Singing About Love: Capture the Role of Love in Billboard Lyrics Across Social and Economic Conditions

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Abstract

Besides entertainment, music also serves as an informative media to reflect or regulate the mental states of the listeners. By looking into the most frequently used word in lyrics, love, in Billboard Hot 100 lyrics, this research examined its socio-psychologic role by exploring its language trend in word frequency, sentiment polarity, and semantic. Using the framework of critical discourse analysis with computational linguistic methods including rule-based sentiment polarity computation and dynamic word embedding, the author verified the regulation role of love in Billboard lyrics, which is consistent with the environmental security hypothesis built on previous findings. The results suggest that word love in Billboard lyrics tends to have more occurrence per song, higher sentiment polarity associations, and more closeness to romantic elements in worse socioeconomic conditions, which is likely to provide comforts and motivations to the listeners.

Keywords: Billboard Chart; Critical Discourse Analysis; Environmental Security Hypothesis; Sentiment Analysis; Dynamic Word Embedding

1 Introduction

Music has long been an effective tool for human beings to express their thoughts and feelings. The study of music and its components "creates a picture of how they work together to communicate the ideas, values, and identities that comprise broader discourses that constitute the ways I understand the world" (Machin, 2010). Compared to other phonological components of music like rhythm and pitch, lyrics are the most straightforward part to shed light on the meaning of the music, which always contain the fact and interests of the society (Filardo Llamas and Iglesias, 2010). Viewed as a special type of artistic literature, lyrics have always been an informative resource for understanding the social role music plays in different periods as well as how socioeconomic conditions shape the characteristics of different music (Machin, 2010). In this process, the linguistic framework of Critical Discourse Analysis (CDA) becomes one of the conventional approaches for such analyses (Alvaro, 2017). Different from traditional linguistic analytic methods which focused on the syntax or semantic structure within a sentence level, CDA generally views languages or discourses as a sort of social practice (Janks, 1997). It not only captures the linguistic properties or patterns in discourses but cares more about what kind of external power (socioeconomic impact) contributes to these patterns. This framework provides scholars with an ideal channel to explore the connections between language use and socioeconomic factors, and more details would be reviewed in Section 2.

In this research, lyrics serve as the target discourses of the CDA. As Gee (2008) argues, understanding the functions and uses of discourses requires an understanding of how language is being used in a specific context. Fairclough (2003), one of the main contributors to the CDA frameworks also mentioned that the analysis of relations between language and their contexts is an integral part of his approach. The meaning of context could simply refer to the textual environment, but more importantly, it relates to the extra-textual contexts (Alvaro, 2017), the definition of which is largely used in this research. For lyrics, multiple dimensions could be used to construct the external contexts. Different music genres in which lyrics are embedded in can be viewed as a type of context (music context), where the cultural backgrounds and target audiences could be varied. Another more commonly acknowledged context would be the socioeconomic contexts of the lyrics. Socioeconomic contexts have both qualitative and quantitative representations. Qualitative socioeconomic contexts often refer to important historic events or periods, like financial crisis and sex liberation, while quantitative socioeconomic contexts, which I focused on in this research, are always represented as a socio-economic index like average income, unemployment rate, divorce rate, etc. The variations or differences of socioeconomic contexts are viewed as a highly relevant factor of the discrepancies in linguistic patterns, and previous research shows plentiful evidence of such differences in lyrics. For example, Eastman and Pettijohn (2015) verified that Billboard country songs of the year from 1946 to 2008 are lyrically more positive in difficult socioeconomic times, while Billboard Top pop songs have more meaningful, comforting and romantic contents in worse conditions; Yasaman Madanikia and Kim Bartholomew (2014) studied differentiated between romance-related and sex-related words in Billboard hits and found that lyrics about love have declined, whereas themes of lust have increased since the sexual liberation in the 1960s—especially among the songs on the R&B/Hip-Hop charts. Therefore, differentiating the socioeconomic contexts is a necessary step when exploring the properties and patterns in lyrics.

To further understand why language use changes according to their non-textual contexts, linguistic scholars like Halliday (1978) and Eggins (2004) incorporate notions of the functions or purposes of the discourses in their analysis. Likewise, media analysts Eastman and Pettijohn (2015) also explained their statistical results mentioned above from the perspective of the function of lyrical

discourses. He put forward the environmental security hypothesis (ESH) to explain the increase of meaningful and comfort content under threatening socio-economic conditions for pop music, assuming that this kind of music properties could help listeners to relieve their anxiety or depression and to motivate themselves in such context. Following this logic, I also used the functions of lyrics from the perspective of reflection and regulation (the same as ESH) to help explain the socio-psychologic role of love in this research.

