

Rap Music as a Social Reflection: Exploring the Relationship Between Social Conditions and Expressions of Violence and Materialism in Rap Lyrics

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Abstract: Rap music, often scrutinized for its portrayal of violence, misogyny, materialism, and drug use, can serve as an intriguing case study to empirically explore whether art reflects its time. While existing literature has consistently confirmed the prevalence and increasing trend of these themes in rap lyrics, investigations considering the social context during the production of these songs remain scarce. By analyzing lyrical expressions related to physical and street violence, misogyny, money, and drug use in 27,445 underground and mainstream rap singles released in the United States from 1971 to 2016, we observe significant temporal variations in the prevalence of these themes, each following distinct patterns. Importantly, these themes in lyrics are strongly correlated with pertinent social indicators, including the rates of crime, sexual assault, poverty, and DEA arrests, without significant cross-correlations. These findings suggest that music serves as a mirror of the social and economic realities of the time, providing insights into the depiction of deep-seated social problems through art forms.

Introduction

Music historically has been a medium for expressing collective frustrations arising from economic uncertainties and socio-political upheavals (Alridge and Stewart 2005; Blau 1988a, 1988b; Cerulo 1984). Studies examining lyric formulas from the historical perspectives of Black culture signal that themes in rap music are associated with the socio-economic conditions prevailing at the time of song production (Adams and Fuller 2006; Richardson and Scott 2002; Stoa, Adams, and Drakulich 2018). Furthermore, research such as Schmutz (2005) and Lena and

Peterson (2008) underscores the dynamic nature of music, revealing how albums of historical import tend to stand the test of time and how musical compositions evolve in response to shifting artistic classification systems and institutional gatekeeping. This body of research collectively demonstrates how prevailing economic and societal contexts influence musical compositions and preferences and affirms the longstanding role of music as a reflection of its era (Childress and Nault 2019; Griswold 1987). However, the literature still lacks a direct, systematic, and empirical investigation into the broader relationship between social conditions and cultural objects beyond examining the specific effects of social disturbances like war (Cerulo 1984) or organization structures (Lena 2006). This gap is striking given the emphasis on the impact of the social context of production on artistic work (Becker 1982; White and White 1993).

This study explores the production of rap music lyrics as a case study for examining the broader question of whether art reflects society. Rap music provides a compelling lens due to its origins and continued evolution against the backdrop of economic uncertainty and socio-political tensions (Lena 2006; Rabaka 2011; Stephens and Wright 2000; Weitzer and Kubrin 2009). Furthermore, content analysis of rap lyrics consistently projects an upward trend in expressed violence within rap (Herd 2005, 2009; Holody et al. 2016; Hunnicutt and Andrews 2009; Kresovich et al. 2021; Weitzer and Kubrin 2009; to name a few), making it an ideal genre to examine whether such trends persist independently of social conditions. Through a systematic analysis of themes expressed in underground and mainstream rap singles over several decades in the United States, this study investigates the correlation between volume of predominant lyrical themes and relevant indicators of socio-economic realities over time. The analysis reveals that often-criticized violent and materialistic themes in rap may in fact mirror the prevailing conditions faced by its creators. By exploring rap music as an example, this study aims to provide perspective on the complex interplay between art and society while considering contemporaneous societal trends into the investigation, which of such research has been limited in the literature.

Researching Rap through Content Analysis

Rap music has significantly expanded its influence since its inception in the late 1970s, captivating a diverse audience beyond its original urban African American base (Keyes 2004; Kitwana 2005; Morgan and Bennett 2011). This expansion is evidenced by a National Endowment for the Arts

(NEA) sponsored survey highlighting rap/hip-hop music's growth over the past decade, with its fan base reaching 17% of the adult population in the United States (Mizell 2005). Moreover, Nielsen reports that hip-hop and R&B have overtaken rock and pop as the leading music genres (Nielsen 2015). This widespread popularity of the genre not only denotes its cultural legitimization (Baumann 2007; Tanner, Asbridge, and Wortley 2009) but also signals its increasing acceptance in society. Consequently, rap music and its artists have become trendsetters, influencing various spheres, from music and fashion to broader social behaviors.

Yet, rap often faces criticism and is frequently portrayed as exerting a harmful influence, especially on vulnerable audiences (Keyes, 2004), with much research emphasizing its potential adverse effects on mental health outcomes and other social issues (Best 1993; Holody et al. 2016; Keyes 2004; Knutzen et al. 2018; Kubrin and Nielson 2014; Tanner et al. 2009). However, existing studies are often limited in scope, focusing largely on a small selection of mainstream tracks, such as those found on Billboard's top charts, or a specific sub-genre like Gangsta rap (Forman 2000; Herd 2005; Kubrin 2005b, 2005a). This selective approach leaves a significant gap in our understanding of the representations of rap music as it ignores a substantial body of work produced by independent labels or artists, often classified as 'underground' rap music, despite the widespread influence of underground rap (Oware 2014) and their unique characteristics related to rich self-expression and less commercialized expressions (Lena 2006).

Many of these studies have explored the themes and messages embedded in rap lyrics, particularly focusing on potential harmful elements such as physical and street violence (Binder 1993; Herd 2009; Rebollo-Gil and Moras 2012), misogyny (Adams and Fuller 2006; Rebollo-Gil and Moras 2012; Weitzer and Kubrin 2009), substance use (Herd 2005, 2014; Holody et al. 2016), and intense metaphors surrounding suicide and homicide (Hunnicuttt and Andrews 2009; Kresovich et al. 2021). Content analysis has been the predominant method for these investigations, with scholars employing both qualitative techniques such as close reading and quantitative methods encompassing word counts and dictionary-based categorizations, to understand evolving trends in rap lyrics, especially those that emphasize themes of violence and its possible adverse impact on society. It is notable that content analysis in rap music often reveals *upward empirical trends* in expressions in harms and violence. Several notable trends emerge from existing studies: the rise in violent depictions (Herd 2009); the glamorization of alcohol use often associated with affluence, potentially leading to negative societal implications

(Herd 2005, 2014; Holody et al. 2016); an uptick in lyrics portraying women derogatorily (Weitzer and Kubrin 2009); the nuanced treatment of violent deaths and homicides within rap's broader narratives (Hunnicuttt and Andrews 2009); and the concerning increase in themes of suicidal ideation, depression, and mental health struggles (Kresovich et al. 2021). However, these analyses, while longitudinal, typically rely on samples of 100 to 400 popular songs spanning multiple decades. Such limited datasets raise concerns about the robustness of the findings and the generalizability of their conclusions, especially considering the potential challenges in achieving reliable statistical power with limited data points over specific time periods. Furthermore, previous research often fails to account for the socio-economic context under which the music was produced, thus overlooking the potential of rap music as a sociological tool to understand the societal trends and conditions of its time.

