process of agglomeration, various formulas and conventions in the Western Classical idiom gradually harden into acknowledged musical reference points. These come with particular, idiosyncratic connotations that can be called to mind in a way that is very nearly propositional if not quite semantic: the "brilliant style," for example, is evoked by fast virtuoso passagework, the "learned style" by complex and venerable counterpoint, or the "Turkish sound by certain harmonic and intervallic behaviors (namely, the flat ninth tonicizing the minor). All of these topoi would have been immediately recognizable to initiated contemporary audiences. Some might have even been officially codified and defined like words.[33] These are necessarily limited in scope and number, but they enable a broad alignment with 18th century rhetoric and admit of a certain kind of pseudo-semanticity: "These materials formed part of a musical language understood by composers, performers and

32. Eero Tarasti, *Sigs of Music: A Guide to Musical Semiotics* (Mouton de Gruyter, 2002), 4.

33. These are more or less what Patrik Juslin, in the discipline of music psychology, terms "evaluative conditioning." Juslin, "From everyday emotions to aesthetic emotions: Towards a unified theory of musical emotions"

listeners, and constituted a vast thesaurus of ’words’ and ’phrases’ from which anyone could draw.”[34] As Kofi Agawu notes, this treatment of musical meaning implies a system in which music can refer both to itself and beyond itself, genuinely achieving a middle ground between the polar extremes of the meaning debate. By generating a kind of pseudo-semanticity, topic theory ignores the terms of the familiar argument. It is a theoretical paradigm capable of tremendous analytical perspicacity but one that sometimes seems to shrug its shoulders at the hardest questions of musical semanticity: for example, in Agawus noncommittal “music is like language but not identical to it.”[35]

To this category, where music is pseudo-semantic, we can add as well the various theories of musical communication. This theme has been developed most prominently with reference to jazz, as early as 1956: Marhshall Stearns even uses the word itself in the very definition of jazz: it is a “semi-improvisational American music distinguished by an immediacy of communication.”[36] Ingrid Monson, too, has famously theorized the “communication” metaphor that is common in jazz music, in scholarly circles and among performers. This is, for Monson, specifically *not* the affinity with language made possible by Ratner’s pseudo-linguistic topics; the analogue is conversation rather than rhetoric. Jazz musicians are not drawing on familiar conventions to evoke rhetorical cliches, but doing something really akin to talking to one another.[37] Nevertheless, if jazz musicians are really “saying something, the theory represents a case where music has certain properties that are very nearly, but not quite, propositional.

4.1.4 The meaning of music resides in the creative work of the interpreter

There are also authors who locate the meaning of music in the act of interpretation, a discursive move familiar from the “cultural turn” in musicology. Lawrence Kramer is a good

34. Leonard G. Ratner, “Topical Content in Mozart’s Keyboard Sonatas,” *Early Music* 19, no. 4 (1991): 615.
35. Agawu, *Music as Discourse: Semiotic Adventures in Romantic Music*, 41.
36. Marshall Stearns, *The Story of Jazz* (Oxford University Press, 1956), 282.
37. Ingrid Monson, *Saying Something: Jazz Improvisation and Interaction* (University of Chicago Press, 1996), 82.

example. Kramer situates music in the familiar dialectic of absoluteness (or "formalism") versus contingency. Reasoning from the ubiquity of this very dyad in the history of music criticism, Kramer argues that musical meaning is actually an adjunct to musical interpretation: "meaning arises where interpretation does," when in the hermeneutic act we combines a variety of "semantic sources – tropes, tones, phrases, images, ideas."[38] More systematic philosophers would quarrel with this heterogeneous mixture of signal types, pointing out that some are, strictly speaking, not semantic at all (e.g. tones). Or, at least, the quarrel would be that, if these things (tones) are semantic, the whole problem would be first to demonstrate how that is the case rather than elaborate a theory of musical meaning that takes it for granted that they are.

Setting aside the question of whether we can accept "tones" as "sematic sources," the way in which this theory locates musical meaning primarily in the mind of the interpreting subject is an important contribution in the history of this subject. In de-centering the formal properties of the text under investigation, Kramer follows trends in humanistic thinking of the 1990s away from "master narratives" and autonomous truth, toward subjectivity and relativism. Kramer also exemplifies an important shift in rhetorical emphasis. Where semiotic approaches (e.g. those discussed below) had distributed meaning evenly among signs, semiospheres and interpreters, this kind of critical musicology places a unique importance on the latter; *people* become as important as texts in the moment of interpretation, and the attendant production of meaning. This is why Raymond Monelle points to "post-modern musicology" as a response to the perceived formalism even of musical semiotics, which had sought to overturn the stuffy tradition of musical formalism: "even music semiotics," he writes, "began as an attempt to dismiss semantics."[39] Music semiotics, in other words, while nominally an attempt to move us beyond the paralyzing dogma of the analytic idea of semantic reference, doesn't go far enough. Monelle thus revises Leonard Ratner's topic theory so that topics are construed as music-theoretical (as opposed to music historical) phenomena. Treating musical topics as historical artifacts anchored to the 18th

38. Lawrence Kramer, *Interpreting Music* (Unversity of California Press, 2011), 68.
39. Monelle, *The Sense of Music: Semiotic Essays*, 9.

century renders them philosophically trivial and leaves intact the traditional formalism; music still cannot reach beyond itself, even if it seemed to be able to, at a certain time and in a limited way. For Monelle, the existence of musical topics shows us, then, not a particular case where music functions pseudo-semantically, but rather a particular case of the general way in which music, like language, represents the world only partially: "music, then, is not opposed to language in being unable to represent the real world; on the contrary, *it shares this feature with language.*"[40]

A similar perspective was articulated in a more straightforward way (and more than a decade earlier) in an article by Mary Louise Serafine in the *Journal of Aesthetic Education.* Following the scholarly conventions of the field of education, and the intellectual tradition of Jean Piaget, Serafine arrives at more or less the same conclusion as Kramer: that too great a focus has been placed on a model of music as a "transmission" of meaning from the composer to the listener via a stimulus: the dominant picture in music education, she tells us, is "that of a reacting, not an active, subject."[41] Serafine, instead, advances a picture of musical thought that "goes beyond the mere transmission, perception, and memory of preexisting musical sounds and instead has as its origin the cognitive construction and creation of (perhaps new, hypothetical, or not-yet-existing) musical entities."[42] This is more than a music teacher extolling the virtues of active listening; like Kramer and Monelle (and many others not included in this survey) Serafine sees the interpreting subject as constitutive of every musical encounter, and therefore of musical meaning itself.

4.1.5 The meaning of music resides in its disclosures of social truths

The unseating of "positivist musicology" touched on above is a signature contribution of the "New Musicology" that emerged in the 1980s and 1990s. Perhaps no single idea better unites this group of thinkers than its commitment to a particular parry to the formalist approach:

40. Monelle, *The Sense of Music: Semiotic Essays*, 12.
41. Mary Louise Serafine, "Against Music as Communication: Implications for Education," *Journal of Aesthetic Education* 14, no. 4 (1980): 89.
42. Ibid., 91.

that music is not just music, but it is "cultural," that is, its meaning consists of its actual usage in culture, and cannot be understood without the appropriate cultural context. This turn is not just about valorizing the hermeneutic act, however. The idea that music, even "art music," can only be understood "culturally," that is, as an expression or reflection of the cultural environment which engendered it, is the signal contribution, one that stands distinctly at odds with the picture of music as inherently meaningful that "absolutists" had long endorsed.

Musical meaning is "cultural," in other words, in that it tells us something true about a given culture. When Susan McClary argues for the existence of narrativity in a Schubert Impromptu, then, it is part of a broader critique of the social convention of the *Bildung* in 19th century music. McClary argues that the music contains, somehow in its sheer formal content, the very ideology of Enlightenment reason itself. In the example of the Schubert Impromptu, the ideological commitment is the tacit assumption that "self-development always results in success, that reason inevitably steps in to save the day."[43] Schubert's notorious harmonic transgressions serve to make visible the normative harmonic logic they defy, and to render intelligible the ideological content implicit in it. Schubert is, in other words, a form of discourse and social critique, one whose meaning is cultural while its content is formal – and McClary's interpretation, therefore, is a form of knowledge rather than mere opinion. In a network of signification that represents a kind of semanticity different from the preceding forms, the music makes an argument in the domain of aesthetic form, the scholar decodes it.

In a similar vein, Rose Subotnik offers a reading of Chopin's *Prelude. No. 2* in which the work is shown to embody "something paradigmatic of Romantic culture: the existential and in a sense even the essential priority it gave to the contingent, the concrete, the individual."[44] The prelude, with its distinctive idiosyncratic meander, makes a statement (not necessarily a musical one) about the idea of the individual. Once again, the question of musical meaning is about

43. Susan McClary, "The Impromptu That Trod on a Loaf: Or How Music Tells Stories," *Narrative* 5, no. 1 (1997): 30.

44. Rose Subotnik, "On Grounding Chopin," vol. Music and Society: The Politics of Composition, Performance and Reception (Cambridge University Press, 1987), 129.

music's power to disclose some social truth, in the discourse of pure form. The prelude mounts an argument, one that the critic's act of interpretation decodes for us. Chopins music is not just music, nor just pseudo-semantic sound (although there is no reason it cannot, in this system, use of pseudo-semantic rhetorical *topoi*). Instead, Chopin's music "functions as an archetype of the patterns out of which Western society makes sense of its experience."[45] The piece contains an insight about how 19th century Romantic culture operated and what it valued – namely the "contingent, the concrete, the individual." It is not merely diverting but genuinely meaningful. Its meaning, moreover, has a social, often critical purpose, illuminating something true and important about the world it comes from.

This model of musical meaning can, in some ways, be traced to Theodor Adorno, who again and again makes the case that music is a site for the expression of social truths. Adorno has a convoluted and difficult to construe notion of aesthetic autonomy that can sometimes resemble the formalism against which many New Musicology adherents position themselves, but his aesthetics make a clear case that art is fundamentally connected to its social conditions, and that its highest purpose is to lay plain the contradictions inherent in those conditions. Art performs the indispensible function of disclosing critical truths about society. In the case of Adorno, those truths are usually barbarous; the meaning and normative purpose of music is to give an honest expression to these difficult truths. This, for Adorno, is accomplished best in the dodecaphonic method of Schoenberg, an argument advanced at length in the *Philosophy of Modern Music*. The idea that musical meaning depends upon its connection to the social world is one that the New Musicologists frequently attribute gratefully to Adorno.[46] On the other hand, Adorno's commitment to elite European forms, and his argumentative predilection for totalizing master narratives marks him as part of tradition authors like McClary, Susan Cusick, and Subotnik were working to upend. The reception of Adorno in 20th and 21st century musicology is a complex issue, but what we can say for sure is that the idea that music can disclose social truths –

45. Subotnik, "On Grounding Chopin," 131.
46. See, e.g., Rose Subotnik's introduction to *Developing Variations*

something that Adorno, in turn, inherits largely from Hegel – is an important part of that terrain.

4.1.6 Music's meaning is in the way it serves to create identity or regulate behavior

Others regard the meaning of music as being in the way in which it makes it possible to create or project a personal identity: music's meaning is not in music itself but in its deployments by human subjects as self-expressions. As Nicholas Cook writes, "in today's world, deciding what music to listen to is a significant part of deciding and announcing...who you *are*."[47] This is an idea that has been explored from the domain of experimental psychology as well, most notably in Anthony Kemp's 1996 book, *The Musical Temperament,* where he synthesizes a range of empirical research on musical taste to produce a theory of "musical personalities," including the connections between personality and listening preferences (or, as he puts it, bringing substance to the apparent truism that "different kinds of people like different kinds of music."[48] Whether believe that there exist discrete musical personalities with inherent affection for certain sounds, or we simply notice the ways in which people use music to signal things about themselves, this is a very different position on musical meaning from, say, the Adornian one: musical meaning here is about taste, subjectivity and identity.

An important example of this perspective on musical meaning comes from Simon Frith in his writing about rock and pop. Frith actually accepts the Adornian idea that music can offer a symbolic critique of its parent society's internal "contradictions." In a line worthy of Adorno himself, Frith writes, "Rock star 'politics' are derived from an aesthetic reaction to the social conditions of capitalism."[49] The political dimension of rock music is a latent expression, in artistic form, of its social conditions – very Adornian so far. Frith adds to this traditional materialist conception of musical meaning the element of personal identity: he notes that rock music is not

47. Nicholas Cook, *Music: A Very Short Introduction* (Oxford University Press, 1998), 6.
48. Anthony E. Kemp, *The Musical Temperament* (Oxford University Press, 1996), 121.
49. Simon Frith, *Sound Effects: Youth, Leisure, and the Politics of Rock'n'Roll* (Pantheon Books, 1981), 79.

just an expression of these conditions, but an avenue for resisting them. Through rock music, citizens of a society, particularly citizens of a consumer culture, use music to create individual identities and social formations that countermand the injustice of dominant social hierarchy. So, for example, the musical style of Rock was part of a broader cultural movement to upend the traditional British caste system, to create a new culture ("youth culture") that was "young but not specifically working-class."[50] For Frith, it is this kind of thing (music's relationship to culture, specifically its deployment in identity formation), that constitutes its meaning. This, he tells us, is the proper sociological study of music, a way of unearthing "the *meanings* that are produced and consumed" (italics added).[51]

I noted above that the New Musicology of the 1990s straddles the sometimes uncomfortable double legacy of Adorno: on the one hand, Adorno insists on a vital relationship between music and society, one that is important for musicology's rejection of the traditional positivism. On the other hand, Adorno is committed to grand, totalizing narratives and the primacy of the Western canon – both of which stand at odds with the general scholarly and moral agenda of 1990s intellectual culture. But there is another problem for Adorno's legacy, one that animates the work of the sociologist Tia DeNora: there are no empirical facts in Adorno, and no effort to render his argumentation empirically verifiable. If there exists an isomorphic relation between music and society in some way, there ought to be some way to substantiate that claim. If the mass music industry has ushered in a regression in the character of modern listening, such that music has been drained of its traditional critical power, we ought to be able to observe music actually behaving that way, or listeners actually regressing. We ought to be able to recognize the actual places where music operates as a commodity rather than a stimulus to critical thinking. In spite of how influential he has been for 20th century musicology, DeNora points out, these claims are made with virtually no evidence in Adorno. DeNora's criticism, moreover, is not merely of Adorno himself but of his readers; she points out that, in continuing to ignore the empirical

50. Frith, *Sound Effects: Youth, Leisure, and the Politics of Rock'n'Roll*, 189.
51. Ibid., 11.

existence of the people actually doing all the listening, scholars like McClary actually partake of the same kind of musical formalism against which they are nominally positioned. As DeNora puts it, in the end McClary's arguments are "indistinguishable from simple assertion."[52]

DeNora proposes to revisit many of Adorno's compelling arguments about music and sociology, but, "this time, the music-social structure nexus was specified in a manner amenable to observation."[53] For DeNora, this leads to an "ethnographically oriented, pragmatic theory of musical meaning and affect."[54] Note that, once again, the study of music in society touches nothing less than the subject of meaning itself. It is a theory in which music's meaning is in how it actually functions in everyday life (hence the title); to calm passengers on an airplane before takeoff, to help people workout at the gym, or, one might add, to "make everything better, as Ellen observed in her Spotify Hub.