Among countless words in different lyrics, the word "love" is a special but eternal theme for music as well as for the human society, which ranked No 1. by word frequency (no stop words) among records of lyrics of pop music[1]. Meanwhile, the language use of "love" in lyrics tends to be different in unsimilar contexts: ·

- "Love will save the world" - Jessie J ("Love will save the world" 2018) ·
- "All you need is love, love" – Beatles ("All You Need Is Love" 1967) ·
- "Love wounds and marks" - Nazareth ("Love Hurts" 1974) ·
- "I'm so sick of that same old love" - Selena Gomez ("Same Old Love" 2015)

The above examples suggest that the language use of love could be different in multiple dimensions, including the meanings of love, the sentiments associated with love, and also the frequency of using "love". Though some of these questions might have been partially touched by previous research (Alvaro, 2017; Eastman and Pettijohn, 2019), most of them are still unexplored with the consideration of socio-economic conditions. Especially, with the framework of CDA, more than just seeing these differences or trends, I could provide some possible explanations, making this research as an entry to link the role of love in lyrics to our society.

In this research, I examined the role of the word love in Billboard song lyrics by looking into how the language use of love varies according to overall socioeconomic conditions with the framework of CDA. Specifically, trends of three dimensions have been explored: word frequency, sentiment, and semantic. For each of these three analyses, I examined or extended Terry's environmental security hypothesis with computation-based methods like word-embeddings and sentiment analysis, which are illustrated in Section 3. In Section 4, I describe and further explain the findings of the three sub-studies using the environmental security theory as the interpretation step in CDA. Finally, the major conclusions are depicted in Section 5, and limitations as well as future expectations are discussed in Section 6.

2 Related works

2.1 Critical Discourse Analysis

Critical discourse analysis (CDA) stems from a critical theory of language that assumes the use of language as a form of social practice, where all these social practices are highly related to their historical contexts (Alvaro, 2017). Conventionally, CDA starts from the questions about how the text is positioned, structured, or used to further exploring the consequences or motivations of such patterns. During the development of three decades, three key researchers made essential contributions to the methodological frameworks of CDA: Teun van Dijk, Ruth Wodak, and Norman Fairclough.

[1]Resource: https://codingintune.com/2018/04/09/statistics-most-used-words-in-lyrics-by-genre/

van Dijk (2009) put forwards his sociocognitive approach to the discourse studies by building up a three-layer model to reveal the interrelations among discourse, cognition, and society. In his model, cognitive schema theory (Anderson, 2010) is incorporated to build the socio-cognitive layer to bridge the microstructure (i.e., language use and discourse structure) and macro-structure (i.e., social structural or conditions). An example (Dijk, 1993) of this approach is Van Dijk's analysis of racist discourses across the world where both linguistic and socio-phycological theories are applied. Based on Bourdieu's theories (2003) about how a society's dominating elites use their symbolic capital to legitimate and authorize their habitus including language use, van Dijk argues that "it is the racist discourses of the elites in different domains of society that provide both the cognitive frameworks (schema) and the discursive resources for the reproduction of ethnic stereotypes in everyday talk and thought of the masses.". Van Dijk's framework's strength lies in the incorporation of the socio-cognitive layer to map the macro and micro structures, which yet also becomes the source of potential inconvenience because cognitive schema tends to show the reproductive or reflective functions of language uses, which generally makes the analysis static in the time dimension, ignoring the transformations or evolutions in discourses and their contexts.

Compared to Van Dijk's approach, Wodak's Discourse-Historical approach (Wodak and Meyer, 2001) pays more attention to the evolution of textual or discursive materials on social or political topics over certain periods. The historical dimensions are described as the social field or context where the target discursive events are embedded and analyzed chronically via the changes in language use. Wodak makes this approach more concrete and executable by defining eight sequential steps in her studies of discourses of climate change (Lin, 2014), from consulting existing literature to define certain discursive topics, data preparation, and case study to theoretical interpretation. Similar to the micro-macro matching process (i.e., the construction of cognitive schema) in Van Dijk's approach, Wodak also tried to use a mediate tool to combine linguistic analysis with social factors, which she referred to as discursive strategies. For example, she uses the analysis of deictic, anthroponyms to understand the discursive construction of social process or phenomena, and explicit predicates or predicative collocations to infer how people qualify these social processes or phenomena discursively. Despite these advantages from elaborations on methods, the DHA approach is still critiqued by some (Lin, 2014) for its excessive use of linguistic concepts or methods in defining these discursive strategies, which might provide difficulties for social theories to match or explain.

The framework provided by Norman Fairclough also incorporates three interrelated layers (Fairclough, 2009):

1. the object of analysis (including verbal, visual or verbal and visual texts);
2. the processes by which the object is produced and received (writing/speaking and reading/listening) by human subjects;
3. the socio-historical conditions that govern these processes.