To address these limitations, this study leverages large-scale data combined with advanced computational methods. By applying a word embedding model to an extensive dataset that encompasses both mainstream and underground dimensions of rap music, our investigation provides a holistic view of the changes in certain themes expressed in lyrics over the years. This innovative approach enables us to go beyond traditional methodological constraints and more accurately examine the interplay between lyrical themes and concurrent socio-economic shifts. Our approach not only accentuates the vast potential of computational techniques in decoding cultural narratives embedded in lyrics but also ensures a rigorous empirical analysis unmarred by biases. This robust approach offers an opportunity to empirically test correlations between lyrical content and broader social conditions, demonstrating the considerable advantages of adopting computational tools for a systematic exploration of cultural expressions such as rap lyrics.

The Present Study

The opportunities emerged from the observed limitations in existing content analyses of rap lyrics lead us to three pivotal research questions that guide this study. Firstly, is it feasible to automatically identify nuanced expressions in rap lyrics related to themes such as physical/street violence, misogyny, drug use, and money/materialism? Rap's unique linguistic style often demands an in-depth understanding of localized cultural expressions, encapsulating elements like street code and specialized slang (Bennett 1999; Rose 1994). Previous researchers frequently relied on predetermined dictionaries, which may not comprehensively capture the unique lyrical

expressions of rap, or turned to resources like *The Rap Dictionary* (Kubrin 2005a). The development of an automated tool to discern these intricate expressions would mark a significant methodological advancement.

Secondly, do we observe temporal fluctuations in the emphasis on these core themes in rap lyrics, or is there a consistent increase in their prevalence, as some previous work suggests? By examining the trajectory of these themes, we can offer a more nuanced perspective on rap's evolving cultural narrative, contextualizing its portrayal of socio-economic conditions.

Lastly, if such fluctuations are detected, do they align with broader societal trends? Examining this query in detail could unravel the complex relationship between rap lyrics and their socio-historical context. A strong correlation between the two would indicate that rap primarily mirrors the realities of its time, rather than merely promoting specific themes. Unpacking this relationship can deepen our understanding of rap's cultural significance and also provide empirical support for the notion that art reflects society.

In response to these questions, this study embarks on a comprehensive, data-driven exploration of thematic content in rap lyrics and its alignment with broader social dynamics. The emphasis is placed on four predominant topics that have been the focal point of past research: physical/street violence, misogyny, money/materialism, and drug use. Distinctive contributions of this study include: (1) Utilizing a comprehensive dataset, we analyze over 27,000 rap songs released from 1971 to 2016 in the United States, bridging both mainstream and underground domains. Such a broad scope enhances the robustness of our findings and lends them greater generalizability; (2) Instead of relying solely on pre-defined dictionaries, we employ computational text analysis tools like word embedding to capture a broad range of expressions related to specific themes in rap lyrics, which include slang, metaphors, and changing expressions over the decades, thereby extending beyond the conventional vocabulary typically analyzed in prior research; and (3) Further deepening the analysis, we juxtapose the thematic content identified in the lyrics with real-world social indicators, such as crime rates, sexual assault rates, drug-related arrests, and economic trends. This correlation provides a window into the potentially reflective nature of rap, casting light on the intricate relationship between art and societal realities.

In sum, our study employs sophisticated computational methods on a comprehensive dataset to deepen the understanding of thematic expressions in rap music. Our findings go beyond the broad assertion that music mirrors the spirit of its era; we highlight that prevailing

socioeconomic conditions distinctly shape the interplay between rap’s topical attention and the wider societal narratives.

Data and Methods

Rap lyrics data

Our dataset was compiled by scraping 66,275 rap lyrics from the *Original Hip Hop Lyrics Archive* (OHHLA), one of the most expansive user-contributed archives. It encompasses the bulk of English hip-hop produced in the United States from the 1970s to today. While fan-transcribed, the OHHLA lyrics are the result of a community-driven effort, incorporating active verification and correction processes. This ensures adequate quality in general. We further confirmed the dataset’s credibility by cross-referencing a subset with multiple sources, thereby verifying its accuracy for rigorous analysis. This approach aligns with the methodology of previous studies that employed such archives (Hunnicuttt and Andrews 2009; Karsdorp, Manjavacas, and Kestemont 2019).

Additionally, we secured the precise release year metadata for 27,445 songs from 1,519 artists using Spotify’s API. This was based on artist and album names, enabling us to position lyrics within their respective socio-historical contexts. For our correlational analyses, we exclusively used songs with definitive release years. However, for training our Word2Vec model, we used the entire 60,000+ song corpus to maximize vocabulary exposure.

Selection of topics and seed words

Drawing from rap music literature, we pinpointed four recurrent topics that often distinguish rap from other cultural content: physical/street violence, misogyny, money/materialism, and drug use. For each topic, we curated five representative words, bearing in mind the context of rap lyrics. Since our Word2Vec model adeptly identifies and integrates an array of non-standard English terms and nuanced lyrical expressions with similar meanings, our main focus was on selecting the best seed words to capture the gamut of the category. These would cover a wide range of related concepts, such as tools, actions, people, and places.