4.2 Meanings and Models

In the previous section, I tried to trace the outlines of the spectrum of musicological thinking about meaning. Needless to say, the survey is not complete, and it inevitably does not do justice to the contributions of any single author included in it. Nevertheless, it gives a representative picture of the diversity of thinking on this subject, and it is useful to compare it with the sense of "meaning" at work in the Spotify engine. Table 4.1 summarizes the various ways these authors have construed the question of the meaning of music:

Looked at together like this, it is obvious that this survey embraces a vast range of subjects, so much so that it's not even clear that they belong in the same conversation. Frith and Kivy, for example, both use the word "meaning," but are they really addressing the same issue at all? This brief survey is restricted to authors that actually use the word *meaning*, but in a sense even

52. Tia DeNora, *Music in Everyday Life* (Cambridge University Press, 2000), 29.
53. Ibid., 5.
54. Ibid., 21.

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

that is an arbitrary delimiter. At some point it becomes hard to imagine any musical writing that could not in some way be said to address the topic of "meaning." There is something a little tautological, then, in assembling a group of diverse authors, declaring that they all are writing about "meaning," and then elevating their very diversity into a musicological argument.

That may seem to neutralize the whole idea of this survey. And indeed if Spotify were not so influential, it may never have been necessary. But the vaguely tautological quality of this survey is actually the whole point; given the ubiquity and influence of a service that embeds Putnam's rather narrowly deterministic notion of reference meaning, it bears repeating that the question of musical meaning is intractable and variegated, and that it arises virtually any time anyone tries to say something "meaningful" about music; it is not a simple matter, in other words, nor a regular one, nor one that you can just shrug off by virtue of a marketable product. My point, then, is not just to demonstrate that Whitman's efforts to situate his system in a humanistic tradition are superficial; that alone is not really surprising or instructive. Clearly, we cannot expect that every person researching recommender systems would get to know the intellectual history of 20th century musicology. Instead, I hope this chapter serves as a reminder that the diversity of that thread in musicological thinking is a special case of the diversity of musical experience in general, which is something that Spotify generally serves to simplify and flatten.

It may be that virtually any scholarly work on meaning, or for that matter any statement about music at all, embeds some notion of musical meaning, just as these authors have. And more than one such notion can operate simultaneously. Sometimes, some people like music in a way that really *is* derived from its abstract formal content, as Peter Kivy seems to do. Other times, the same listeners may ignore formal considerations altogether; they may enjoy music, say, because it calls to mind a loved one or makes dancing fun. Other times it may be a matter of identity construction. The number of ways to like music – and the number of attendant notions of what music "means" – are virtually infinite. Whitman's "relational" theory is just one of them.

What the survey above demonstrates, above all, is that the lines between these various types of affection are vanishingly small. Not only is none more "right" than the other, but they overlap constantly. The question then becomes: how well can a system like Spotify's, embedding one system that bridges Putnam and Support Vector Machines, account for the intractable diversity of musical experience? The "big data" approach to human problems assumes that from large amounts of information about complex human problems there will emerge some kind of reliable logic – the logic, that is, by which an audio frame is evaluated as belonging or not belonging to a given semantic category. The process moves from the aggregate (the multiplicity of aesthetic judgment and a huge array of empirical observations about the same) to the individual (is this or is this not "sad" music?).

Spotify is, in other words, a statistical "model" of musical affection. And here it is relevant to consider an often-cited adage about statistical models, usually attributed to George Box:

> All models are wrong. But some are useful.[55]

It is easy to see what is meant by "wrong" in this aphorism: no scientific model could ever fully reproduce the complexity of any actually existing system. All models are "wrong" to the extent

55. George E. P. Box, "Science and Statistics," *Journal of the American Statistical Association* 71, no. 356 (1976): 791–799.

that total comprehension is beyond the scope of any serious scientific inquiry. What, then, do we mean by "useful?" In the example used by philosopher of science Peter Truran, this word seems to mean "capable of explaining the universe:" the Newtonian theory of gravitation is "wrong" in light of Einstein's theory, but still "useful" in explaining the behavior of apples falling from trees.[56]

But this is not at all the sense in which Spotify is useful. It tells us nothing about trees or gravity or human musical affection. Instead, its true utility is perfectly clear: it is a commercial utility. Nevertheless, as a doctoral dissertation approved by a prestigious institution of scientific learning, and as a service that wants you to believe it's really worth more than its competitors, the system in question also wants to be knowledge of some kind, to contain some insight about music, to have "learned" its "meaning." The true objection to Whitman's dissertation, and to the system for which his dissertation is at present standing in, is that it has not made up its mind about this question. Or, rather, that its true utility is simply commercial but that its sales pitch is tacitly predicated on the sense that somewhere it has utility in the broader, scientific sense of the word. "Learning the meaning of music," as a doctoral dissertation from MIT, makes a scientific promise, at least rhetorically. The Spotify system, however, delivers only a commercial product. Some scientific discoveries have commercial applications, of course; the two are by no means mutually exclusive. But if there is a legitimate scientific insight behind the software that powers Spotify's system, it is not at all the same kind of insight pursued by any of the authors discussed in this survey.

Confronted with the messiness of the faculty of aesthetic judgment, the Spotify system's approach, in a sense, responds in kind: since we can never know how music works on people, we have no choice but to assume that from the mess will emerge *some* kind of useful truth, whether that's useful commercially or scientifically or both. Doesn't matter; the data can't lead us astray. At the same time, the system hews closely to the externalism of Putnam, and Whitman is right

56. Peter Truran, "Models: Useful but Not True," in *Practical Applications of the Philosophy of Science: Thinking about Research* (Springer International Publishing, 2013).

to cite him: however agnostic the system remains on the actual psychological facts of music, it still seeks to pinpoint and specify musical "meaning." So it's a system that throws a bunch of math at the wall and sees what sticks, but it's also a system invested in pinpointing meaning in a rather narrow fashion modeled on Putnam. It is a theory where there really is some thing called "meaning" that, while it can never really be found, is nevertheless available to be approximated.

The system may be good or bad; that is another question. What is at issue here is the availability of a pretheoretical notion of musical meaning itself. We are not asking whether we should agree with Kivy that music "has no meaning" in the specific technical sense in which he understands that term. Instead, we are asking whether it even makes sense to produce a system that characterizes musical meaning in a general way, that makes a determination about the significance of a given piece of music abstracted from an actual act of listening, from an actual person with an actual belief system. Putnam's theory of meaning, transposed to the musical domain, says that there should be one. As I argue in Chapter Three, Spotify agrees. The lived reality of musical experience, the unruly diversity of thinking about musical meaning, and Chomsky's rebuttal to "externalism" (transposed in similar fashion to music) all say that there should not be one. Perhaps our decision on whether or not to use Spotify should, ultimately, depend on where we come down on this question.

5 Statistical Shadowboxing with Spotify

In this chapter, I discuss quantitative experiments conducted to probe the issues raised in the first four chapters. If Spotify's system has indeed failed to "crack the code" of musical meaning, or if the theory of musical meaning upon which it based is basically faulty, that ought to be somehow statistically measurable. To investigate this question, I use the Spotify API to solicit automated recommendations, and then look at the large-scale statistical characteristics of the generated playlists. Before explaining the experiments themselves, a few preliminary remarks are necessary.

The Spotify API is a tool made available to software developers who wish to include some Spotify functionality in their own software applications. If you want to, say, embed Spotify recommendations into an app or use Spotify user data to inform your own software's functionality, you'll need the API. While it does provide actual access to elements of the Spotify system, it is not, strictly speaking, the Spotify system itself, as experienced by those users. I have used Python to interact programmatically with Spotify via the API; Spotify customers use a mouse to click around the desktop application. The differences between them is, in most cases, impossible to pinpoint. For example, consider the questions raised by this minimal example of an API recommendation call:[1]

```
import spotipy
sp = spotipy.Spotify()
sp.recommendations(seed_genres=['reggae'], limit=20)
```

1. This uses the Spotipy library, which is a Python wrapper for the Spotify API. See https://spotipy.readthedocs.io/en/latest/, accessed 10-10-2019.

This code snippet produces a list of 20 Spotify "track" objects, seeded by a 1-item long list of "seed genres." A playlist, in other words, for the genre "reggae." This recommendation is not associated with any particular user, but is simply a list of recommended tracks using one genre as a seed. Now, presumably, we can go on to look at the seeded playlist and make deductions about the nature of the automated playlist engine. But already there are points of confusion. Which of the Spotify functions, as they are actually encountered on the GUI, does this functionality power? Is it the "radio" function, where Spotify suggests "stations" of interest to users based on their listening history? Or is it the "Discover Weekly" service, which offers a personalized playlist each week? Or is it used to create the "By Spotify" playlists that appear under the "browse" tab but don't seem to be "personalized?" Or is it that the API function is used to create raw lists which are then tweaked by hand?[2] It could be all of these are the case, or it could be none; there is simply no way to know, nor is there even any reason to suppose that the answers to these questions are at all stable. This chapter makes no hypothesis as to which Spotify functions are being emulated, but simply deals wit the API itself.

Even beyond the possible differences between the API and the GUI, there are issues to consider. The "limit" field in the snippet above, for example, represents the number of playlists solicited in a given call. What, then, is the difference between soliciting 100 playlists in one call and soliciting a one-track playlist 100 times? Which of those do we suppose Spotify is really doing for its users? In experiment 5, where I calculate mean "popularity" per genre, I use the latter method, soliciting many recommendations per call. The number of unique items per playlist tends to be higher using this method, but not dramatically so – see Appendix 2.2, which shows the number of unique tracks per genre using using multiple calls of one track versus one call of multiple tracks. Nevertheless the two are different, and it is basically impossible to know which one is used in the Spotify system.

2. As Ugwu, "Inside the Playlist Factory: The Unsung Heroes of the Music Streaming Boom" notes, there are in fact human curators working at Spotify, even if the company has distinguished itself from its competitors with a greater reliance on automated methods.

Another issue derives from the question of how to normalize data. The idea behind data normalization is to make it meaningful to compare data from different scales, by comparing standard deviations above the mean rather than raw information. To do this one needs a general picture of the data distributions across a population as a whole. In the present case, that would literally mean knowing the average value for every audio feature in Spotify's entire 30 million-song catalogue. This is not possible to obtain, for a few reasons, mostly because it's too much data. The expedient used here is a common solution for this common problem: I log feature values for ten thousand randomly chosen songs and treat that as representative of the whole Spotify catalogue. I then use these means and standard deviations to normalize the rest of my data.

But what is a "random song?" If you think about it this is a philosophically dubious concept. Spotify certainly offers no "random" recommendation function, and it is unclear what the meaning of "random" would be in the musical context anyway. The "random" process undertaken here is just to seed tracks with arbitrary names, using a random number generator and a dictionary. Random words as song title seeds, ten thousand times: what do we make of that as a corpus representative of Spotify as a whole? It might be good, but it might be defective too. Song titles in the aggregate, compared with random words, are probably weighted toward certain themes like love and death. If that weighting is high enough, our normalized data would tend to locate the songs that *do* sound these common themes as more distant from the mean than if we had normalized using some weighted lexicon more representative of song titles in general. It is unclear, though, how you would get such a weighted lexicon, or how you would know that it did a better job representing all of music than had 10k random songs.

There are, in other words, standard methods for normalizing information in situations like this, but when you put them in a musical context, where there are countless factors not necessarily amenable to quantitative consideration, you run into logical conundrums that threaten to impugn experimental integrity, even at the very basic level of data normalization.

I do not believe that the above problems represent crippling deficiencies in my own experiment design, but they are emblematic of the general problem of this kind of investigation, which does make it difficult to build substantial claims about the Spotify recommendation engine from the API alone. One can show that certain genres exhibit certain features, or that certain features correlate with others. One can make claims about what genres are more geometrically clustered than others. But to go from there to a grand narrative about the aesthetic or social toxicity of Spotify would be irresponsible. The experiments discussed below were conducted in an open, exploratory fashion, following one experiment into the questions that it raised. Where they do support conclusions about Spotify "in the wild," they will be of a humble and sometimes tentative nature. But that fact alone – the humility that the art of music imposes on quantitative study – turns out to be the most significant finding in this chapter. The difficulty of making claims about Spotify may not be solely an artifact of poor experimental design or technical limitations. Instead, the difficulty of critiquing Spotify on experimental grounds is the mirror image of Spotify's own difficulty in automating music recommendation in the first place. Both project assumptions about musical salience that are hard to justify. Both have to wrestle unruly data into some kind of computational legibility. Both, in short, suffer from difficulties of interpretability; the experiments herein are better at gesturing at this difficulty than they are supporting grand critical claims about the nature of Spotify's engine itself.

These difficulties are endemic to the field of machine learning in general. As Doshi-Velez and Kim, "Towards a rigorous science of interpretable machine learning" point out, a general low level of model interpretability may be a frequent cause of both persistent software bugs and, more importantly, some of the much critiqued "unfairness" of machine intelligence. It is often because it is so hard to know why a system behaves the way it does that they can be so socially pernicious. Doshi-Velez and Kim, "Towards a rigorous science of interpretable machine learning" raise, for example, a case where a system learns a relationship between suffering from asthma and *decreased* risk for pneumonia. If interpretability of such a system is low enough, as in certain cases it is, we have no way of knowing that the correlation is due to the aggressive treatment asthma patients in the data set tend to receive. Spotify's system may be "un-interpretable" in just this sense.[3] Who knows why Spotify recommends "more of the same," or behaves differently for different gender and age groups?[4]

Zooming out, Spotify suffers from another crisis of interpretation. Although Lawrence Kramer is not an author who ever addresses himself to this kind of quantitative investigation, his comment on interpretability here is nevertheless instructive:

> Meaning arises where interpretation does. It thrives, or not, on what might be termed the *contexture* of interpretation, the capacity to draw together a variety of semantic sources – tropes, tones, phrases, images, ideas – into a sustainable discourse that resembles the way sense is made within a certain social, cultural, or intellectual milieu.[5]

Musical meaning, for Kramer, happens when *humans* respond to music, which they do from a position situated in an unfathomably complex circumstancial lattice; this is something like Chomsky's assertion that meanings can only be made with reference "whole belief systems."[6] To speak of music having meaning in the manner that Spotify seems to require is to perform a sweeping set of reductions on this lattice, on these belief systems. It is in its inability to embrace the whole of Kramer's variety of semantic sources that Spotify suffers from a crisis of interpretability – and thus, following Kramer, a crisis of meaning. It is not so much that a given feature might perturb recommendations in a way that is hidden from the human observer, although that too may be true. Instead, belief systems are reduced to "cultural metadata," songs are reduced to feature vectors, musical connections reduced to "likes." The result is something like the "meaning" outlined in Jerrold Katz's instructive example: "smoke means fire." Katz

3. Whitman's 2005 system uses a support vector machine, which falls under the class of "linear" models whose interpretability is usually thought to be higher. See Zachary C. Lipton, "The Mythos of Model Interpretability," *Commun. ACM* 61, no. 10 (2018). Spotify's currently used system, of course, may be using neural nets or some other method.

4. See Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*

5. Kramer, *Interpreting Music*, 68.

6. Johnson et al., "Language from an Internalist Perspective," 128.

derisively refers to this kind of meaning as mere "historical lesson." Smoke means fire in the basic sense that one has often come after the other. If this is meaning, it is of an essentially "extra-linguistic" variety.[7]

The sense in which *sad* "means" something in music – precisely the sense required by the acoustic signatures for various classifiers identified in Whitman (2005), cited above – is, it seems to me, a straightforward matter of historical conditioning or life lessons, except that even in this capacity a certain specificity or explicitness goes wanting. Whitman wants this meaning to be "relational" but also analogous to Putnam's. On the other hand it seems to have a lot in common with Katz's "historical lesson"; the terminological heterogeneity of Whitman's dissertation mirrors the inevitable complexity of musical experience even as it makes the actual content proposed in the dissertation harder to follow. The relationship of that variegated "meaning" to its audio signal is "learned" by a machine with whatever interpretational problems *it* brings to this situation.[8] Meaning and interpretation, with all the various things those two can mean, moreover, continually slide into one another. Such are the compounded difficulties for a critical study of this system; that the findings of this chapter are tentative is both an expression of these difficulties and a useful reminder that they are what any system like Spotify's will have to face.