For each of the layers, Fairclough points out an analytical focus:

1. text analysis – description
2. processing analysis – interpretation
3. social analysis – explanation

Compared to the previous two approaches, Fairclough's approach gave scholars of different backgrounds (whether linguistic or social sciences) a clear entry of the whole analysis: either of the three layers could become a start point (Janks, 1997). In most research, authors prefer to start with text analysis with traditional linguistic approaches like systematic functional analysis (Eggins, 2004; Alvaro, 2017), semantic analysis (Alvaro, 2017), and syntax structure analysis (Tlili, 2016). Sometimes, quantitative measurements like word or collocation frequencies would also help in this step (Alvaro, 2017). Then researchers would look at the generating process or field of these discourses. For example, whether it is an advertisement for pedestrians to view with a glance, a book for readers to look through carefully, or a song for audiences to listen to. These different generating contexts can guide researchers to finally look for existing arguments or theories in related fields and set up their hypothesis for the social analysis part after they captured their interested socio-economical contexts. Fairclough's approach is also the one with the most applications to media analysis including advertisements and music (Alvaro, 2017; Tlili, 2016), and the one with the most applications to relatively large-scale discourse analysis due to its flexibility and compatibility with various social theories and with both qualitative and quantitative methods.

Despite the different descriptions or analytical basis of these frameworks, the essence of them remains quite similar: trying to theorize about the connections between language/discourses (micro-level) and society (macro-level), with a mediating middle layer (e.g., social fields, context models, cognitive schema). Also, most existing CDA studies perform traditional linguistic analysis in the step of text analysis. Though some of these analytical logics could dig deep in some representative cases they can hardly be applied to discourse analysis on a large scale, because they rely on the extraction of specific words or syntax relationships in these textual samples. Some progress is made using computational tools like LIWC to perform a frequency analysis (Tlili, 2016; Alvaro, 2017) on certain entities (personal pronouns, spatial-temporal collocations, etc.), but more advanced computational methods like sentiment polarity analysis and word-embeddings are rarely used in CDA. These methods could help quantify high volumes of discourses, which serves as an interface for more computational analysis like correlation tests or word distance comparisons based on embedding vectors, and might provide new insights on language use or semantic evolutions out of the restriction of syntax structures. Therefore, a combination of CDA framework and advanced computational linguistic methods would be developed in this research.

2.2 Relationships Between Music and Socio-Economic Conditions

The relationship between music and socio-economic conditions has been a popular topic in media analysis for years. Compared to other media formats like TV or films, music has its unique values from three aspects (Eastman and Pettijohn, 2019):

"First, although audiences usually put forth conscious effort in consuming TV, movies, and magazines, music is ever-present in our lives while I go about our daily activities—even including the consumption of media like TV and film that uses music to heighten the meanings communicated visually. Second, similar to magazines marketed toward specific demographic groups (which show their unique trends through time), the culture industry (music) targets numerous genres toward particular groups that share a class, ethnicity, subculture, and so forth. Third, because of genres with demographic targets music is much more influential than other media in the development of both an individual and a collective identity."

These three reasons highlight the cultural significance of music in different genres, the differences between which can sometimes become a sort of natural symbol of socio-economic or cultural segmentation of their producers and target audiences. For example, pop music is believed to target

the majority of middle-class audiences by (Eastman and Pettijohn, 2015); while the main audiences of country music are described as "rural, and working-class Whites". Also, Hip-hop music is claimed to have a root in black culture of sex and violence, though it tends to be mainstreamed nowadays (Eastman and Pettijohn, 2019). In this research, we focus the analysis on Billboard Hot 100 songs, which can be viewed as a mix of music in multiple genres. A benefit to doing so is that it would be able to cover the preference of more social groups or classes in the samples, which is believed to better connected to the overall socioeconomic conditions in the US we measured.