For instance, words pertaining to physical and street violence category were sourced from earlier studies exploring either violent themes in rap or street identity within the genre (Harkness 2013; Herd 2009; Krohn and Suazo 1995; Kubrin 2005a; Oware 2014). This yielded words

linked to violent actions ('kicking', 'shot'), tools ('gun'), organizations ('gang'), and locations ('prisons').

Similarly, our misogyny-related terms drew from previous investigations into the misogynistic aspect of rap lyrics (Adams and Fuller 2006; Krohn and Suazo 1995; Kubrin 2005a; Rebollo-Gil and Moras 2012; Weitzer and Kubrin 2009). These terms encompassed language that objectified women ('bitch', 'pussy'), touched upon prostitution and pimping ('pimp'), and even included positive terms related to women for comparative purposes ('lady').

The selection of money-related words was informed by studies analyzing rap lyrics that reflect the socioeconomic challenges faced by the low-income Black community and the glorification of materialism (Harkness 2013; Kubrin 2005a; Payne 2016; Sköld 2012). This category includes words denoting economic concerns ('phone bill') and places of residence ('hood'), as well as terms opposite to the concept of poverty ('success', 'business'), along with a general term related to this theme ('money').

Finally, our terms for drug use were sourced from several studies addressing drug and alcohol content within rap lyrics (Christenson, Roberts, and Bjork 2012; Dennis 2007; Markert 2001; Primack et al. 2008). This led to the selection of words detailing various facets of drug use ('drug', 'stoned'), distribution ('street', 'dealer'), and enforcement ('DEA').

Expanding topical words through Word2Vec

To move beyond the confines of our pre-selected keywords and construct a *relational and static depiction of language* (Arseniev-Koehler 2022) in rap lyrics across three decades, we adopted the Word2Vec model (Mikolov, Chen, et al. 2013; Mikolov, Sutskever, et al. 2013), an unsupervised neural language model that learns vector representations encoding semantic relationships between words. After excluding words that appeared less than five times across the dataset to minimize noise, we trained a single Word2Vec model on our entire 60,000+ rap lyrics corpus—rather than training separate models for different time periods. This approach aligns with our objective to identify the most general and representative terms related to each seed word across vast time periods, instead of capturing trendy expressions specific to a particular era. While this approach inherently limits our ability to capture the dynamic and evolving nature of linguistic expressions in rap music, it also maximizes the accuracy of our model by leveraging a larger dataset. We employed the Continuous Bag-of-Words architecture, optimal for large datasets, setting the vector

dimensions at 100. Given its ability to represent words as vectors in a semantic space, we utilized the trained model to expand our list of topical words.

Starting with our seed words, we incrementally expanded our topical word clusters. This involved initiating with a keyword vector, locating the most closely related word, determining the centroid of these word vectors, and repeating this until a set of 20 topically relevant words were identified for each keyword. This process unveiled a myriad of related terms, including slang and other creative expressions, which often elude predefined keyword sets in earlier research. This data-driven method mitigates limitations set by fixed dictionaries, circumventing potential biases and ensuring a more inclusive representation of lyrical content.

Correlational analysis with social indicators

We collected official statistics to discern societal trends concurrent with the release of these lyrics. Data such as violent crime rates were obtained from the FBI's Uniform Crime Reports, while statistics on sexual assault were derived from the National Crime Victimization Survey. Additionally, we used the U.S. Census Bureau and Drug Enforcement Agency databases for poverty rates and drug-related arrests statistics, respectively. To measure correlations, we assessed the prevalence of each lyrical theme against these social indicators over time. This allowed us to identify whether positive correlations existed, suggesting that lyrical themes paralleled actual societal conditions. Conversely, non-significant or negative correlations could denote that lyrical content was more a stylistic choice rather than a reflection of prevailing social realities. These analyses encompassed data ranging from the initial available release year up until 2016, the most recent year within our corpus.

Preliminary Results

As an initial analysis, we compared word frequencies between Billboard and non-Billboard rap songs over time. We aimed to validate whether the long-term patterns in the mention of culturally significant individuals and civil rights-related terms are consistent with our expectations in both subsets of songs. We also sought to assess if mainstream (Billboard-charted) and underground rap lyrics displayed differing trends in these terms to get insights on whether including non-mainstream lyrics impacted the results for topical attention over time.

Inspired by culturomics research (Michel et al. 2011), we examined the frequency with which names of historically important individuals appear in lyrics from both song groups over different eras (see **Fig. 1**). We calculated this frequency by dividing the number of mentions of a particular name in a given era by the total word count for that era's corpus, scaling this to a frequency per 1,000 words for ease of interpretation. For example, in the 1980s, the term 'Malcolm X' had frequencies of 0.027 and 0.023 per 1,000 words in Billboard and non-chart rap songs, respectively (**Fig. 1a**). Similar to societal tendencies to forget past events (Halbwachs 1992), the mention of 'Malcolm X' peaked in the 1980s and then sharply declined in both corpora—entirely disappearing in Billboard chart songs over subsequent decades. Despite minor differences, the longitudinal trends are quite similar between mainstream and underground rap songs.

Terms like 'Obama,' 'Brown,' and 'Ferguson' also exhibited specific patterns. 'Obama' was virtually absent from both song groups prior to the 1990s but surged in the 2010s through 2000s, correlating with his increasing influence as President of the United States (**Fig. 1b**). Names like 'Brown' and 'Ferguson,' connected with Black rights movements, showed peaks in the 1990s, dips soon after, and then renewed attention in the 2010s (**Figs. 1c,d**). These patterns suggest that rap lyrics do not substantially diverge from broader cultural trends regardless of commercial success.

[**Fig. 1** about here]

To systematically validate these observations, we employed Named Entity Recognition techniques (Jiang, Banchs, and Li 2016) to identify the 50 most frequently mentioned unique terms across both song groups in ten distinct categories: people, groups, facilities, organizations, locations, products, events, art, and laws. Spearman's correlation coefficients were computed between the yearly usage rates of each term across the two groups from 1980 to 2016. The average correlation was 0.392 ($SD = 0.244$), indicating a similar frequency of term mentions in both Billboard and non-chart songs. Based on these consistent trends, we opted to combine both song groups in subsequent analyses, aiming to examine overarching connections between violent themes in rap lyrics and relevant social indicators.