This chapter is animated by a general intuition that, at some level, machine listening and aesthetic pleasure are incommensurable, and that the essential elements of musical "meaning" reside somewhere beyond the reach of this kind of information processing. In particular, many of the experiments below are structured around the idea that "homogeneity" in automated playlist creation would be a bad thing, or at least an indication that the general intuition is right. But these experiments are undertaken in an exploratory and open minded manner, each one leading to a question that the next one tries to answer. In most cases they simply lead to other questions, rather than the damning revelations a determined humanistic partisan might crave. It is yet another

7. Jerrold J. Katz, "Chomsky on Meaning," *Language* 56, no. 1 (1980): 1–41.
8. Model intepretability is a common problem in machine learning. See, e.g. Doshi-Velez and Kim, "Towards a rigorous science of interpretable machine learning"

indication of the unruly and variegated nature of musical affection that these experiments will rarely if ever produce definitive proof that Spotify gets it wrong or right; indeed, what they point to more than anything else is just how hard to imagine what such "rightness" or "wrongness" actually is in the aesthetic domain. They point, in other words, to the fact that with music there is no right and wrong, which is what makes it incommensurable with machine learning in the first place.

5.1 Methods and Data Set

Spotify today continues to make an API available to software developers, which is a replacement for the API that the Echo Nest had long offered before Spotify acquired it (it is now depreciated). This API makes it possible to automate many of Spotify's core functions. These experiments deal primarily with two of these functions:

1. Get automatically generated music recommendations based on provided "seed" information.
2. Run a song through the API's musical analysis algorithm, which outputs various musical metrics for a given song.

There are two ways this second function works: the "audio features" endpoint and the "audio analysis" endpoint. The "analysis" is very detailed, containing information about putative "bars," "beats,' "tatums,"[9] and "sections." The "audio features" output, on the other hand, is an 18-point high-level summary of a given song. Both API objects will be considered in these experiments. Sample output of the "audio features" object is shown in figure 5.1.

Each of these fields represents a feature along which Spotify's machine listening algorithm has rated the track. Spotify's full explanation of the meaning of each of these fields is given in Appendix 1. It should be noted that while Spotify tells us what it thinks is "meant" by, for

9. A term of art from the world of music information retrieval, denoting the smallest perceptible unit of rhythmic pulsation.

```
{
  "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
}
```


Figure 5.1: Spotify API audio features analysis for Ginuwine's *Pony* (1996)

example, "danceability," it never explains how the number is actually arrived at; thus the enticing question "how did you arrive at that figure for danceability?" is one we can only guess at. A close examination of the full "audio analysis" can yield some plausible theories, but I regard this information as basically inaccessible (and, as Nick Seaver points out, subject to constant mutation) and it is not the goal of these experiments to hypothesize about it.

Taken together, the metrics in the "audio features" output represent the song's musical fingerprint, as Spotify understands it. As argued in Chapter Four, it is reasonable to assume that, when Spotify "learns" a relationship between audio signal and "cultural metadata," it is using these feature extraction methods to render the signal legible to the system. These features therefore represent an opportunity to make claims about the behavior of Spotify's recommendation engine, with reference to musical properties themselves, as these are construed by the program itself. This is a different type of inquiry from the one undertaken by, for example, Snickars,[10] which only addresses homogeneity as repetition of artist or song (homogeneity equals "more of the same").

To approach these questions, many preliminary steps are necessary, which I now outline. The first step is to gain an authorization token from Spotify for Developers, which is necessary to

10. Snickars, "More of the Same–On Spotify Radio."

make more than a single API query at a time. Using the Spotipy library for the Python language[11], I wrote Python scripts that use this token to access the API programmatically, doing things like getting recommended songs, creating playlists, and populating those playlists. It is important to note here that none of the playlists I will deal with in this chapter are "personalized" or associated with any particular user history; they are just "recommendations" given in the abstract, by the system in response to various kinds of seed data (seeded with genre, or with tracks, or with specified target values corresponding to the output of the feature extraction method).[12]

Of the 13 musical features available on the Spotify API (see "Pony" output above), I chose to use only 10, omitting *mode*, *key* and *time_signature*. I made these omissions because I felt that the "aesthetic distance" between songs was not captured in any meaningful way by comparing them along these dimensions; a song in the key of A does not differ from a song in the key of D in the same way that a song with energy level .8 differs from energy level .01. As far as possible, I wanted my features to represent information of equal musical salience and, moreover, the same kind of musical salience. Thus a given song, for the purposes of the experiments to follow, is represented as an 10 dimensional array of values selected from the "get audio features" API object. "Pony," then, would be represented as the following array:

[0.115, 0.966, 0.605, 0.749, 0.086, 0.0381, 142.024, -9.359, 251733, 0.00186]

where these values correspond to its

[liveness, valence, energy, danceability, speechiness, instrumentalness, tempo, loudness, duration_ms, acousticness]

I then normalize this information, using the random song lookup technique described above to yield mean values and standard deviations representative of Spotify's catalogue as a whole. Normalized values are simply the raw score (above) minus the mean, divided by the standard deviation. The normalized representation of "Pony," for example, is:

11. https://spotipy.readthedocs.io/en/latest/

12. Snickars (2017) demonstrates that Spotify's personalization has little to no effect on recommended content. Still, that may have changed in the last two years and I regard it as a topic for future investigation.

[-0.49096966, 1.99657033, 0.10854259, 1.07965357, -0.16169302, -0.68504791, 0.74268285, 0.19946204, 0.01355802, -0.95613235]

where the values now represent standard deviations above the mean for each feature. For "Pony," duration and loudness, for example, are roughly normal, whereas its valence (happy/sad) and danceability are significantly higher than normal.

A playlist, then, can be represented as a list of these normalized arrays. I then measure some geometric properties of these lists. A playlist, for example, can be very spread out over 10-d musical space, or it can be very clustered. This kind of geometric clustering is my proxy for aesthetic self-similarity, or "homogeneity." Self similar playlists are homogeneous, disperse playlists are not. I measure this homogeneity in three ways:

1. by calculating the average dot product of all pairs of songs in a playlist,
2. by calculating the average Euclidean distance between all pairs of songs in a playlist,
3. by calculating the convex hull of the playlist representation as a whole.[13]

The result is a small program, analyze_playlist.py, which takes as input a Spotify Playlist ID, logs all its audio features, and outputs these aesthetic homogeneity measures. Figure 5.2 shows sample output of an early version of analyze_playlist. The complete Python script (of one representative version) is offered as a reference in Appendix 2.[14]

Data Set

Because constant queries to the Spotify servers are time consuming, it was necessary to store large numbers of recommended songs on a local device. Random samples from this

13. Convex Hull is the smallest convex set that contains a given geometric region, commonly visualized as the "least amount of bubble wrap" needed to enclose a given set of points. Convex Hulls in this project are calculated using the ConvexHull method from the standard scipy.spatial library.

14. Note that the actual scripts I used were tweaked for the purposes of different experiments. The script listed there, though, should give a basic idea of the techniques I used.

```
Playlist ID is 1YCJoOCI0zdg1EIUwkM99f
Got playlist titled new years 2019
Extracting features from playlist...
done
whitening data....
done
calculating dot products...
average dot product is:  0.7057604081736711
calculating euclidean distances...
average euclidean distance is:  3.180953523334021
calculating convex hull...
convex hull area and volume:  98.3075012685 7.37266054787
```

Figure 5.2: Sample output of playlist analyzer script

ordered database could then serve as simulations of Spotify recommendations. The data set was assembled by doing the following:

1. Determine how many *genres* exist in Spotify's system: there are 126, a complete list of which is provided in Appendix 1. The genre 'comedy' was omitted from all experiments, as it contains very few musical recommendations.

2. Get recommendations from Spotify using each *genre* as a seed. There are other possible seeds with which one can solicit recommendations. They can be seeded by other songs, or by target market, for example. For this dataset, I use only genres.

3. Funnel recommended tracks (500 per genre) to actual Spotify playlists, owned by user "tobinchodos." Note that this does not mean that the playlists are in any way affected by the user's listening history; the recommendations were generated with API queries associated with no user in particular, the track IDs pulled from the recommendations, and then the lists of track IDs pushed to "tobinchodos" as a matter of convenience. Now user 'tobinchodos' has 126 playlists each corresponding to a Spotify genre, each populated with 500 automatically generated Spotify recommendations.

4. Run Spotify "get audio features" module on each track in a given playlist, store one .json file containing 500 audio features objects (like the one shown above for "Pony") for each

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

Figure 5.3: Ten least repetitive genres in the data set

genre. Do the same for the full "audio analysis" object, which includes more detailed information.[15]

After removing "comedy," the resulting databases are: two arrays, grouped by genre. One contains audio feature objects and the other audio analyses.

Before proceeding further, I should note that the playlists in no case represent 500 unique recommendations. They actually all have many repetitions. This is assumed to be an accurate reflection of the actual behavior of the Spotify system in the real world, and so the repetitions have been preserved in the data set. Not all genres are equally repetitive, of course, which is an interesting preliminary finding on its own. Figure 5.3, for example, shows the ten least repeating genres, while figure 5.4 shows the ten most repeating genres. That information, given in full in Appendix 2, will form part of the discussion of the results, but I have made no effort to artificially obtain non-repeating playlists.

15. The analyses objects are large, and so the analyses database contains only 100 songs per genre.

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

Figure 5.4: Ten most repetitive genres in the data set

5.2 Experiments

5.2.1 Experiment 1: determine Spotify genres with greatest and least aesthetic diversity

In the first experiment, I aim to determine which genres have the greatest and least feature diversity. Feature diversity here is evaluated using each of the four geometric measures outlined above: convex hull (area and volume), euclidean distance, and dot product. An experiment is run that gets a specified number of playlists and determines which genre had the highest and lowest rank for each of these four homogeneity metrics. This produces a histogram of "winning" and "losing" genres per metric. The experiment proceeds like this:

1. It iterates through the database and generates two playlists per genre, each 40 tracks long. These are created by randomly sampling the 500 songs Spotify recommended for each genre.

2. It evaluates the four metrics for each playlist, then stores the mean of the two values for each metric, per genre. One run of the experiment, then, "rates" a genre in four ways.

3. It iterates through the evaluated list of rated genres and returns a "winner" and a "loser" for

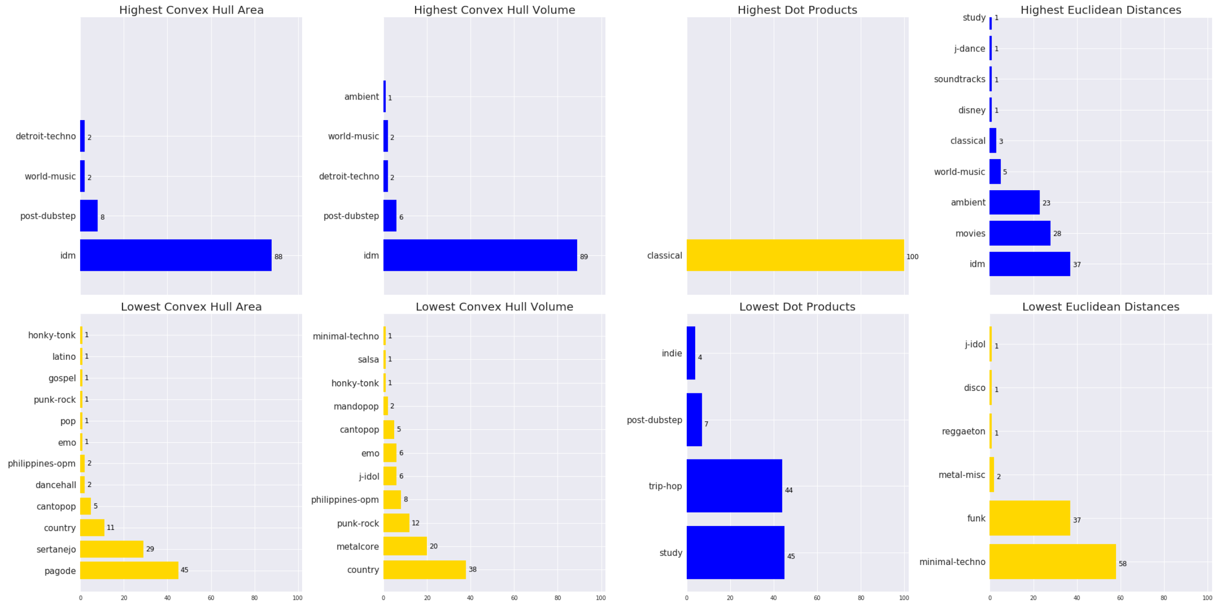

Figure 5.5: Most diverse (blue) and least diverse (gold) genres as evaluated by the four diversity metrics, n=100

each experimental run. That is, for each of the four metrics, the script returns the genre with the maximum and minimum score, respectively: the genres that are most and least diverse, according to four measures.

Three of these measures (convex hulls and distances) will tend to go up when a playlist is more "spread out" in 10-d musical space. Dot products, on the other hand, are higher when vectors are similar; a high dot product measure thus represents less, not more, aesthetic diversity. Figure 5.5 shows the results of experiment 1, with high diversity indicators in blue and low diversity indicators in gold.

IDM ("intelligent dance music") seems to dominate as most diverse. Given the nature of the genre in question, one that includes atmospherics that lack tonal center, pulse, or the human voice, as well as familiar tropes from electronica (four-on-the-floor backbeats, pulsing, unambiguous tonal drones), this makes some sense. We might suppose that this diversity is due to the sheer size of the IDM catalogue itself, but if that were true we would expect it to number among the top-10 in total number of unique songs (see 5.4), which it does not. So we can assume that this experiment reveals something unique about IDM as a genre – at least according to the metrics in the Spotify system.

5.2.2 Experiment 2: aesthetic diversity by mean variance

Another way to measure aesthetic diversity is to look at the mean feature variance per genre. Genres that tend not to vary much in their feature measures are, in this case, more self-similar and therefore less diverse. The process to do this is simple:

1. Create playlists by the same method as above (by sampling randomly from the sorted database).
2. Find the mean feature variance across all features per genre.
3. For each run of the experiment, register a "winner" and "loser" (the genre with highest and lowest mean feature variance, respectively).

The results of this experiment conform somewhat to the picture painted in the first experiment. While IDM appears among the most "diverse" genres by this measure, it is actually "tango" that consistently registers the highest mean feature variance. The histogram in 5.6 shows the results of 100 mean variance experiments.

5.2.3 Experiment 3: feature with greatest and least variance by genre

After seeing that a handful of genres consistently rank as most and least aesthetically diverse, I became interested to know what features in particular were most salient to a given genre. Another way of asking this is, "what is the feature that varies the least within a single genre?" The feature that varies least for a genre is assumed to be the one that best defines it, that is most salient for it. It may also be relevant to know which feature is *least* salient for each genre. To answer these questions, I designed a simple experiment:

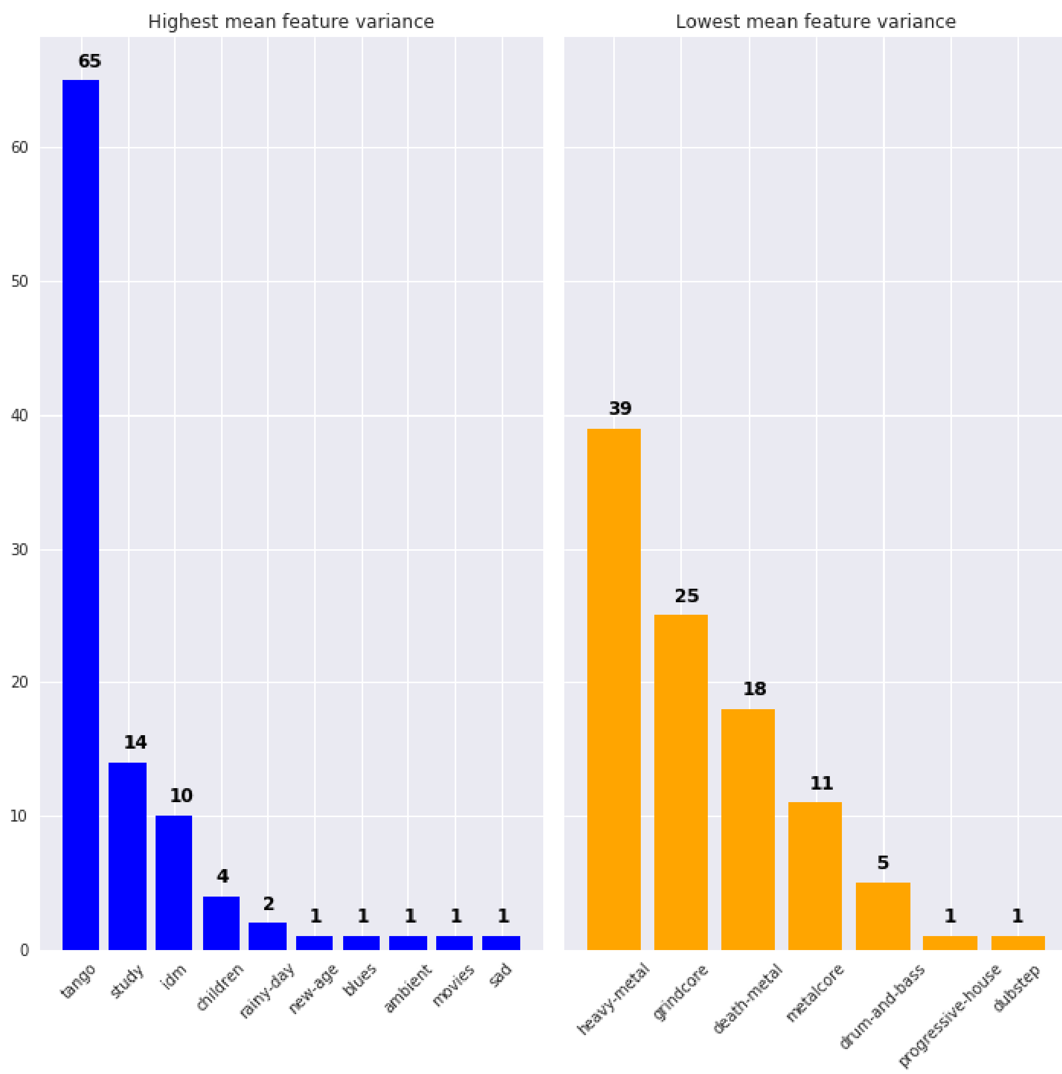

Figure 5.6: Genres with highest (blue) and lowest (gold) mean feature variance, n=100

genre	lowest_variance_feature	% of exp selected	highest variance feature	% of exp selected
acoustic	speechiness	0.83	liveness	0.59
afrobeat	speechiness	0.97	acousticness	0.34
alt-rock	speechiness	1	tempo	0.96
alternative	speechiness	0.99	tempo	0.91
ambient	speechiness	1	duration_ms	0.45
anime	instrumentalness	0.58	tempo	1
black-metal	speechiness	0.91	liveness	0.95
bluegrass	speechiness	1	valence	0.62
blues	instrumentalness	0.54	liveness	0.78

Figure 5.7: Sample data from the greatest and least feature variance experiment

1. Get 10 50-track playlists for each genre, log audio features for each track.

2. For each genre, determine which audio feature has least variance.

Each time this experiment is run, it returns the feature for each genre that had the least variance over the specified range of tracks. This yields 125 histograms, representing the features that have tended to vary least for each genre. The data basically looks like this: for genre x, experiment number one, the least varying feature was "danceability." For genre x, experiment two, the least varying feature was "tempo," etc. From these lists it is possible to select the feature that most frequently appears as having the least and greatest variance, and thus to get a sense in general of what feature is most and least salient to each genre.

Figure 5.7 shows a representative sample of the data. What this means is that, e.g. for the genre "blues," instrumentalness was the feature that most frequently appeared as the one with least variance. Nevertheless, it did so in only 54% of the experiments; not a very high confidence measure. Similarly, liveness was the feature that appeared for "blues" more than any other as the one with highest variance, which it did 78% of the time. I am not extremely confident, in other words, that instrumentalness is in fact the most salient feature for the genre *blues*, although it is the feature that most frequently presented with lowest variance. Compare this with afrobeat, for which speechiness was the least variant feature 97% of the time. In this latter case I can say with confidence that, for the "afrobeat" genre, speechiness is the most salient genre. Note that sometimes the feature that presents most frequently hardly does so with much frequency at all:

acousticness for “afrobeat” beat out all other features for most variant, but did so 34% of the time.

In the vast majority of cases, though, one feature appears much more frequently than the others, indicating high confidence that that feature is indeed the one that varies least. Setting a confidence threshold reduces the total number of genres about which one can make claims about what features matter most and least; but many genres do indeed meet very high thresholds. With a threshold of 85%, there emerge 81 genres with a least varying feature. At a threshold of 90%, that number drops to just 77. At 95%, it is still 66, meaning that for 66 genres, we can say with 97% confidence what is the most salient (least varying) feature. Indeed, there are only two genres for which the dominant feature appears less frequently than 50%: “cantopop” and “electronic.” What this means is that, for all but these two genres, we can say that there is one feature that will, in a majority of cases, vary less than the others. Even if we set the threshold extremely high, we still get many genres presenting with a defining feature. Table 5.1 shows all genres with their least variant features, thresholded at 97% confidence.

Table 5.1: Spotify genres with least variant features, thresholded at 97% confidence

Genre	**Feature**	Confidence (selections/no. experiments (n=100))
alt-rock	speechiness	1
alternative	speechiness	0.99
ambient	speechiness	1
bluegrass	speechiness	1
bossanova	duration_ms	0.98
children	duration_ms	1
club	duration_ms	0.99
country	instrumentalness	1
death-metal	acousticness	0.99

Table 5.1 continues on next page

Table 5.1, Spotify genres with least variant features – continued from previous page

Genre	Feature	Confidence
deep-house	tempo	0.98
detroit-techno	speechiness	0.99
drum-and-bass	acousticness	1
dub	acousticness	1
dubstep	acousticness	1
emo	instrumentalness	0.99
folk	speechiness	1
gospel	instrumentalness	1
goth	speechiness	1
grindcore	acousticness	1
grunge	speechiness	1
guitar	speechiness	1
happy	duration_ms	0.98
hard-rock	speechiness	0.99
heavy-metal	acousticness	1
hip-hop	instrumentalness	1
indian	instrumentalness	0.98
industrial	speechiness	0.99
j-dance	speechiness	0.98
jazz	speechiness	1
k-pop	duration_ms	1
kids	duration_ms	1
latin	instrumentalness	1

Table 5.1 continues on next page

Table 5.1, Spotify genres with least variant features – continued from previous page

Genre	Feature	Confidence
latino	instrumentalness	1
minimal-techno	tempo	1
movies	speechiness	1
new-age	speechiness	1
new-release	duration_ms	0.99
pagode	instrumentalness	1
piano	speechiness	1
pop-film	speechiness	1
post-dubstep	duration_ms	1
psych-rock	speechiness	0.99
r-n-b	instrumentalness	1
reggae	instrumentalness	1
reggaeton	instrumentalness	1
samba	duration_ms	1
sertanejo	instrumentalness	1
show-tunes	instrumentalness	1
sleep	speechiness	1
songwriter	speechiness	1
soundtracks	speechiness	0.99
spanish	instrumentalness	1
swedish	instrumentalness	1
techno	acousticness	0.99
trip-hop	speechiness	1

Table 5.1 continues on next page

Table 5.1, Spotify genres with least variant features – continued from previous page

Genre	Feature	Confidence
work-out	duration_ms	1
world-music	speechiness	1

5.2.4 Experiment 4: "confidence" and "popularity" measures

The API offers, in addition to the "audio features" output upon which many of the above experiments are structured, an "audio analysis" with more granular detail. The analysis almost certainly underpins the higher-level features from the "audio features" endpoint. A large portion of the analysis, for example, is devoted to "beats" and "bars," musical features that are represented as python dictionaries where onset time and duration are logged. It seems reasonable to suppose, for example, that the degree of consistency among these "beats" across a song would be a sensible way to estimate "danceability" – more constant beats usually equals danceability. The tonality stored in the analysis might be a factor in calculating "valence," which Spotify defines as "the musical positiveness of a track."[16] But, as noted above, while they are highly plausible, such conclusions are inevitably speculative, since Spotify does not publish the formal derivations of the audio features fields.

One interesting feature of the full audio analysis is that it contains various "confidence" measures. As Spotify puts it in its API documentation,

> Confidence indicates the reliability of its corresponding attribute. Elements carrying a small confidence value should be considered speculative. There may not be sufficient data in the audio to compute the attribute with high certainty.[17]

These "confidence" measures are attached to granular attributes like beats and sections, but they are also attached to four crucial song-level metrics: *key, mode, tempo* and *time signature*. The

16. See appendix 1
17. Spotify API documentation, available at https://developer.spotify.com/documentation/web-api/reference, accessed 08-14-2019

audio analysis, in other words, tells us how confident the system is about these four basic musical properties. In experiment four, I determine the mean confidence values per genre, using these broader attributes, for my entire data set of musical analyses.

Because the analysis files are so large, my data set of analyses is smaller than my "audio features" data set: just 100 song analyses per genre. These 100-song playlists are subsets of the broader 500-song database, so the same caveat about repetitions should be borne in mind. In this experiment, I am not simulating playlist recommendations the way I did for the audio features, but instead I tabulate mean values on the entire data set. This gives a rough idea of the genres that Spotify, in general, feels more and less confident about. Figure 5.8 plots every genre on a plane that represents popularity (x axis) and confidence (y axis).

5.3 What do these results show?

A preliminary finding not labeled as an "experiment" above is simply that there are significant differences across genres in terms of how many unique songs appear per 500 recommended songs. The genres that rank as most and least repetitive are sometimes curious; why, for example, is "j-rock" so full of unique songs (321), where "brazil" has only 100 of them? The latter, after all, names an entire nation that embraces many different musical styles, while j-rock is comparatively specific and, compared with Brazil, rather new. The disparity is anomalous. And "funk," a genre with the relatively high popularity score of .66, is the second-most repetitive genre, with just 80 unique items, a figure that is not improved by making larger calls to the recommendation function. Other popular genres are not so repetitive – why, then, is funk? It's hard to think of a good answer; on the other hand, it's hard to say exactly what this experimental result says about Spotify in a global sense.

It is hard, in general, to make sense of these results or comment on them with any real confidence. You might suppose, for example, that the repetitiveness of a genre would mean that

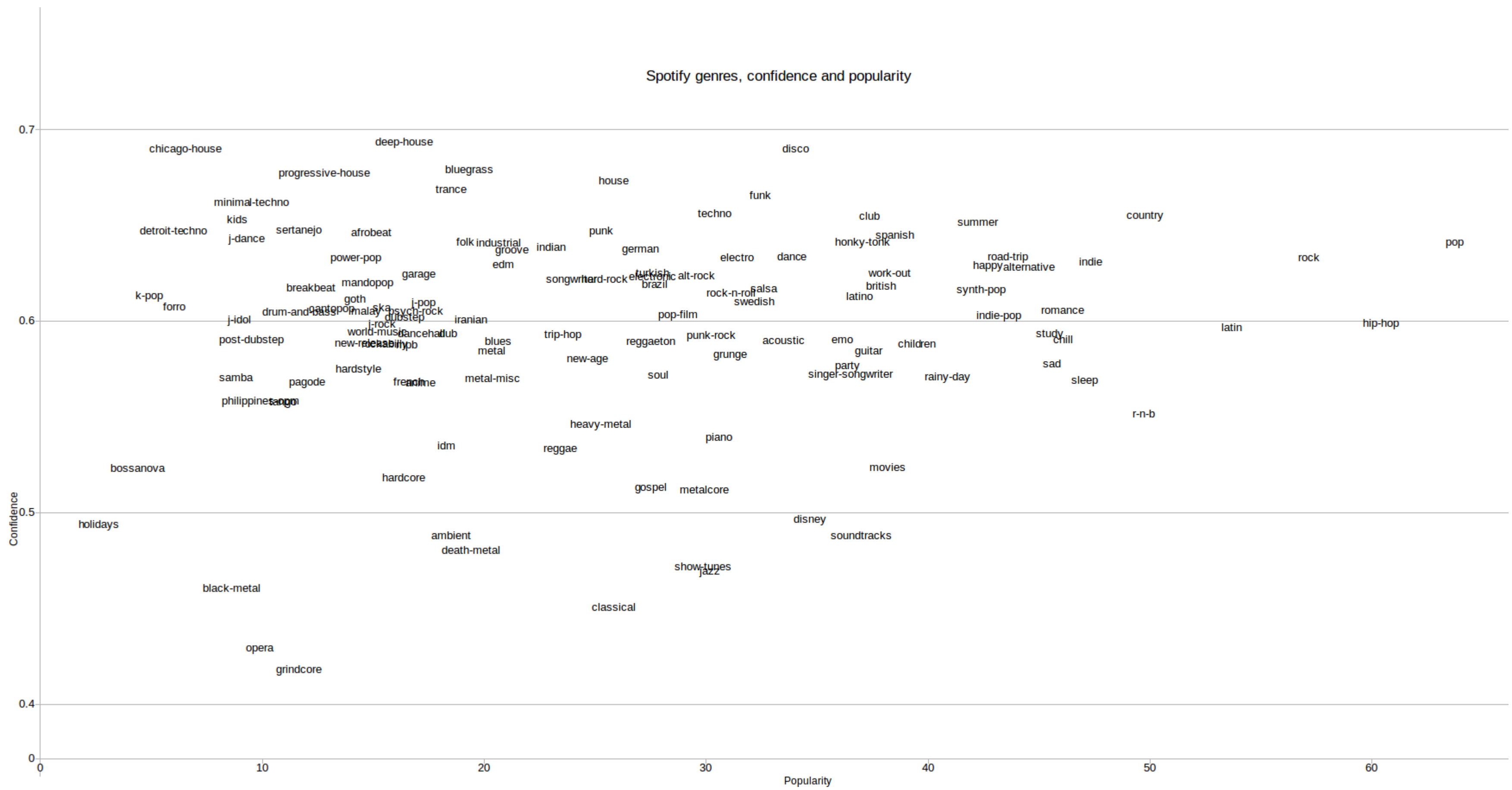

Figure 5.8: Spotify Genres, plotted as confidence and popularity

the genre as a whole has fewer tracks associated with it. But do we accept the idea that there are so many fewer "funk" tracks in existence that Spotify has more trouble populating 500 tracks with unique recommendations than, say, "turkish?" It doesn't seem likely. Given the immense size of Spotify's catalogue, and the comparatively small sample size for this experiment, it seems surprising that there are any such differences at all. And yet there they are; solicited for 500 songs, Spotify's recommendation engine recommended just 80 unique funk songs, whereas it recommended 320 unique reggaeton songs. The finding, in general, is that some genres are much more repetitive than others, in a way that is hard to explain.

Experiments 1 and 2 are about making determinations of aesthetic homogeneity. Experiment 1 determines which genres tend to be most and least diverse according to the four geometric methods, while experiment 2 uses average feature variance. By the convex hull method, the IDM genre is very consistently the most "diverse." By a thinner margin, it is also the most "diverse" as measured by Euclidean distance. By the dot product metric, on the other hand, it is never the most diverse. This seems to suggest, at a minimum, that the dot product measure is capturing something different from the other three, which is confirmed by the rest of the findings (the gold bars, indicating most homogeneous genres, are consistent across three of the measures, but they're different in dot product). These diversity metrics, moreover, seem not to correlate with the number of unique playlists particularly strongly. It is not the case, in other words, that it is simply the genres with the most unique tracks that rate as most diverse. Instead, the experiments seem to determined which genres "really" are more or less diverse, as measured in these four ways.