Results

Algorithmic keyword expansion

Table 1 presents the outcomes of our word expansion efforts using the Word2Vec model. As anticipated, the expanded lexicon includes not only standard English terms but also slang, non-standard vernacular, and unique lyrical expressions. For example, our model identified various slang terms for ‘money’—such as ‘dough,’ ‘cheddar,’ ‘scrilla,’ and ‘loot’—that have been discussed in previous literature (Sköld 2012). In addition, our method uncovered further expressions like ‘fetti,’ ‘feddy,’ and ‘pesos,’ which were possibly missed in prior studies due to their Spanish origins or regional usage in the Bay Area. We also observed spelling variations, for example, ‘cheddar’ vs. ‘chedda’ and ‘scrilla’ vs. ‘scrill.’ Other noteworthy findings include terms like ‘fofo’ for gun (Kubrin 2005a), and ‘pig’ and ‘popos’ for police (Alim 2006).

Given that many of the expanded words have not been previously discussed in academic literature, we conducted a systematic evaluation of the word expansion’s quality. To achieve statistical power of at least $1 - \beta = 0.9$ with those who are knowledgeable enough about rap and hip-hop, we employed a rigorous rater selection process, targeting a significance level of $\alpha = 0.05$. Following prior research (Hoyle et al. 2021), we recruited nineteen independent raters for each category, using a screening test that matched 3 rap songs with their corresponding artists to estimate the raters’ familiarity with hip-hop and rap. While 54 participants completed the survey, evaluations by only the 19 who answered all screening questions correctly were used to report the following results. Note that inclusion of other participants’ evaluations did not make noticeable changes on the results. Participants were compensated at a rate of approximately 18 USD/hour for their time, regardless of their qualification status.

Each rater received four sets of five seed words along with their 20 algorithmically expanded counterparts across categories, shown similarly in **Table 1**. Raters were asked to assign quality scores on a conventional three-point ordinal scale (Hoyle et al. 2021; Mimno et al. 2011): -1 (not very related), 0 (reasonable/acceptable), and 1 (very relevant). The average quality scores were 0.579 ($CI = 0.293$), 0.263 ($CI = 0.218$), 0.474 ($CI = 0.247$), and 0.263 ($CI = 0.218$) for the categories of physical/street violence, misogyny, money/materialism, and drug use, respectively. These scores suggest that the Word2Vec model is effective in capturing the nuanced lyrical expressions associated with these topical keywords, thereby forming coherent thematic clusters.

[Table 1. about here]

Correlations with social statistics

We calculated Pearson correlation coefficients to assess the relationships between the prevalence of yearly keyword sets in lyrics and corresponding social indicators over time. Notably, the majority of these keyword sets were significantly correlated with relevant social statistics. For instance, the prevalence of physical violence-related terms such as ‘gun,’ ‘shot,’ and ‘kicking’ showed a strong positive correlation with crime rates, as documented in the FBI’s Uniform Crime Reports over the past three decades (Pearson’s $r = 0.714, 0.966, \text{ and } 0.964$; $P < 0.001$ for all word sets). The trends in sexual assault rates, which have decreased over time similar to the longitudinal trends of crime rates, also closely align with the frequency of relevant terms in rap lyrics. Specifically, the terms ‘bitch,’ ‘pussy,’ ‘pimp,’ ‘rape,’ and ‘lady’ corresponded with sexual assault rates, yielding correlation coefficients of 0.559, 0.033, 0.760, 0.648, and -0.739, respectively ($P < 0.001$ for all word sets except ‘pussy’ with $P = 0.886$). It is important to note an exception: The keyword set ‘gang,’ which is associated with physical and street violence, displayed a moderate correlation in an unexpected direction ($r = -0.185$; $P = 0.398$), although this correlation was not statistically significant.

In contrast to the longitudinal trends observed for physical violence and sexual assaults, those for poverty rates and drug-related arrests differed significantly. Yet, despite the dramatic fluctuations in poverty rates over time, the prevalence of money and materialism-related keyword sets such as ‘money’ and ‘business’ remains highly correlated with the rates ($r = -0.566$ and -0.711 ; $P < 0.001$ for both word sets). Other related keyword sets, including ‘phone bill,’ ‘success,’ and ‘hood,’ also displayed moderate correlations in the same direction ($r = -0.376, -0.304, \text{ and } -0.198$; $P = 0.070, 0.149, \text{ and } 0.354$, respectively), though these were not statistically significant. Similarly, terms related to drug-related activities, specifically ‘dealers,’ ‘drug,’ ‘street,’ ‘stoned,’ and ‘DEA,’ showed correlations with drug-related arrest rates, with coefficients of 0.783, 0.289, 0.516, 0.412, and -0.130, respectively ($P < 0.001$ for ‘dealers’; $P = 0.170, 0.010, 0.046, \text{ and } 0.546$ for ‘drug,’ ‘street,’ ‘stoned,’ and ‘DEA’).

Our time series analysis, visualized in **Fig. 2**, highlights these relationships, showing that trends in lyrical content closely parallel trajectories of associated social indicators across decades. Importantly, the differences in correlation directionality based on semantic associations provide

evidence that these relationships are not spurious. More specifically, keyword sets with opposite meanings correlated inversely with the same statistics (such as ‘pimp’ vs. ‘lady’; ‘dealers’ vs. ‘DEA’) and the negative correlations between money and materialism-related words and the poverty rates. Furthermore, we correlated each violence-related word-set frequency with corresponding social indicators using Kendall correlations, nonparametric tests suitable for assessing trends over time. To mitigate the confounding effect of temporal variations, we regressed out variance associated with year within each variable, and found that the correlations were similar (see **Table 2**).