What do we make of the dominance of IDM? At first, I thought there must have been an error in my code. It seemed unlikely that a dance genre, any dance genre, would occupy this position. This perhaps suggests some of my own personal assumptions about the genre, about which I didn't know very much. The IDM genre ("intelligent dance music") turns out to be a sort of blend of metered dance music with an experimental, atmospheric style. It frequently presages backbeat dance sections with long, ambient sections. It may be that this blend lends itself to varied audio features readings. Many IDM tracks, for example, at first fail to establish a tonal center, but most eventually do. Some feature vocals, some do not. One hypothesis, then, is that IDM, as a genre that mixes electronically generated atmospherics with more familiar "danceable" tropes, is legible to the system as more "diverse" because it manages to score both high and low on these crude musical metrics. It would send the feature ratings in extreme directions, which my script would pick up as geometric spread-out-ness. As such this genre is an interesting focal point for the difference between human listening and machine listening: while probably no human listener would really understand the IDM genre as inherently "diverse," if I'm right about what's happening in these experiments, the machine will.

The above hypothesis, if we accept it, is actually a statement about how "IDM" sounds to Spotify. It is a possible explanation for why it would rank as "diverse" according to the methods employed in this experiment, and an interesting difference between human and machine listening. And there are other interesting findings like it. Classical music, for example, ranks as least diverse by the dot product metric *every* time. The least diverse genres as measured by convex hull tend to be the ones associated with particular cultures: mandopop, country, sertanejo, pagode, philipines-opm, cantopop, j-idol. This suggests that, whatever registers as "diversity" in IDM is manifestly absent in musics associated with particular nations and subcultures (of which I think "classical" is probably one, at least here in the Spotify universe). More generally, it seems that Spotify makes recommendations that are less self-similar for genres that are in an ambient, electronic vein: idm, ambient, post-dubstep, trip-hop.

It is probably not unfair to say that these "ambient" genres do all share certain broad traits. This is a difficult fact to reckon with, and one that admits various different readings:

- That listeners of these genres are getting a more aesthetically diverse experience than listeners of funk, classical, and minimal-techno. Here we assume that the feature extraction methods, and the aesthetic similarity measures built upon them, tell us something musically meaningful. We thus conclude that, in Spotify's system, some genres are genuinely more diverse than others. Then, we have to decide whether we think this is evidence that Spotify is working well, or that it is dysfunctional somehow; if classical listeners are getting a less diverse experience, are they being done a disservice by Spotify? Or is it actually working well for them? On this point, there are intelligent arguments in both directions; perhaps the greater homogeneity is just an accurate representation of certain genres.

- We take it for granted that all genres *should* be equally diverse, and point to the fact that Spotify's system does not reflect this as a dysfunctional behavior. Here, we assume that the similarity measures are meaningful, but are not committed to believing that the features themselves are meaningful; either they tell us something meaningful about the music, and the Spotify recommendations are defective, or they don't, in which case Spotify is defective in a different way.

- We reject the validity of the aesthetic homogeneity measures, and of the features themselves too. Here our interpretation is that the results tell us nothing useful at all.

Given the variety of these interpretive options, can we say anything certain about these results at all? I think we can, but only something rather humble. If we look at the results of experiments one and two together, the general impression is that a handful of genres tend to rank as least and most diverse. Which genres rank where varies somewhat from technique to technique, but it is never the case that more than 13 genres appear as either most or least diverse. There are, remember, 125 genres in total. The vast majority of genres never appear as the most or least diverse. It was *never* the case, for example, that the "new age" playlist was the most diverse one. It was *always* the case that "classical" was least diverse as measured by dot product. We might reasonably have expected a much wider spread, with, say, the title "most" and "least" diverse distributed among, say, 50 genres rather than 13. Even given the crudeness of the audio features, this does not seem like an unreasonable expectation. The picture we get, though, is considerably more constrained, with just a handful of extremes at either end. So, the humble claim is following from experiments one and two is that, even taking into account the dubiousness of the features and the diversity measures measures, Spotify does indeed recommend more diverse and less diverse playlists for a tiny fraction of the total number of genres in its system. Spotify has a few genres that, a striking majority of the time, lead the pack (and trail the pack) in terms of aesthetic diversity.

The finding of experiment four is straightforward: it shows that, for a majority of genres, it is possible to say with high confidence which feature is most discriminating. The feature that varies least for, say, alt-rock, is almost always "speechiness." The feature that varies least for "ambient" was *always* speechiness. Not all genres present with such compelling figures. That is to say, some genres don't really have *just one* most discriminating feature; features for their tracks tend to vary in more than one dimension. We might have expected many or most genres to behave that way, not presenting with just one feature that defines it a majority of the time. But this is not the finding; the vast majority of genres do give you just *one* feature that doesn't really change much no matter what, even thresholding at 97% confidence. This, too, can be a kind of a statement about Spotify in general: it is a system where, for a given genre, one thing usually emerges as the most discriminating feature. According to Spotify, "jazz" playlists vary least in their "speechiness" 100% of the time; this feature, more than any other, is the most definitive of the genre. The system is, in other words, sort of prejudiced against "speechy" jazz. There are, once again, readings of this that can see it as a defect and readings that can see it as evidence of success, but what is certain is that it is a true feature of the genre as Spotify understands it.

Experiment five plots every genre's mean confidence and popularity. The chart is a useful reference for the analysis of the other experiments but it shows little of consequence on its own, except for the rather predictable fact that most of the most popular genres tend to have high confidence measures.

5.4 Shadowboxing

From the analyses above, it should be clear what is meant by "shadowboxing." In part because of the scope of the project, and in part because of the nature of working with a for-profit corporation that does not disclose its trade secrets, there is an enormous amount of mystery in these experiments. There are many things I cannot know. I don't know how Spotify makes its recommendations; I am left to monitor its behavior instead of hypothesizing about its inner logic. I have no way to know in what ways its actual recommendations differ from the behavior of its API. A serious deficiency is that, lacking a machine listening engine of my own, I use Spotify's instead. While this makes sense from a certain perspective, it also presents with logical conundrums. Aesthetic diversity, after all, should probably be validated by some external system in order to become really meaningful; here I am restricted to using Spotify's metrics to analyze Spotify's behaviors. I don't even know what "genre" is to Spotify, beyond being an available recommendation seed; while there is no "genre" value assigned to a given "track" object, there might be one represented internally somewhere for Spotify. At the broadest level, I don't even know for sure that Spotify is even using the technology at work in this machine listening engine. Nor do I know whether Spotify's proprietary playlists, the ones users actually encounter, are machine or human curated, or both.

The results, moreover, while often quite interesting, are highly ambiguous. This ambiguity is intimately connected to the argumentative double bind of music recommendation discussed in the introduction to this dissertation: the fact that I don't know what would constitute a successful or healthy recommendation engine in the experimental terms laid out above. The results sometimes seem to go one way; but if they had gone the other, in general my interpretive extrapolations could have remained the same. If, for example, 70 genres had registered as "most diverse" by the convex hull method, I might reasonably have asked, why did not any genre emerge as the most diverse one? Don't genres, after all, sound different? If the goal was to reverse engineer the Spotify system, or to catch it in blatant acts of implicit bias, then it must be admitted that the results are profoundly inconclusive. They are, I think, enjoyable and can lay a valuable foundation for future experimentation that may indeed reveal something about Spotify, but they do not amount to an indictment of Spotify on their own.

On a higher level of abstraction, though, they do present something more instructive; the mere fact that the project undertaken here leads to a kind of solipsistic shadowboxing may be the whole point. The ignorance that I am kept in as an experimenter is the same ignorance facing all Spotify users, who also have know way of knowing how their recommendations are made. The fact that we are kept in the dark like this is a basic part of musical life in the era of digital streaming. This opacity has a practical dimension and a philosophical one. The difficulty I face, in other words, in defining the success or failure of Spotify is the same one Spotify itself must necessarily face is designing its system. No matter what choices you make as a critic – or, for that matter, as a designer – of a recommendation system, you pretty much have to end up talking yourself in circles. That's the true source of the ambiguity of the experiments above. In the world of automated music recommendation, whether we're users or critics, we are all in a sense shadowboxing.

This is not necessarily a bad thing. Like Spotify's recommendation engine, the shadowboxing I have done in this chapter occasionally (not always) produced worthwhile results. Shadowboxing, in other words, can be amusing. Even if I had definitively shown that it produced "more of the same" on the level of audio features, it would not necessarily be my place as a researcher to condemn that as a failed recommendation engine. Instead, my experiments can serve as a reminder that the right way to approach Spotify is probably philosophically, since quantitative critiques will always face the same kind of argumentative circularity. In order for the shadowboxing in this chapter to amount to real claims about the quality of the Spotify recommendation engine would mean taking on one commitment or another, embracing one theory of musical meaning as more "right" than another, which is the user's job rather than the researcher's.

Ultimately this chapter is a long winded way of reminding us, by way of a detailed look at its behavior, that Spotify's system is just one of many. Spotify's system will inevitably have made some commitments in that department; it may have hard-wired in a prejudice against one genre or in favor of one particular record label. We just cannot know what these are, if they exist at all (at least, not from the experiments in this chapter).

If we choose to regard Spotify recommendations as the almost-arbitrary output of the kind of shadowboxing I have done in this chapter, I would say that we are responsible Spotify users. 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. If, on the other hand, we accept that Spotify has some kind of special insight into musical meaning – that, in the words of Whitman, it truly has "learned the meaning of music" – we risk the musical equivalent of what Dreyfus warned us about in the 1970s with regard to the study of human intelligence in general. We risk, that is, not just getting it wrong intellectually, but blunting the very parts of ourselves that make the problem tricky in the first place. Bearing in mind that shadowboxing is the best you can hope for seems like a good way to avoid that.

Conclusion: Spotify, Semantic Skepticism, and Platform Capitalism

The original provocation for this dissertation was a talk I saw by a leading researcher in the field of MIR. As he described a new project of his that would make recommendations for users based on very refined information about their activities and whereabouts, I heard for the first time some of the standard strategies for getting a machine to recommend music to a user. You can base the recommendation on information in the audio signal, like its key, tempo and mode. Or, you can use its its metadata: country of origin, genre, user reviews, etc. You can use collaborative filtering, or you can use "personalization." You can log real-time information about your users, like their location or even, he said hopefully, their biometric data, and make judgments about what music will be best for the given activity or mood. We can know that user X is almost certainly at the gym on such a day at such an hour, and so we can know to make recommendations for exercise music. The idea that was always present but left unsaid was that this kind of situational appropriateness would give us a market edge. The market orientation of the research was taken for granted, and it seemed to imply certain ideas about what music could mean. The engineering involved in such a system is by no means trivial, but the outcome itself – getting the right music for the right moment – seemed odd to me as an exemplary case of a successful music recommendation. As we have seen, these days this kind of situational appropriateness is essentially Spotify's whole mission statement. The idea that music is for situations has hardened into a foundational truth for the automated music recommendation industry, and, as the latter sits at the center of the industry's financial recovery, into the a core principal of music listening in the 21st century.

As I listened to the presentation, it occurred to me that most of the musicians I know don't even listen to music while exercising. It would be distracting, and you wouldn't be able to hear the music well enough to really enjoy it. At the risk of reinforcing an outdated myth of the idealized listener, I'd say that for many musicians it might even feel disrespectful or sacrilegious to turn music into background music like that, to relegate it to a kind of sonic adornment. These artists didn't labor every day of their lives so that my time on the stairmaster would be more endurable, I thought, indulging in a rather common flavor of 21st century Romanticism as I heard the researcher speak. Adorno's grand ideas about music communicating some abstruse kind of truth content, hard as they sometimes are to swallow, do give voice to an intuition that is, I think, shared among many musicians to this day: that music really *does* matter, that it's not just a diversion or a side dish, that it stimulates a unique kind of critical intelligence and merits serious, devoted attention. Automating music recommendation, in its commitment to the "music as soundtrack" idea, seemed to do violence to this intuition, and thus to something basic in the discipline of music itself.

At the same time, to privilege that kind of listening, the one where you take music so seriously that you couldn't possibly be doing anything else at the same time, or where its meaning has at some level to be inherent and in no way dependent on other factors, resumes a milder version of the musical absolutism that, for good reasons, most of musicology has moved on from. The musical features amenable to workouts, for example – repetitiveness, accessibility, sensuousness, what Adorno derisively called a "culinary" quality – have traditionally been the grounds upon which structures of elite music have dismissed and excluded popular forms.[18] Since excluding popular forms is unacceptable, this presents a tricky conundrum: one intuition says that

18. Richard Middleton, "In the Groove or Blowing Your Mind: The Pleasures of Musical Repetition," in *The Popular Music Studies Reader*, ed. A. Bennett, B. Shank, and J. Toynbee, Popular music /cultural studies (Routledge, 2006).

tethering automated music recommendation to the "situational" must miss something important about what musical meaning really is, but another has difficulty locating that musical meaning anywhere that doesn't feel like a stodgy rehashed Romanticism.

My way out of this conundrum is via Noam Chomsky and his lucid expression of what is sometimes termed semantic skepticism, or, in John Searle's words, the idea that meaning is "too vaporous and unscientific a notion for use in a rigorous science of language."[19] That comment was made in connection with the structuralist school of linguistic inquiry, which Chomsky is usually thought to have overturned, so it may seem odd to align it with Chomsky. But the truth is that Chomsky's "internalism" too is somewhat quiet on the subject of semantics. Since his system approaches language as a basic biological endowment to be studied for its formal properties (its syntax) rather than one whose primary function is communication, the whole idea of semantics sort of takes a back seat. That we communicate meanings with language is, for Chomsky, true but somewhat incidental to the study of the language organ.

This complicated idea has many implications. The one that applies here is that "meaning," while definitely real, is also scientifically intractable and probably inextricable from the beliefs and world view of the speaker. It is not unreasonable to extend this idea to the musical domain, and when we do, a philosophical posture toward Spotify becomes available that neither indulges the market-inflected pretensions of the automated recommendation industry, nor dismisses vernacular musical forms and casual listening.

Recall the quotation, referred to frequently throughout this dissertation, that "meaning ain't in the head."[20] The assertion is made, originally, as part of Hilary Putnam's effort to attack semantic internalism, the idea that, just as there are formal rules governing the transformation from deep structure to surface structure in language, so there exist on some level internal mental representations corresponding to what we think of casually as the linguistic "meaning." Putnam, in other words, is attacking the idea that meaning *is* in some sense in the head. A good expression

19. John R. Searle, "Chomsky's Revolution in Linguistics," *The New York Review of Books* 18, no. 12 (1972).
20. A paraphrase of the thesis in Putnam, "The Meaning of 'Meaning'"

of the kind of semantic internalism against which Putnam is positioning himself is Jerrold Katz's "Chomsky on Meaning," where he makes the case, actually against Chomsky, that linguistic theory *can* provide a system for the representation of meaning (Chomsky's skepticism about this will be reviewed in a moment).[21] Putnam argues that there are no such "linguistic universals" as those posited by Katz, and that, instead, theories of meaning, essentially, should look for the relationship of mind to world (the subject of traditional semantics) in a "sloppy and impressionistic fashion." Semantic theory, dealing with the unruly matter of how people try to refer to things, ought to be seen as part of "social science."[22] So we see, once again, just how coherent an application of Putnam's approach to meaning is found in Whitman's 2005 dissertation and, I argue, contemporary Spotify, which, amalgamating various types of internet behaviors and dumping them into a support vector machine, really is an exceptionally sloppy (sloppier, probably, than Putnam would ever countenance) form of social science.

But the point here isn't that Whitman has correctly cited Putnam. Nor is it to replace Putnam's impressionistic social science or Whitman's data driven recommendations with a theory of internal music-semantic "universals." That would mean, in music, a "content only" approach to recommendation that derives musical information from the audio signal alone, which Whitman is correct in claiming doesn't work very well. Instead, my point is to look to semantic skepticism as a verification for what feels intuitively wrong about an automatic system of music recommendation in the first place.

Semantic skepticism comes in more than one flavor. There is Wittgenstein, who ridiculed the whole idea of looking for word-world correspondences as unscientific:

> You say: the point isn't the word, but its meaning, and you think of the meaning as a thing of the same kind as the word, though also different from the word. Here the word, there the meaning. The money, and the cow that you can buy with it.[23]

21. Katz, "Chomsky on Meaning."
22. Hilary Putnam, "Is semantics possible?," *Metaphilosophy* 1, no. 3 (1970): 201.
23. Jeff Speaks, "Theories of Meaning," in *The Stanford Encyclopedia of Philosophy*, Fall 2019, ed. Edward N. Zalta (Metaphysics Research Lab, Stanford University, 2019).

Or, there is Quine, whose thesis of translational indeterminacy undermines the whole possibility of a "semantic theory."[24] Then there is Chomsky's skepticism, similar but not identical to these two, maintained more or less in tact throughout his career. As John Searle points out, Chomsky's indifference to meaning is actually something he shares with some of the behavioralists he is credited with overturning, but which probably comes from his deep philosophical commitment to syntax as the essence of the language organ.[25] Here is a representative comment of Chomsky's on meaning:

> Much of what is often regarded as central to the study of meaning cannot be dissociated from systems of belief in any natural way.[26]

The study of language, for Chomsky, is the process of discovering the rules by which a certain biologically endowed component of mind operates, to solve the following empirically observable puzzle: how is it that mastery of language means the capacity to produce an infinite number of expressions that are not analogous to previous experience? This is the puzzle of what Chomsky terms the "creativity" of normal language use.

It will be useful at this point to review a concrete example of a Chomskian insight. In English, nominal phrases exist for sentences whose surface form and deep structure are close, but not for sentences where they are remote. This degree of proximity can be rendered precise. The rule explains thus the empirical fact that, for the sentences

1. John is certain that Bill will leave

2. John is certain to leave

there is a correct nominal phrase "John's certainty" corresponding to (1) but not to (2).[27] We can observe this English peculiarity as a matter of empirical fact; it is the job of linguistic theory

24. Willard Quine, *Word and Object* (MIT Press, 1960).
25. Searle, "Chomsky's Revolution in Linguistics."
26. Noam Chomsky, "The logical structure of linguistic theory," 1975, 23, quoted in Katz, "Chomsky on Meaning"
27. N. Chomsky, *Language and Mind* (Cambridge University Press, 2006), 89ff.

to explain why it is so. This example is trivial but nevertheless serves to illustrate the kind of knowledge that generative grammar aims for: the description of rules according to which a natural system (language) operates. This is distinct from the project undertaken by Putnam, which instead attempts to render precise a concept "meaning" that is, for Chomsky, basically unscientific.

Deeper examples than the one reviewed here, moreover, have deeper implications for theories of psychology and philosophy of mind in general. They will tell us something about what it means to be human in the first place. And although he is always careful to avoid humanistic representations of the internalist perspective, these conclusions have unambiguous implications outside of linguistics, some of which even Chomsky acknowledges. One of these implications, for example, involves human-technology interactions:

> Technique and even technology is available for rapid and efficient inculcation of skilled behavior, in language teaching, teaching of arithmetic, and other domains. There is, consequently, a real temptation to reconstruct curriculum in the terms defined by the new technology.[28]

This skepticism about the technologization of education, the replacement of real learning with mere proficiency, oddly echoes Hubert Dreyfus. It is also probably what motivates Chomsky's frequent indifference about the prospect of machine intelligence more generally. And, more than that, it implies a devastating critique of many different fields that are in one way or another built upon behavioralist assumptions. Among these fields are, of course, the social sciences. As Harry Bracken writes,

> Chomsky's attack on behaviorism has threatened the social scientists. That in turn has begun to affect the university institutionalization of the social sciences – and hence, in a perfectly direct way, university educational policy.[29]

Internalism and semantic skepticism, in other words, seem to imply not only a rejection of behavioralism, but also a rejection of those social sciences premised on its fictitious pretensions to scientific objectivity. The rejection of behavioralism amounts to "a broad assault on the political

28. Chomsky, *Language and Mind*, 89.
29. Harry M. Bracken, "Minds and Learning: The Chomskian Revolution," *Metaphilosophy* 4, no. 3 (1973): 230.

role of the social sciences and the cult of the expert."[30] Recall that "sloppy social science" is exactly what Putnam called for as a research program into a theory of meaning; recall also that sloppy social science seems to be a good description of at least part of what goes into the Spotify recommendation algorithm. The simple idea that normal language creativity is not, in fact, under any stimulus control, that it is not necessarily "for" communication, and that all people are basically born with the same biological endowment – ideas that are in fact, for Chomsky, recovered from Descartes and Wilhelm von Humboldt,[31] – demand that we take a close look at structures of authority that claim to have found the "key to understanding man's apparently unique qualities of mind."[32] Behavioralism and the social sciences are two places where that skepticism should kick in; automated music recommendation, which 1) deals with a medium as distinctively human as language while being even less obviously communicative, and 2) does so in a way that closely resembles social science, is another.

Usefulness

To return to Adorno and music recommendation itself: as I sat listening to the MIR research mentioned above, it occurred to me that the whole idea of automating music recommendation seems like a paradigmatic example of a great Adornian sin, the instrumentalization of reason. What is the industry of automated music recommendation if not the application of complex logical processes to standardize and automate what should be one of the most human expressions of all? And this particular expression, music, is Adorno's personal favorite, the art form around which more than any other he elaborated a theory of aesthetics that located art at the center of human individuality and freedom. Music was his best hope for mankind, our last guard against the totalizing crush of mass culture and the dark side of enlightenment. In the industry of automated music recommendation we have a large apparatus of speculative capitalism, leveraging

30. Bracken, "Minds and Learning: The Chomskian Revolution," 234.
31. Chomsky, *Cartesian Linguistics: A Chapter in the History of Rationalist Thought*.
32. Chomsky, *Language and Mind*, 88.

the latest fad in mathematics (machine learning) to tell millions of people how to listen and what to listen to; how could it fail to have the same neutering effect on music today that Adorno noticed with respect to Beethoven and the radio? When it comes to automatic music recommendation, in other words, the scene is set all too perfectly for a heroic act of Eve Sedgewick's "paranoid reading"[33] and the critical apparatus of *Dialectic of Enlightenment.* Somebody, it seemed, had to pull back the veil and reveal the industry for the ideological steamroller it undoubtedly was.

Spotify's API often seems to confirm this paranoia. A song is reduced to an atomistic "analysis" with a crude semantics heavily geared toward the musical attitude evinced in the Spotify slogan, "soundtrack your life." Music can be happy or sad ("valence"), it can be danceable or not ("danceability"), it can involve human speech or not ("speechiness"), etc. A song, that complex conjunction of memory and sensory pleasure and identity construction, is represented as an array of 10 floating point scalars. These scalars, moreover, explicitly participate in a system that locates the meaning of music in its relationship to non-musical things and events. In this way Spotify's marketing strategy and its GUI are in striking harmony with each other, and, moreover, with the philosophical posture assumed in Brian Whitman's 2005 dissertation: that musical meaning is "relational." Or, as Ellen Degeneres puts it in her promotional materials for her partnership with Spotify, music "makes everything better." The consistency across the academic dissertation, the GUI design, and the marketing is remarkable. Such a system leaves little room for any kind of Adornian locution, or the closely aligned romantic aesthetics of music that are actually pretty common today. Listeners who want to see critical truth content represented in Spotify, of course, will always be disappointed. Art may be "the social antithesis of society," but that fact will never be part of a Spotify recommendation.[34] An intimation of the absolute, of which this kind of truth content can be seen as a kind of variant, is not something we would ever expect the Spotify API to capture.

33. E.K. Sedgwick et al., *Touching Feeling: Affect, Pedagogy, Performativity*, Series Q (Duke University Press, 2003).

34. T.W. Adorno et al., *Aesthetic Theory*, Athlone Contemporary European Thinkers Series (1997), 8.

So far we are on firm ground; even a mild version of this kind of aesthetic theory will definitely be incommensurable with machine listening and recommendation. What would it even mean for a machine to understand the socially antithetical character of music? It is hard to imagine there actually being an answer. In other words, Spotify's machine listening outputs, while more sophisticated than their competitors', are crude. This is not really a novel finding, however, and is really little more than saying "machine listening isn't the same as human listening." It is an obvious claim, not a particularly interesting one, and even it can always be parried with the familiar adage in statistics from George Box, cited previously in this dissertation:

> All models are wrong, but some are useful.[35]

This insight appears in a paper about the scientific method in general. It is in the nature of scientific knowledge, Box points out, to be approximate; the essence of the scientific method is the "iteration between theory and practice." Theories – all of them – are wrong or incomplete, to say nothing of the ways in which they are also informed and inflected by the social positions of the people assembling them.[36] The famous case for this lesson in the philosophy of science is Newton's laws of motion. They are silent on where the gravitational force comes from, on exactly why it is that two bodies have this strange property of attracting each other. They have, moreover, been superseded by Einstein's theory of general relativity, which recasts the gravitational force as an expression of the curvature of space-time. Newton didn't know about space-time. Would it be accurate, then, to say that Newton's laws were wrong? No, it would not, because all models are wrong, and scientific models are "right" insofar as they tell us something useful about the universe. Newton's laws remain very useful and are taught unceremoniously as true facts in high school physics courses to this day.

It is a very special sense in which these laws are useful, though, and this is perhaps the sticking point when it comes to music. Newton's laws have the virtue of explaining effectively

35. Box, "Science and Statistics."

36. As Donna Haraway writes, "official ideologies about objectivity and scientific method are particularly bad guides to how scientific knowledge is actually made."Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective"

some observable phenomenon in the universe, solving a scientific problem. Aristotle was wrong; a heavy stone does not fall to the earth faster than a light stone. Newton's theory explains why (its greater gravitational acceleration is offset by its greater inertia). It is in this respect specifically that Newton's laws are useful, and it is this usefulness that qualifies them still as scientific knowledge. The theory that superseded Newton's is useful in exactly the same way.

Spotify's "theory of musical meaning," such as it is, is also useful, but in a different way. As I hope that my reading of Whitman and the Spotify GUI have shown, this theory does not really tell us anything about the universe. There is no empirical puzzle that it solves. There do exist real problems when it comes to the study of musical meaning: why does music, which is just a bunch of sound waves ordered in enigmatic, unsystematic ways, appear so profoundly meaningful to human beings? That is the problem of music, considered scientifically, and it is this question to which the majority of the authors in surveyed in Chapter Four address themselves. Music works by delayed gratification, or by facilitating identity construction, or by exercising a hypothesized music organ analogous to the language organ – these are proposals with true explanatory power. Spotify, though based on an academic dissertation called "Learning the Meaning of Music," does not share this property.

The Whitman dissertation, in other words, effectively ignores the problem of musical meaning, even as it sort of misconstrues other efforts to solve it. In doing so, Whitman really wants to have it both ways; he sometimes seems to be making statements about the meaning of music as this problem has been construed by philosophers from time immemorial, but sometimes seems simply to be building a system whose ultimate purpose can only be commercial. The question becomes, exactly how tongue-in-cheek is the dissertation's title? Sometimes, it seems to be winking at us. "Learning" as in machine learning, clearly. But "meaning" as in...what exactly? This is, after all, a dissertation accepted for publication by a prestigious institution of higher education, which would traditionally mean it contained knowledge. It ought to be "useful."

And so it is, but only if we construe Box's "useful" in a way that he probably never intended it: as referring to potential "uses" in commerce. It is useful for increasing "enjoyment," which, as Yves Raimond observed in a recent paper at ICML, "directly impacts customer satisfaction" in recommender services.[37] That a dissertation can be published that is "useful" in this narrow sense is perhaps an expression of just how deeply the academic profession has been penetrated by the ideology of capitalism. What in another era might have been classed as an invention, subject to patent protections instead of academic credentialization, today gets institutional sanction as a kind of knowledge. Whitman's dissertation earned him a Ph. D., but it was always pointed at industry, which is where he headed immediately after finishing it. And on some level this rhetorical slippage – between "useful" as scientific and "useful" as commercial, between research as knowledge and research as products – serves Spotify in its commercial application. Their pretension to knowledge, the idea that a particular company has "solved the problem" of musical meaning, is a major part of what music information companies are selling; this is perhaps most visible in the pseudo-scientific jargon of Pandora around its "music genome project" but the posture is equally true of Spotify and most of the others. They're supposed to have real insights about musical affection. They're supposed, in other words, to have solved it.

If Spotify doesn't have some special kind of insight, why after all should it deserve its annointed status as the savior of the music industry? If there is anything this dissertation has demonstrated clearly, it is that Spotify is not so exceptional. Not legally, not technologically, and not philosophically. Spotify is an good expression of the copyright norms for which the recording industry has been lobbying heavily since the 1970s. It is an ingenious, but not terribly innovative, combination of natural language processing, DSP and machine learning. And philosophically, its major commitment seems to be that "music" equals "soundtrack." There is nothing necessarily diabolical about these features of the Spotify service, especially from the commercial perspective, but they are definitely not particularly innovative. Spotify's great insight, if it has one, is simply to

37. Seen in his paper, "From Listening to Watching, A Recommender Systems Perspective," ICML June 2019, https://slideslive.com/38917438/from-listening-to-watching-a-recommender-systems-perspective, accessed 9-01-2019

become what Napster was trying to become in 2001 but couldn't: a digital distribution platform that the major labels are invested in, whose copyright norms are written into the technology, and from which they alone profit.

Spotify as Platform

To claim that Spotify is unexceptional sounds mild, but I don't mean to downplay the weight of that insight. To show that Spotify is not that special involved a close reading of Whitman's dissertation against the philosophical tradition in which it partially situates itself, and a comparison of that dissertation with the behavior of the GUI. It also meant situating Spotify in the history of copyright legislation in the 20th century. It runs against the grain of Spotify's marketing, and it can re-frame how we think of the future of the music business in general. It means, in other words, seeing Spotify as primarily a straightforward economic actor rather than some novel type of entity with some special power to reinvigorate a troubled industry. With the decline of CD sales at the end of the 20th century, the record industry faced a crisis, from which it has only partially recovered. Streaming music is the prime driver of that recovery, and Spotify is the biggest streaming music company. It is, moreover, one of the few to have traded on the music commodity alone (others, like Amazon and Apple, use music to sell other products and services).[38] This has led many to see Spotify as *the* driver of the industry's recovery.

But that picture, as I have argued, is misleading. It would be more accurate to see Spotify as a straightforward case of "platform capitalism," that is, as a company that sells a platform rather than a traditional service. A company whose nominal purpose is to bring two things together (users, say, and music catalogues) but whose true traffic is in data, participating in a system where "the product of work becomes immaterial." The rise of the "platform" in the US economy, according to Neal Srnicek, is a kind of compensation for the decline of the manufacturing sector; the economy has "turned to data" because traditional production has ground to a halt, and because

38. Although Spotify is aggressively developing its podcast platform.

post-2008 monetary policy has freed up enormous amounts of capital eager to see a better return than the Fed-mandated low interest rates. This signals an economy dominated by a new class that controls not the means of production but rather holds ownership over information.[39] Platform capitalism is a model in which data is the raw material. This material takes novel forms (forms whose immateriality is usually overstated, witness the enormous amounts of energy needed to run a data center) but is nevertheless produced and exploited in ways perfectly familiar from older forms of capitalism.