[**Fig. 2** about here]

Aggregation of correlated keyword sets produced strong composite predictors of aligned social statistics, with R-squared values up to 0.66 as shown in **Fig. 3**. Moreover, the breadth of correlated themes suggests wide-ranging responsiveness of rap lyrics to social conditions. This may also signal that rappers creatively encoded lived realities across topics like violence, economics, and substance use over time. It is important to note that no significant cross-correlations were observed with different lag lengths, jointly suggesting that rap reflects the time while culture drives social change and social change drives culture.

[**Fig. 3** about here]

These results indicate rap music has evolved sensitively to reflect conditions in their time. Rappers composed lyrics responding to the very real trends of violence, poverty, discrimination, and dysfunction confronting them. Their lyrical output held up a mirror to the societal inequities and pathologies shaping everyday life in the neighborhoods and social networks within which hip-hop culture emerged. Rap music surged in popularity in part because it authentically channeled these marginalized experiences excluded from mainstream discourse and consciousness. Our findings empirically demonstrate rap’s intricate relationship with broader forces in society as simultaneous cultural expression of and commentary upon these realities.

Discussion and Conclusion

Our study presents a computational analysis of over 27,000 rap lyrics spanning from 1971 to 2016, revealing a robust correlation between the themes of rap lyrics and relevant social indicators like

rates of crime, poverty, drug arrests, and sexual assaults. Contrary to views dismissing the genre as largely graphic or offensive (Alexander 2003; Best 1993; Sacco and Kennedy 2002; Tanner et al. 2009; Tatum 1999), we find that rap lyrics dynamically reflect current social conditions. This tight coupling occurs without significant time delays or cross-correlation, aligning with long-standing theories in cultural sociology that emphasize the embeddedness of cultural artifacts and styles within the social contexts and constraints navigated by their creators (Griswold 1987) as a channel to narrate lived experiences. Our computational integration of textual data from an expansive rap lyrics corpus with extensive socio-historical time series data provides a powerful quantitative framework for studying the dynamics of culture-society interplay at scale.

These results open up promising new research directions centered on using rap music lyrics as a lens for understanding the contemporary struggles and frustrations faced by disadvantaged minority groups in navigating continuing societal inequalities and realities. Many opportunities exist for social scientists across disciplines to further investigate the intricacies of the interplay between culture, as crystallized in artistic outputs like rap, and the broader evolution of society through large-scale longitudinal analyses of text (see Caliskan et al., 2017; Garg et al., 2018; Hamilton et al., 2016 for examples on semantic changes of words or the underlying human biases). This computational approach leveraging rap lyrics could also help elucidate the emergence, evolution, and diffusion of distinct cultural styles, perspectives, and languages over recent decades as minority communities have fought to make their voices heard.

From a methodological perspective, there is also much potential for combining semantic representation models like Word2Vec, which can capture linguistic nuance and vernacular, with other analytical techniques such as natural experiments and causal inference. Such integrations may reveal additional insights into the narratives, metaphors, and societal commentaries encoded within the dense and diverse linguistic landscapes of rap lyrics over time. For instance, examining the directionality and causal impacts of the culture-society relationship under specific conditions or during major events could be an exciting direction; tracing how major societal shocks or touchstones subsequently shape topical trajectories in rap lyrics could substantively illuminate the complex dynamics of cultural response and resistance.

This study is not without its limitations. First, in order to avoid bias related to the top-down selection of words, we developed a bottom-up linguistic semantics of social dislocations through Word2Vec algorithm based on how hip-hop musicians actually speak about the issue in the lyrical

form, but we still relied on the qualitative selection of seed words. However, this may not be truly a limitation as this provides rooms for researchers to introduce their knowledge and theory. Second, the word relevance may be conditional on time variable because the usage of slangs and creative expressions in time is less stable as they are more *fashionable*. While we comprehensively capture those words over time and combine them as a group of topic words to establish reasonable stability over time, methodological advance on measuring relevance conditional on time would definitely benefit further research. Third, the process of keyword expansion may yield outcomes that are not entirely intuitive. For instance, the term ‘rape’ under the category of misogyny could encompass words seemingly unrelated to sexual violence, such as ‘diss’ and ‘kill.’ While these associations might initially appear as noise, they could also offer insights into how the concept of ‘rape’ is contextualized within the culture. This perspective provides an opportunity to reevaluate how certain social issues are framed within specific cultural narratives. Fourth, we focused our analysis solely on rap music. To strengthen empirical evidence—and to assess whether rap music generally presents more violent themes compared to other genres—further research could examine whether similar relationships between lyrical themes and socio-economic conditions exist in other musical genres. Additionally, the methods used here could be applied to other forms of art and popular culture.

Finally, it is important to stress that while our findings demonstrate that rap lyrics can serve as societal indicators, they are not the ultimate representation of individual or localized experiences. Artistic productions are interactive creations whose meanings arise from a complex interplay between artists, audiences, and broader social conditions (Blau and Quets 1987). Thus, further qualitative and critical analysis is essential for a fuller understanding across the art form, the societal contexts it reflects, and the motivations and emotions that drive artists, particularly in marginalized communities like African American men, as their perspectives offer invaluable qualitative data that could have major social policy ramifications (Stephens and Wright 2000).