The only way, then, to really understand tech platforms, is to abstract them from the "Californian values" with which they are so deeply enmeshed, and to see them as a straightforward capitalist actors in the traditional sense. Doing so reveals, for Srnicek, that in most of the important ways, the tech companies that appear to be so novel actually represent "simple continuities" of traditional forms of accumulation and exploitation.[40] All of which gives us a different perspective on the Spotify business model from their marketing materials. It also suggests a different perspective from the one taken in the quantitative experiments conducted in the previous chapter. We ought to look not at the music data, or at the recommendation engine at all, but at the economics, since that has always been the guiding principle for Spotify. As a "platform" in Srnicek's sense, Spotify could be successful, for example, by being purchased by a larger company, which many have speculated will happen soon.[41] That company might go on to turn a profit by finding a way to sell its user data. This would, at any rate, be the normal course for an internet company that doesn't have a true commodity from which it can actually profit; if these are Spotify's maneuverings, the whole quesiton of musical meaning and its commensurability with machine intelligence is irrelevant.

Spotify does not contribute directly to swelling the ranks of new social class of the

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39. Srnicek, *Platform Capitalism*, 3-10.
40. Ibid., 9.
41. See, e.g., Tim Ingham, "Who Will Own Spotify in Five Years?," accessed September 9, 2019, https://www.rollingstone.com/music/music-features/who-will-own-spotify-in-five-years-876693/

"precariat" in the way that Uber does.[42] Nor is its monopoly power as decisive as the power wielded by Facebook and Google. Nevertheless, insofar as its true commoditites are its own technological novelty and its surveilled user data, and insofar as its value as a service scales in direct proportion to its size rather than its quality (which, as we have seen, is pretty much impossible to gauge), it can coherently be regarded as part of the same economic trend. This is a trend that, according to Frank Pasquale, can be told with two narratives, one positive and one negative. It is either an invitation to make a living with flexible, creative labor (the "neoliberal narrative") or a "glidepath to precarity" (the "progressive narrative"). There are, of course, legions of musicians ready to accuse Spotify of exploiting their creative work and making it harder to make a stable living. Pasquale's sympathies are clearly with these exploited workers, but he also argues in general against the monopoly that atomistic, quantitative narratives have on the truth about platforms. Narrativity, he argues, is valuable precisely because it *doesn't* "model our understanding of people on our understanding of atoms or molecules; nor [does it] promise the false precision of numerical estimates of well-being."[43] The numbers about Spotify as a business, in other words, don't tell its whole story. In much the same fashion, nor do its numbers about musical meaning.

This leads to an unflattering but instructive comparison. If Spotify was never actually supposed to turn music profitable again, it would mean that Spotify is no different from, say, the Angry Birds smartphone game, which earns its money by selling the geolocation data of its customers to third parties. This leads naturally to a comparison between the pseudo-service provided by Angry Birds (the game) and the Spotify recommendation engine; can we conclude that Spotify's recommendation engine is not really about musical quality at all, but is "gamefied" in the same way that Tinder, or Angry Birds, is? Can we assume that Spotify, like so many other digital platforms, wants nothing more than to retain its users, monitor their behavior, and eventually sell that information to the highest bidder? Can it be that a statistical query of Spotify's

42. Guy Standing, "The precariat," *Contexts* 13, no. 4 (2014): 10–12.
43. Frank Pasquale, "Two narratives of platform capitalism," *Yale L. & Pol'y Rev.* 35 (2016): 309.

recommendation behavior (like mine, or like Ericksson's) is no more musically valuable than the same query brought to bear on a non-musical platform?

We cannot make that claim yet, but it is to this conclusion that the suggestion that Spotify is not special points. Nothing, after all, could be less exceptional than a company that lures us into volunteering personal information, and then sells that information to a data broker. We confront that kind of thing constantly. The data broker Axciom, for example, claims to have information on "two thirds of the world's digital population."[44] As Tim Sparapani, the former director of public policy at Facebook, puts it, "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."[45] Spotify doesn't even own the stuff that constitutes its "primary" source of income; the only thing it can really be said to own is the immensely valuable information about what music people like: data, the raw material of platform capitalism. Whitman's dissertation certainly hasn't "learned" the meaning of music, but the company that is built upon it certainly trades upon the fact that musical meaning is real. Given how personally meaningful music is for almost everyone on earth, it seems safe to assume that Spotify is sitting on some extremely valuable information. All Spotify would have to do would be to click the link on Axciom's site that promises to "create new revenue streams," and they could finally start making money. If Spotify is so unexceptional as to be a participant, present or future, in this "new data economy," it could mean that its recommendation engine is really no more musically significant than Angry Birds. The recommendation system, in other words, would be exactly what Nick Seaver said it was: a "trap," a way to seduce users into retaining engaged and surrendering as much valuable information as possible.[46] Incidentally, this conclusion would also obviate certain music-focused parts of the critique mounted in this dissertation.

44. From Axciom's promotional video, available at https://www.acxiom.com/

45. In a recent interview with CBS news: https://www.cbsnews.com/news/the-data-brokers-selling-your-personal-information/, accessed 09-09-2019

46. Seaver, "Captivating Algorithms: Recommender Systems as Traps."

This actually seems plausible, but this dissertation does not support that conclusion exactly. We know that Spotify is, from a copyright perspective, unexceptional. We know that it has not managed the miracle of making music profitable again, any more than Napster did. We know that it logs lots of user data, and we know that it has never yet turned a profit. We know, moreover, that Spotify allows advertisers to target users based on their listening profiles; according to Spotify's privacy policy, "we use marketing and advertising partners to show you more tailored content."[47] We know that Spotify is intimately connected with Facebook, which is essentially an empire of monetized user data with a reputation for low integrity in data privacy. If Spotify turned around and sold all our data tomorrow, it wouldn't be the craziest thing that ever happened; nevertheless about its plans for the future we can only speculate.

What does this tell us about its recommendation engine? The short answer is, nothing. The recommendation engine remains a protected trade secret whose true operation is probably not understood by anyone, even internally at Spotify. Considering Spotify as a case of platform capitalism, the best we can do is situate Spotify in the relevant context: we can describe the way things are done in Silicon Valley, and outline the economic pressures exerted on Spotify the company. Doing so predicts certain seemingly sinister practices from Spotify, but it doesn't necessarily tell us anything precise about the recommendation engine's efficacy. The fact that Tinder and OK Cupid's real business models might be trafficking in user data, after all, does not exclude the possibility that, in addition to being effectively gamified data mining tools, their systems do make good recommendations. Or, to put it more precisely, that in spite of the fact that there is probably no such thing as a "good recommendation," in Tinder or Spotify, people do actually fall in love on these services. Tinder doesn't need people to fall in love, any more than Spotify needs us to like our recommendations. But commerce and beauty can happen at the same time; even if it did turn out that the whole idea was always to monetize stored user profiles, the Spotify recommendation engine could still be of very high quality.

47. Spotify, "Spotify Privacy Policy," accessed September 9, 2019, https://www.spotify.com/us/legal/privacy-policy/.

But *is* it high quality? If we try to approach that admittedly alluring question, we quickly lose our footing. Which brings us to the "dissolution" indicated in this dissertation's title. What would it mean for a recommendation engine to be high quality? Would it mean selecting, from a set of music that you already love, music that is appropriate for whatever mood you happen to be in at a given moment? Suggesting music that you didn't already know but which you then turn out to like (what the industry terms "serendipity")? Would it mean deliberately broadening your horizons, or understanding what your horizons are and remaining squarely within them? Or, would it simply mean doing whatever it is that keeps users logged in and generating new profile data? Any one of these goals is plausible; none is more right than the others, even if the economic pressures on Spotify strongly incline toward the last one. The whole idea of a "good" recommendation system, in other words, dissolves when you try to figure out what it would really mean.

Which, in a sense, is the same reason that statistical "shadowboxing" is all we can manage with the Spotify API, and why the quantitative results in Chapter Five are so inconclusive. Just as it is almost impossible to imagine one model of success in music recommendation, it is equally impossible to put your finger on any one indicting piece of statistical evidence. I show, for example, that a handful of genres do in fact turn out to be more diverse than others. Classical music, by one measure, is the least diverse genre 100% of the time. IDM seems, somewhat surprisingly, to be consistently the most diverse. These are findings of the same type as those of Erikssonn et al, who, for example, show that older users in general tend to get more unique artists recommended.[48] They also note that most Spotify proprietary playlists tend to have happy themes rather than sad ones.[49] For some users, these kinds of finding may be genuinely concerning. They might even feel like the "smoking gun" some skeptical luddites hope for.

Probably for most readers this will not be the case. For some, these findings could even be an indicator of a well-tuned system. That's what makes it shadowboxing – any conclusion we're

48. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 134.
49. Ibid., 125.

likely to find is neutralized by the intractability and irregularity of the object under experimental scrutiny. Musical meaning remains as nebulous a quantity in the 21st century as it has been throughout the long history of aesthetic philosophy. The Spotify system is predicated on the attempt to solidify musical meaning, to make it legible to a digital information system. For all the plasticity and interpretational obscurity presented with contemporary machine learning models, they are still essentially digital, in particular when they produce simple binary classification outputs. Does this seed genre produce this recommendation? It's a yes or no question, and the only sense in which the answer to it can be successful is a commercial one. Whether or not users stay logged in, a purely financial measure, is the only measure that seems not to evaporate upon close inspection. In a philosophical sense, on the other hand, it seems pretty clear that musical meaning, like meaning in general, is not any one thing such that it can be specified or have attributions made to it.

This dissertation, in other words, ultimately sides with Chomsky (or, at least, mimics him in the musical domain) on the question of precisifying "meaning." This is a simple claim that might strike some people as anti-philosophical: any pre-theoretical inquiry into musical meaning is a topic unworthy of philosophical attention. There is no real quantity "meaning" such that it can be located in the audio signal, cultural metadata, the relation between them, or anywhere else. The attention this topic is given in Whitman's dissertation, and even more so in Spotify's system, is not scientific but rather commercial. Its definition of musical meaning is, as a result, stipulative rather than explanatory, and its true goal was always industrial implementation rather than knowledge. It is more of an invention than a discovery. What Whitman terms "musical meaning" is the philosophical equivalent of any proprietary term of art. It's something like the way computers are said to go to "sleep." *Sleep* here is an invention made by the computer manufacturer to the improve battery life of its products; it doesn't tell us anything about the kind of "sleep" that doctors might want to study to understand this peculiar property of human biology. The same is true of Spotify's *meaning.* It is no more a statement of fact about the world than the Spotify "track" objects are actual pieces of music. True philosophers of musical meaning, whatever we might say of their results, *do* try to think about musical meaning in a scientific sense: they try to answer questions that arise from the actual operation of music in the world. Leonard Meyer really does posit an answer to the problem of how music works on people. In a very different way, so does Susan McClary. This is just a different kind of project from Spotify's.

Which brings us back to the nature of the Spotify project, and the related question of why Spotify cares if users listen. As Eriksson et al point out, the Spotify pitch has always emphasized scale.[50] Spotify has both a larger user base and a much larger catalogue than, say, Netflix; it's a similar machine learning problem posed on a vastly larger scale. But users don't care about scale; only investors do. Spotify's investors (Goldman Sachs, Coca-Cola, countless Silicon Valley investors, and after Spotify's IPO, its public shareholders) are the audience Spotify will ultimately have to satisfy. And these stakeholders are not to be satisfied with the musical commodity, no matter what contortions Spotify forces it into; they are interested in stock value, of which scale is, in today's investor climate, a primary determinant. Spotify's real marketplace, in other words, is in finance, not music.

We would expect such a system to behave more or less like Tinder's, whose commodities are, similarly, *not* those of human affection around which its sales pitch is structured. It makes sense, when you look at Spotify from this materialist perspective, that its system would seek simply to tap into a basic human need as a way of keeping users engaged. That's why Spotify promises to make our lives better, to make us happier, to help us better conform to the "chrononormative" picture of happy, productive, fit consumers, engaged in various enriching activities at different times throughout the day.[51] As Eriksson et al point out, "soundtrack your life" really means that music can make your *work* life (specifically, your office life) better, can help you get fit at the gym, or focus better while you're preparing for an exam. The "curatorial turn" for Spotify may have meant that the company had to start making judgments about music itself in

50. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 160.
51. Ibid., 153.

a way it never had before, but those judgments are ultimately far less important than the metric of user retention. Recommendation quality and user retention are essentially the same thing for Spotify, and the primary task of machine learning is unambiguously to keep users tuned in for as long as possible, something that Spotify's vice president of machine learning makes clear:

> My hope is that three years from now, machine learning becomes less myopic. It should figure out the best sequence of actions to lead you on a journey where you discover new great audio content, become more engaged, and stay satisfied as a listener for years to come.[52]

The facile critiques of Spotify's machine listening and recommendation engine, in other words, while they might be right, also miss the point. The system doesn't have to be good at understanding musical meaning, isn't even aiming at a "good" recommendation service, unless we define the same as one that keeps people tuned in. The Spotify business model has shifted over the years, from one where users were assumed to have their own well-defined musical preferences to one where Spotify helps you figure out what those preferences are. The business model, though, an unexceptional case of platform capitalism focused on financial markets and scaling up aggressively, has been totally consistent.

The affect management element of Spotify's service may indicate a more salient critique than quantitative methods ever could. Again, like Tinder, Spotify has every incentive to try to convince its users that it will make them feel better. The "mood" section in Spotify is really a series of mood *management* tools: "mood booster," "have a great day," "confidence boost," "sunny bliss," and many more of the like. Even the nominally "sad" playlists promise some kind of consolation or soothing. The "life sucks" playlist, for example, offers commiseration: "Feeling like life sucks? We've all been there."[53] This particular playlist, as a matter of fact, seems recently to have removed from its byline the one phrase that *didn't* promise to help you feel better: Erikssonn et al cite it as containing the phrase, "these songs will probably only make you

52. https://newsroom.spotify.com/2019-10-24/6-questions-and-answers-with-tony-jebara-vp-of-machine-learning/, accessed 10-15-2019

53. Spotify GUI, accessed 09-09-2019

feel worse, but least they'll let you know you're not alone."[54] That decidedly negative tone has been excised since Erikssoon et al published. Spotify is clearly committed to fostering positive thinking in its users, which is a profound aesthetic limitation that flows naturally from its market orientation and conforms disturbingly with the very worst suspicions about aesthetic homogeneity. There is no space to "let suffering speak," which is one of Adorno's basic criteria for any kind of truth.[55] Or, to take a less abstruse example, James Baldwin, who saw music as a place to confront pain unflinchingly. He contrasts true musical experience, which deals with pain, with a chilling Cold War example: bomb shelters. Sheltering yourself against pain, managing your emotions so as to exclude negative feelings, is, for Baldwin, the polar opposite of true aesthetic experience. Bomb shelters are thus "very close to being a crime." If we side with Adorno, Baldwin, or if we just believe that music shouldn't *always* be about soundtracking your life in a way that makes things better, more manageable, more productive, then we'll always run against the grain with Spotify.

Thus the kind of identity construction that mass data surveillance makes possible is not just a matter of discerning "measurable types" and evaluating individual users against them, but also of actively modulating the emotional contours of those types.[56] Whereas we usually think of music as part of the subjective act of identity construction, where a person figures out for herself who she is and what kind of persona she wants to project, the identity construction in the world of surveillance capitalism is largely objectified, out of control of the user, and not in her interests anyway. It is the difference between identity construction that is useful for the person, and identity construction that is useful for the corporation, or, to take a case from music recommendation itself, between "taste" and "taste profiles."

The music industry, of course, has never been particularly distinguished for its moral rectitude or its commitment to artistic nuance. It is the industry of "race records," "world music,"

54. Eriksson et al., *Spotify Teardown: Inside the Black Box of Streaming Music*, 125.
55. Lambert Zuidervaart, "Theodor W. Adorno," in *The Stanford Encyclopedia of Philosophy*, Winter 2015, ed. Edward N. Zalta (Metaphysics Research Lab, Stanford University, 2015).
56. John Cheney-Lippold, *We Are Data: Algorithms and The Making of Our Digital Selves* (NYU Press, 2017).