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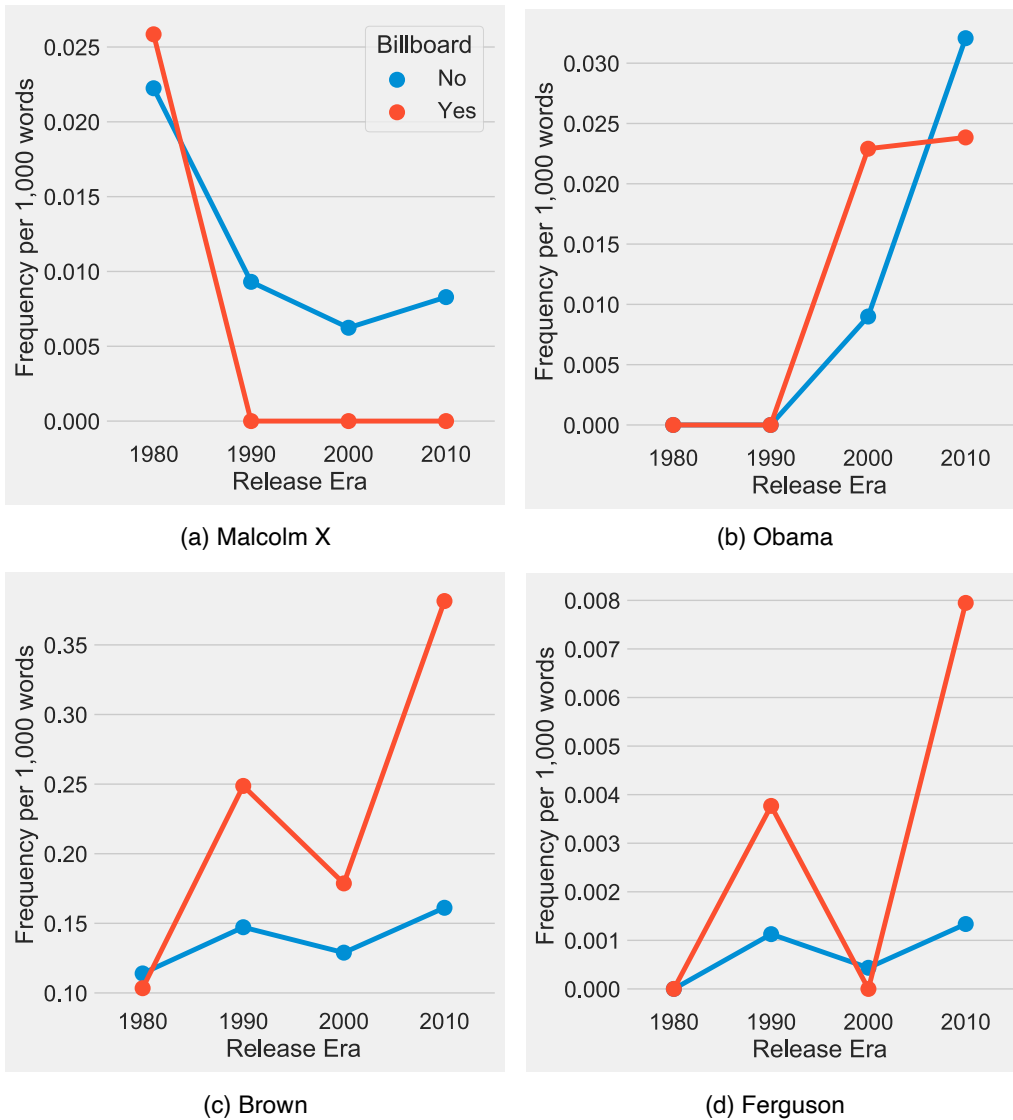
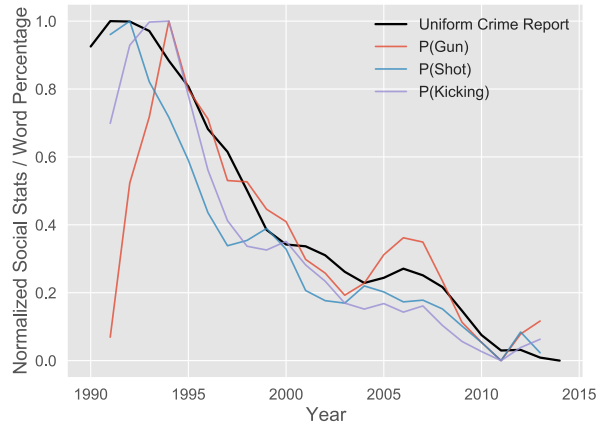
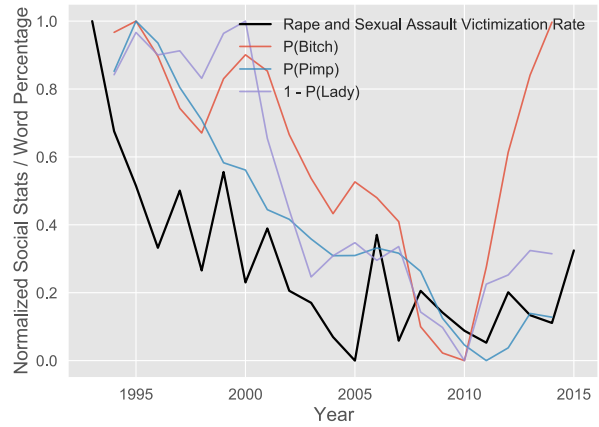


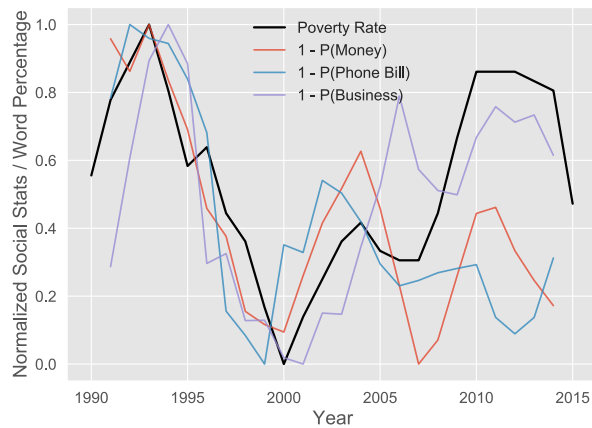
Fig 1. Fluctuations of the use of historically important names in the genre over time. Those terms include (a) Malcolm X, (b) Obama, (c) Brown, and (d) Ferguson. While the average baselines are different, the rate of changes over time are highly consistent between Billboard and non-chart songs.



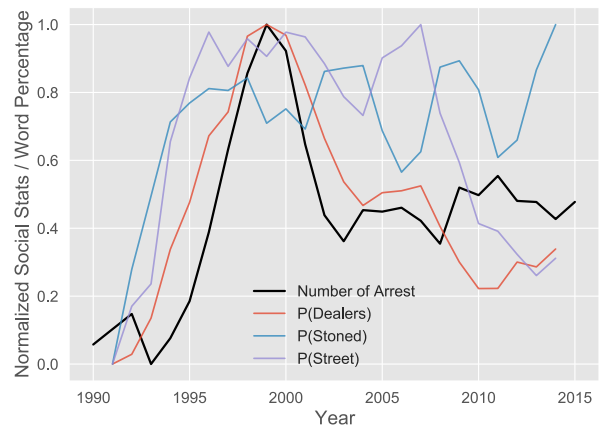
(a) Physical / Street Violence



(b) Misogyny

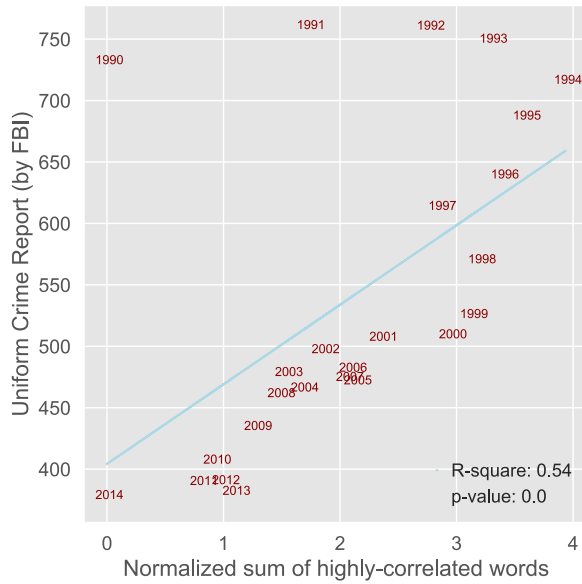


(c) Money / Materialism

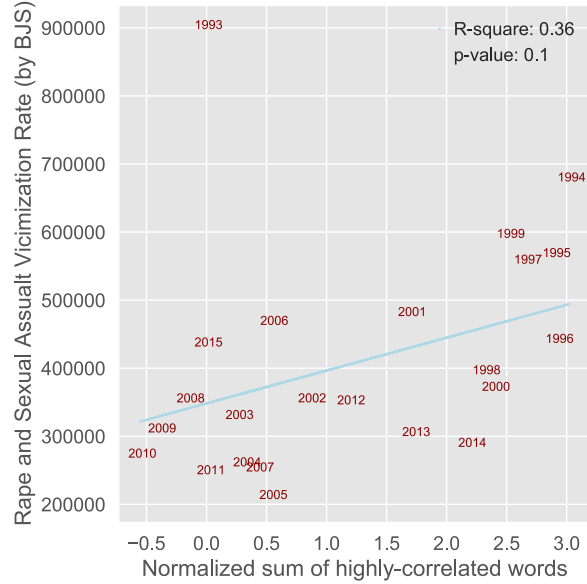


(d) Drug

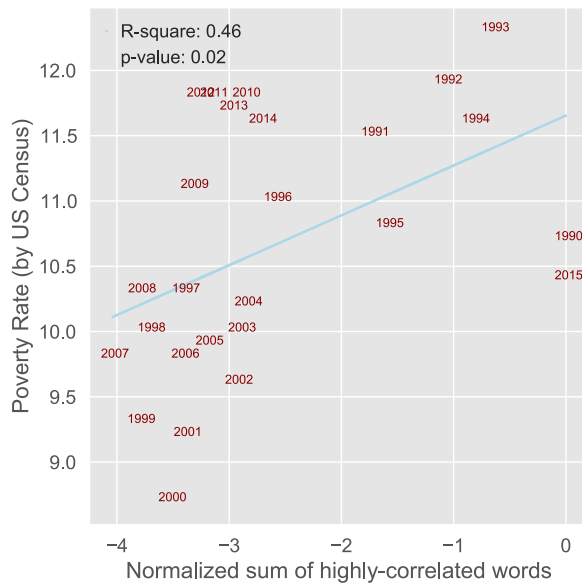
Fig. 2. Comparisons of time series between social statistics and the prevalence of topic words. All values (y-axis) are normalized, so that the minimum and the maximum values in the time period are bounded between zero and one.



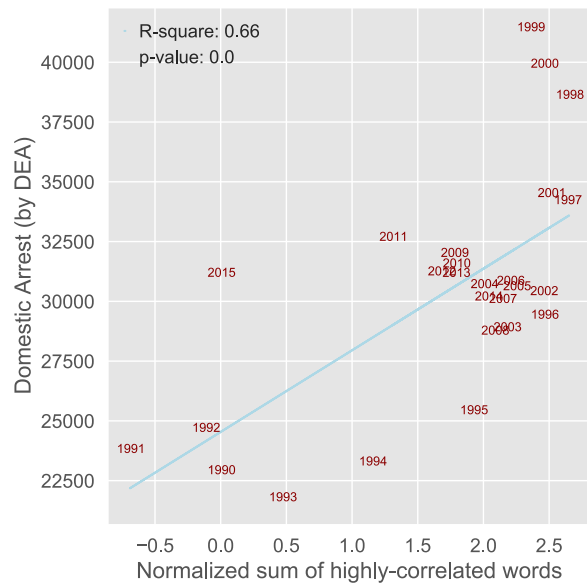
(a) Physical / Street Violence



(b) Misogyny



(c) Money / Materialism



(d) Drug

Fig. 3. Correlations between social statistics and normalized sum of the prevalence of highly-correlated words. Note that an inverse normalization was applied to the sum for Money and Materialism-related words, taking into account the observed negative correlations between the frequency of these terms and poverty rates over time.