“payola,” and a century of racial appropriation. If there are questionable elements to Spotify’s participation in the regime of platform capitalism, it is natural to ask whether these are any worse, or even very different, from the ethical problems that have always been part of the record business. This is a related but different question from the ones I have raised about its general quality, or even its potential to marginalize certain aesthetic categories. It is a question, once again, about novelty: whether Spotify does or does not represent something qualitatively new and different. It is the question of whether Spotify’s potential to exploit its users and artists represents a departure from or a continuation of existent practices in the music industry. In some ways, of course, both are true, and even the novel forms of platform capitalism that Spotify participates in can be seen as carrying on venerable record industry traditions. To commodify wherever possible, to prioritize shareholder value over all else, and to let business strategy be utterly dictated by market need are, after all, the most familiar of capitalist truisms. To the extent that Spotify participates in them, it can be seen as a pretty typical entity. That participation in this broader economy of speculation and surveillance is not atypical is, ultimately, the most important insight that the study of Spotify can produce.

Appendix I - Spotify Materials

5.5 Definitions of Spotify "Get Audio Features" API object fields

Key	Value Type	Value Description
duration_ms	int	The duration of the track in milliseconds.
key	int	The estimated overall key of the track. Integers map to pitches using standard Pitch Class notation . E.g. 0 = C, 1 = C#/Db, 2 = D, and so on. If no key was detected, the value is -1.
mode	int	Mode indicates the modality (major or minor) of a track, the type of scale from which its melodic content is derived. Major is represented by 1 and minor is 0.
time_signature	int	An estimated overall time signature of a track. The time signature (meter) is a notational convention to specify how many beats are in each bar (or measure).

acousticness	float	A confidence measure from 0.0 to 1.0 of whether the track is acoustic. 1.0 represents high confidence the track is acoustic.
danceability	float	Danceability describes how suitable a track is for dancing based on a combination of musical elements including tempo, rhythm stability, beat strength, and overall regularity. A value of 0.0 is least danceable and 1.0 is most danceable.
energy	float	Energy is a measure from 0.0 to 1.0 and represents a perceptual measure of intensity and activity. Typically, energetic tracks feel fast, loud, and noisy. For example, death metal has high energy, while a Bach prelude scores low on the scale. Perceptual features contributing to this attribute include dynamic range, perceived loudness, timbre, onset rate, and general entropy.
instrumentalness	float	Predicts whether a track contains no vocals. "Ooh" and "aah" sounds are treated as instrumental in this context. Rap or spoken word tracks are clearly "vocal". The closer the instrumentalness value is to 1.0, the greater likelihood the track contains no vocal content. Values above 0.5 are intended to represent instrumental tracks, but confidence is higher as the value approaches 1.0.

liveness	float	Detects the presence of an audience in the recording. Higher liveness values represent an increased probability that the track was performed live. A value above 0.8 provides strong likelihood that the track is live.
loudness	float	The overall loudness of a track in decibels (dB). Loudness values are averaged across the entire track and are useful for comparing relative loudness of tracks. Loudness is the quality of a sound that is the primary psychological correlate of physical strength (amplitude). Values typical range between -60 and 0 db.
speechiness	float	Speechiness detects the presence of spoken words in a track. The more exclusively speech-like the recording (e.g. talk show, audio book, poetry), the closer to 1.0 the attribute value. Values above 0.66 describe tracks that are probably made entirely of spoken words. Values between 0.33 and 0.66 describe tracks that may contain both music and speech, either in sections or layered, including such cases as rap music. Values below 0.33 most likely represent music and other non-speech-like tracks.

valence	float	A measure from 0.0 to 1.0 describing the musical positiveness conveyed by a track. Tracks with high valence sound more positive (e.g. happy, cheerful, euphoric), while tracks with low valence sound more negative (e.g. sad, depressed, angry).
tempo	float	The overall estimated tempo of a track in beats per minute (BPM). In musical terminology, tempo is the speed or pace of a given piece and derives directly from the average beat duration.
id	string	The Spotify ID for the track.
uri	string	The Spotify URI for the track.
track_href	string	A link to the Web API endpoint providing full details of the track.
analysis_url	string	An HTTP URL to access the full audio analysis of this track. An access token is required to access this data.
type	string	The object type: “audio_features”

5.6 Spotify's 126 genres

['acoustic', 'afrobeat', 'alt-rock', 'alternative', 'ambient', 'anime', 'black-metal', 'bluegrass', 'blues', 'bossanova', 'brazil', 'breakbeat', 'british', 'cantopop', 'chicago-house', 'children', 'chill', 'classical', 'club', 'comedy', 'country', 'dance', 'dancehall', 'death-metal', 'deep-house', 'detroit-techno', 'disco', 'disney', 'drum-and-bass', 'dub', 'dubstep', 'edm', 'electro', 'electronic', 'emo', 'folk', 'forro', 'french', 'funk', 'garage', 'german', 'gospel', 'goth', 'grindcore', 'groove', 'grunge', 'guitar', 'happy', 'hard-rock', 'hardcore', 'hardstyle', 'heavy-metal', 'hip-hop', 'holidays', 'honky-tonk', 'house', 'idm', 'indian', 'indie', 'indie-pop', 'industrial', 'iranian', 'j-dance', 'j-idol', 'j-pop', 'j-rock', 'jazz', 'k-pop', 'kids', 'latin', 'latino', 'malay', 'mandopop', 'metal', 'metal-misc', 'metalcore', 'minimal-techno', 'movies', 'mpb', 'new-age', 'new-release', 'opera', 'pagode', 'party', 'philippines-opm', 'piano', 'pop', 'pop-film', 'post-dubstep', 'power-pop', 'progressive-house', 'psych-rock', 'punk', 'punk-rock', 'r-n-b', 'rainy-day', 'reggae', 'reggaeton', 'road-trip', 'rock', 'rock-n-roll', 'rockabilly', 'romance', 'sad', 'salsa', 'samba', 'sertanejo', 'show-tunes', 'singer-songwriter', 'ska', 'sleep', 'songwriter', 'soul', 'sound-tracks', 'spanish', 'study', 'summer', 'swedish', 'synth-pop', 'tango', 'techno', 'trance', 'trip-hop', 'turkish', 'work-out', 'world-music']

Appendix II – Experimental Results

5.7 analyze_playlist.py (representative example)

```
import json
from scipy.spatial import ConvexHull
import numpy as np
import random
from itertools import combinations
import itertools
from scipy.spatial import distance
from glob import glob
import os
import os.path
import StringIO
import csv

means = json.load(open('./means.json'))
stds = json.load(open('./stds.json'))

def whiten(features, means, stds):
    whitened_list = []
    for song in features:
        new_song = []
        new_song = [0 for i in range(len(song))]
```

```python
        for i in range(len(song)):
            new_song[i] = (song[i] - means[i])/stds[i]
        whitened_list.append(new_song)
    return whitened_list

def featurize_playlist(playlist):
    features = []
    for song in playlist['tracks']:
        track_array = []
        track_array.append(song['liveness'])
        track_array.append(song['valence'])
        track_array.append(song['energy'])
        track_array.append(song['danceability'])
        track_array.append(song['speechiness'])
        track_array.append(song['instrumentalness'])
        track_array.append(song['tempo'])
        track_array.append(song['loudness'])
        track_array.append(song['duration_ms'])
        track_array.append(song['acousticness'])
        features.append(track_array)
    feat = whiten(features, means, stds)
    feat = np.asarray(feat)
    return feat

def create_playlist(playlist_name, sample_size):
    source = json.load(open(playlist_name))
    playlist = {}
    playlist['name'] = source['name']
    playlist['tracks'] = []
    playlist['tracks'] = random.sample(source['tracks'], sample_size)
    return playlist
```

```
def ave_dist(playlist_array):
    list_of_distances = []
    comb = []
    comb = itertools.combinations(playlist_array, 2)
    for pair in comb:
        list_of_distances.append(distance.euclidean(pair[0], pair[1]))
    ave_dist = np.mean(list_of_distances)
    return ave_dist

def ave_dot_product(playlist_array):
#calculate average dot product of all possible track pairs in playlist
    list_of_dot_products = []
    comb = []
    vectors = playlist_array
    comb = itertools.combinations(vectors, 2)
    for pair in comb:
        list_of_dot_products.append(np.dot(pair[0], pair[1]))
    ave_dots = np.mean(list_of_dot_products)
    return ave_dots

####################################################
lists_of_winners = [[],[],[],[]]
lists_of_losers = [[],[],[],[]]
num_exp = 100
results = {}

for i in range(num_exp):
    print 'working on experiment number ' + str(i+1) +'.....'
    i = i + 1
    analysis = []
```

```
values = []
number_samples = 2
playlist_size = 40
areas = []
volumes = []
dists = []
dots = []
for f_name in sorted(glob('database/*.json')):
    hull_areas = []
    hull_volumes = []
    dots = []
    dists = []
    for i in range(number_samples):
        playlist = create_playlist(f_name, playlist_size)
        features = featurize_playlist(playlist)
        hull = ConvexHull(features, qhull_options='QJ')
        hull_areas.append(hull.area)
        hull_volumes.append(hull.volume)
        dots.append(ave_dot_product(features))
        dists.append(ave_dist(features))
    analysis.append([playlist['name'],
                     np.mean(hull_areas),
                     np.mean(hull_volumes), np.mean(dots),
                     np.mean(dists)])
winner_index = int
loser_index = int
names = []
vols = []
areas = []
dots = []
dists = []
```

```
    for genre in analysis:
        names.append(genre[0])
        areas.append(genre[1])
        vols.append(genre[2])
        dots.append(genre[3])
        dists.append(genre[4])
    lists = [names, vols, areas, dots, dists]
    scores = [vols, areas, dots, dists]
    for score, i in itertools.izip_longest(scores, range(len(scores))):
        winner = max(score)
        loser = min(score)
        winner_index = score.index(winner)
        loser_index = score.index(loser)
        winner_genre = lists[0][winner_index]
        loser_genre = lists[0][loser_index]
        print 'winner for method ' + str(i) + ' is ' +str(winner_genre)
        print 'loser for method ' + str(i) + ' is ' +str(loser_genre)
        lists_of_winners[i].append(winner_genre)
        lists_of_losers[i].append(loser_genre)
results['winners'] = lists_of_winners
results['losers'] = lists_of_losers

json = json.dumps(results)
f = open("scores","w")
f.write(json)
f.close()
```

5.8 Mean Popularity, Confidence, and Unique Items in playlists

genre	popularity	confidence	unique recs (n = 1)	unique recs (n=100)
acoustic	33.484	0.5849475	291	310
afrobeat	14.944	0.641185	302	324
alt-rock	29.584	0.61865	284	314
alternative	44.568	0.6233325	301	318
ambient	18.534	0.483015	312	330
anime	17.128	0.562835	304	324
black-metal	8.638	0.45537	304	324
bluegrass	19.324	0.67385	295	337
blues	20.644	0.5844375	300	311
bossanova	4.412	0.5179225	221	230
brazil	27.71	0.6142	100	100
breakbeat	12.226	0.6121975	300	331
british	37.896	0.6133325	319	322
cantopop	13.152	0.60135	217	228
chicago-house	6.564	0.684885	297	333
children	39.522	0.5830775	293	335
chill	46.112	0.58534	304	326
classical	25.856	0.44557	287	291
club	37.39	0.649655	99	100
country	49.79	0.65028	309	338
dance	33.886	0.6283425	290	311
dancehall	17.174	0.58854	305	321
death-metal	19.426	0.4753675	305	331

deep-house	16.39	0.6886075	315	336
detroit-techno	6.028	0.641855	294	324
disco	34.038	0.684865	308	336
disney	34.688	0.4913925	295	326
drum-and-bass	11.694	0.599825	289	312
dub	18.4	0.5883075	295	328
dubstep	16.406	0.5971175	301	330
edm	20.876	0.6242625	104	105
electro	31.396	0.62801	308	323
electronic	27.614	0.61829	318	340
emo	36.13	0.58528	291	323
folk	19.162	0.6364225	291	320
forro	6.064	0.60225	234	242
french	16.634	0.56295	305	318
funk	32.4625	0.6605575	80	80
garage	17.052	0.6196675	300	314
german	27.036	0.632635	300	327
gospel	27.532	0.5080775	295	313
goth	14.21	0.6063375	289	323
grindcore	11.678	0.41293	304	332
groove	21.28	0.6323625	99	99
grunge	31.102	0.5776125	307	322
guitar	37.342	0.57956	303	313
happy	42.712	0.6238325	304	339
hard-rock	25.43	0.6167375	100	100
hardcore	16.394	0.5133275	288	329

hardstyle	14.334	0.56986	303	331
heavy-metal	25.248	0.5412575	286	329
hip-hop	60.428	0.5937975	301	336
holidays	2.662	0.48895	208	167
honky-tonk	37.066	0.6362175	310	327
house	25.856	0.6683975	288	327
idm	18.32	0.529655	306	341
indian	23.05	0.6336975	315	330
indie	47.328	0.6258775	98	336
indie-pop	43.18	0.5976825	301	100
industrial	20.678	0.63595	301	327
iranian	19.434	0.595575	300	315
j-dance	9.33	0.63789	260	279
j-idol	9.004	0.595505	253	259
j-pop	17.284	0.6048725	303	328
j-rock	15.402	0.593455	321	324
jazz	30.164	0.4642925	286	303
k-pop	4.944	0.608035	300	314
kids	8.904	0.647885	125	126
latin	53.674	0.5915025	310	320
latino	36.91	0.6078075	100	100
malay	14.712	0.6001825	222	231
mandopop	14.742	0.61516	241	255
metal	20.37	0.579435	99	100
metal-misc	20.37	0.56477	100	100
metalcore	29.932	0.50665	310	337

minimal-techno	9.542	0.6569925	304	330
movies	38.202	0.51837	307	312
mpb	16.536	0.5827525	209	236
new-age	24.668	0.575365	308	337
new-release	14.6	0.58326	50	50
opera	9.894	0.424235	307	304
pagode	12.026	0.5633625	216	231
party	36.378	0.57192	321	329
philippines-opm	9.918	0.5532	169	172
piano	30.594	0.5341875	311	322
pop	63.732	0.636015	96	96
pop-film	28.7604166667	0.5981625	301	326
post-dubstep	9.51	0.5853375	311	344
power-pop	14.242	0.6282775	240	253
progressive-house	12.792	0.67227	297	330
psych-rock	16.938	0.600145	307	335
punk	25.306	0.642165	307	315
punk-rock	30.24	0.5877175	299	318
r-n-b	49.724	0.546675	311	334
rainy-day	40.898	0.5660725	308	341
reggae	23.45	0.528385	306	308
reggaeton	27.53	0.5841375	320	326
road-trip	43.588	0.62845	295	322
rock	57.154	0.6280725	304	324
rock-n-roll	31.146	0.6096475	296	336
rockabilly	15.542	0.5828125	303	327

romance	46.06	0.6005075	307	321
sad	45.576	0.5726925	297	306
salsa	32.626	0.6120075	302	308
samba	8.83	0.5654025	225	224
sertanejo	11.648	0.6425125	231	240
show-tunes	29.87	0.4668225	310	315
singer-songwriter	36.528	0.567295	312	323
ska	15.414	0.60188	319	328
sleep	47.064	0.56392	302	315
songwriter	23.946	0.6170125	303	304
soul	27.872	0.5666875	302	321
soundtracks	37.004	0.4830275	306	329
spanish	38.522	0.6396725	312	317
study	45.498	0.5885	304	318
summer	42.234	0.64641	293	327
swedish	32.192	0.60506	296	329
synth-pop	42.42	0.6114675	100	100
tango	10.936	0.5528375	301	310
techno	30.41	0.65122	305	330
trance	18.526	0.6636725	313	323
trip-hop	23.542	0.587935	298	336
turkish	27.614	0.619765	315	320
work-out	38.28	0.6199075	304	332
world-music	15.208	0.5894225	313	334

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