Category	Keyword	Topic Words
Physical / Street Violence	Gun	Pistol, Gat, Gun, Glock, Heater, Burner, Strap, Baretta, Tech Nine, Fofo, Uzi, Ruger, Tec, Semi, 44, Gauge, Cannon, Magnum, Calico, Mac11
	Shot	Popped, Dropped, Knocked, Bumped, Dumed, Smashed, Whipped, Banged, Kicked, Mashed, Socked, Dragged, Rushed, Stomped, Snuffed, Jacked, Slapped, Smacked, Capped, Shankd
	Kicking	Kickin, Kicking, Rippin, Ripping, Tearin, Tearing, Lockin, Shuttin, Choppin, Shutting, Locking, Backing, Backin, Breakin, Beatin, Chopping, Breaking, Cuttin, Tabgin, Smaking
	Gang	Gangs, Gang bangers, Murderers, Gangbangers, Dope Dealers, Killers, Killas, Thugs, Dealers, Mobsters, Criminals, Drug Dealers, Thieves, Crooks, Gangsters, Hustlers, Villains, Convicts, Hoodlums, Villians
	Prison	Jail, Prison, Penitentiary, Penn, State Pen, County, County Jail, Precinct, Slammer, Hospital, Court, Cell, Jail Cell, Court Room, Morgue, Cemetary, Graveyard, Cemetery, Pine Box, Mortuary
Misogyny	Bitch	Hoe, Ho, Bitch, Broad, Chick, Slut, Tramp, Whore, Trick, Stripper, Hooker, Hoochie, Groupie, Prostitute, Diva, Dime Piece, Skeezer, Hoodrat, Lesbian, Actress
	Pussy	Puss, Pussy, Coochie, Clit, Twat, Clitoris, Nipples, Nipple, Lips, Tits, Titty, Butt, Breast, Breasts, Titties, Lipstick, Butt Cheeks, Booty, Boobs, Tummy
	Pimp	Player, Playa, Baller, Balla, Hustla, Hustler, G, Pimp, Rider, Dope Dealer, Drug Dealer, Stunter, High Roller, Stunner, Gogetter, Gigolo, Mack Daddy, Shot Caller, Ghetto Superstar, Dboy
	Lady	Girl, Lady, Girlfriend, Boyfriend, Wifey, Wife, Sister, Daughter, Mom, Momma, Mama, Moms, Mommy, Daddy, Dad, Little Sister, Mother, Grandmother, Little Sister, Mum
	Rape	Kidnap, Rape, Assassinate, Embarrass, Crucify, Taunt, Dismiss, Diss, Punish, Slay, Kill, Merk, Warn, Murk, Smother, Bury, Cremate, Deceive, Confront, Embarass
Money / Materialism	Money	Cash, Money, Dough, Loot, Cheddar, Cake, Fetti, Paper, Cheese, Bread, Chips, Papes, Chedda, Chedder, Scroll, Dividends, Cash Flow, Funds, Feria, Feddy
	Phone Bill	Car Note, Mortgage, Rent, Tuition, Taxes, Tithes, Tithes, Stubs, Fees, Loans, Debts, Phone Bill, Tolls, Respects, Morgage, Close Attention, Homage, Ultimate Price, Child Support, Bills
	Success	Greatness, Perfection, Clarity, Manifestation, Innovation, Creation, Relevance, Existence, Perception, Consciousness, Philosophy, Development, Attributes, Aspects, Principles, Entity, Eloquence, Wizardry, Artistry, Equations
	Business	Bidness, Business, Buisness, Bizness, Biz, Bizz, Bi, Fam, Family, Involvement, Dignity, True Identity, Self, Wealth, Stupidity, Credibility, Mental Health, Integrity, Selfrespect, Morals
	Hood	Neighborhood, Hood, City, Projects, Hoods, Pjs, Gutters, Slums, Burbs, Suburbs, Jects, Boondocks, Alleys, Tenements, Sewers, Project Buildings, Alleyways, Swamps, Meadows, Meadow
Drug	Dealers	Drug Dealers, Dealers, Dope Dealers, Murderers, Thieves, Gangbangers, Criminals, Crooks, Killers, Killas, Mobsters, Villians, Gang Bangers, Gangsters, Hustlers, Killaz, Guerillas, Cap Peelers, Thugs, Villains
	Drug	Narcotics, Caine, Cocaine, Coke, Heroin, Heron, Crack Cocaine, Cocain, Powder, Lleyo, Herion, Amphetamines, Cavi, Yola, Baking Soda, Cola, China White, Crystal Meth, Dub Sacks, Coca
	Street	Streets, Street, Backstreets, Gutters, Alleys, Pjs, Projects, Slums, Trenches, Jects, Burbs, Suburbs, Boondocks, Swamps, Ville, Sewers, Alleyways, Tenements, Meadows, Jungles
	Stoned	Buzzed, Tippy, Woozy, Drunk, Perved, Zooted, Pissy, Lifted, Blitzed, Blowed, Faded, Juiced, Amped, Pissy Drunk, Crunked, Weeded, Blazed, Drugged, Keyed, Krunk
	DEA	ATF, DEA, FBI, Police, Cops, Feds, Coppers, Popo, Popos, Jakes, Pigs, Narcs, Undercovers, Crooked Cops, Narcs, Detectives, Onetime, Jackers, Authorities, Agents, CIA, Juras

Table 1. The selected seed words for each category of social condition and the 20 most similar words for each seed word, expanded by the Word2Vec model.

Category	Keyword	τ (p-value)	Category	Keyword	τ (p-value)
Violence	Gun	0.113 (0.445)	Economy	Money	-0.471 (< 0.001)
	Shot	0.493 (< 0.001)		Phone Bill	-0.243 (0.086)
	Kicking	0.553 (< 0.001)		Success	-0.077 (0.600)
	Gang	-0.460 (< 0.001)		Business	-0.169 (0.237)
	Prison	-0.093 (0.532)		Hood	-0.360 (0.010)
Misogyny	Bitch	0.241 (0.114)	Drug	Dealers	0.532 (< 0.001)
	Pussy	0.233 (0.127)		Drug	0.151 (0.293)
	Pimp	0.225 (0.140)		Street	0.378 (0.006)
	Lady	-0.146 (0.346)		Stoned	0.188 (0.188)
	Rape	0.107 (0.497)		DEA	-0.009 (0.965)

Table 2. Kendall's tau correlations between the volume of violence-related words and corresponding social indicators, controlled for temporal (yearly) effects.