Back to the relationships between musical components and external socio-economic conditions, an early study of this kind (Rothenbuhler and Dimmick, 1982) found post-World War II song lyrics became less about love and relationships and more about the social issues. Also, some recent studies (Yasaman Madanikia and Kim Bartholomew, 2014) suggest that sexual lyrics become increasingly prevalent during the past 40 years, which are suspected to be a consequence of sexual liberation. Besides, Qiu et al. (2020) found in their research that the unemployment rate was able to predict Anger degree in Popular Music Lyrics using the top 10 songs of the year from the United States and Germany between 1980 and 2017. One of the main contributors of this area is Terry Pettijohn, who performed a serial of studies analyzing how musical trends (e.g., lyrics, tempo, chords, demographics of performers) in the Billboard songs change with their General Hard Times Measure (GHTM), a standardized indicator capturing yearly economic and social difficulties in the United States. In his research of Billboard No.1 songs from 1955 to 2003 (Pettijohn and Sacco, 2009), he found that songs with more gentle, soft or romantic words per sentence, or a focus on the future, and greater mention of social processes and intergroup themes dominated the charts during threatening social and economic conditions. Besides, he extended his studies from billboard charts of pop to country, and Hip-hop/R&B charts from 1946 to 2008 (Eastman and Pettijohn, 2015, 2019). He found that unlike pop songs which tend to have sadder expressions in melody and slower tempos, country songs of the year are lyrically more positive, musically upbeat, and use more happy-sounding major chords during difficult socioeconomic times. Besides, female country artists are more likely to top the charts in poorer socioeconomic conditions, whereas the singers of top pop songs on Billboard in threatening conditions tend to be male. R&B songs share the same trend in lyrics with pop songs but have a similar trend in gender distributions on top songs with country charts. Additionally, older artists of these three music genres are more likely to succeed on the charts during harder social-economic conditions. Furthermore, to explain these findings, the authors refer to the ideology of the environmental security hypothesis, which I would review in the next section, as a function of the music in unwanted conditions.

Out of media studies, some linguistic scholars applied the framework of CDA to the analysis of lyrics, trying to gain insights on both the lyrics themselves as well as the social contexts. Alvaro (2017) used Fairclough's framework performing a contrastive analysis of the expression of romantic love among hit songs in English and Spanish from 1950 to 2009, finding the fact that people's change to a more open attitude of loving relationships took place in the English-speaking World earlier than that in Spain, especially for females, which could be revealed by the lyrics of popular songs in different decades. Also, he finds that the concept of romantic love transits from a "mental" process to a "material" process as the social value developed to be more substantial. Arif and Triyono (2018) also utilized Fairclough's framework to study the Korean song "Baby Shark", and suggested the song reflects an educational emphasis of hard-working in Korean society. Other scholars used CDA to individual works of a certain background, like the song "We are the world 25 for Haiti" Herman (2019) to reflect the functions of music in special social or economic events.

2.3 Functions of Music

Theories about the functions of music serve as the bridge to connect the text analysis and social analysis part in this research and also provide possible socio-psychologic roles in which the word love might play in lyrics. Based on Fairclough's framework, the interpretation step needs to consider the producing format of the discourses, which in our studies is music (songs), thus using theories about functions of music is reasonable to fit into the framework. I highlight two types of functions here, which are named with reflection and regulation, respectively.

The function of reflection builds on some psychological findings that individuals prefer to choose lyrics that match their mood and concerns. (McNamara and Ballard, 1999) found that preferences for highly arousing music (heavy metal, rock, alternative, and rap) are positively related to resting arousal, sensation seeking, and antisocial personality. Pettijohn et al. (2010) found that when students think about summertime, they prefer music that is energetic and rhythmic (emotionally warm) and when students think about wintertime, they prefer music that is reflective and complex (emotionally cold). Other researchers (Knobloch and Zillmann, 2002) found out individuals tend to listen to lively jazz music when feeling cheerful, but listen to blues music when they feel sad. Thus, extended to a group or society level, music is considered as a cultural product to reflect and sometimes reinforce collective feelings, mood, or psychological processes in a particular sociocultural environment (Pettijohn and Sacco, 2009).

The function of regulation is aligned with the environmental security hypothesis (ESH), which is originally a combination of several evolutionary and ecological theories (Buss, 2003; McArthur and Baron, 1983) . Under this hypothesis, our perceptions of environmental security influence our social preferences and what we find most desirable during different social and economic conditions. For example, more meaningful, mature, and positive items are likely to be preferred when external socio-economic conditions are worse, to help people mitigate the threat and uncertainty, and motivate themselves. ESH was initially used to explain why models of more mature facial and body features tend to be selected as the Playboy playmate of the year during hard socio-economic periods (Pettijohn II and Jungeberg, 2004), where researchers thought the external maturity could help readers to alleviate their negative emotions. Later, ESH has also been applied to explain why songs of older artists and songs with meaningful lyrics are more likely to top the charts during undesirable socio-economic conditions (Pettijohn and Sacco, 2009; Sacco, 2009).

3 Methods

In this research, three sub-studies were performed to capture the love-related variations in lyrics crossing different socio-economic conditions. For each of the three sub-studies, I followed the framework of Fairclough's CDA approach, viewing the research questions with the layers of text analysis, processing analysis, and social analysis. Especially, the differences between the three sub-studies mainly focus on the text analysis part, the results of which the hypothesis is tested. The theories for processing analysis (reflection and regulation) and the measurements of socio-economic conditions (GHTM) remain the same for three sub-studies to build up logical connections between the results of the three parts. The structure of the entire analysis could be summarized in Figure 1.

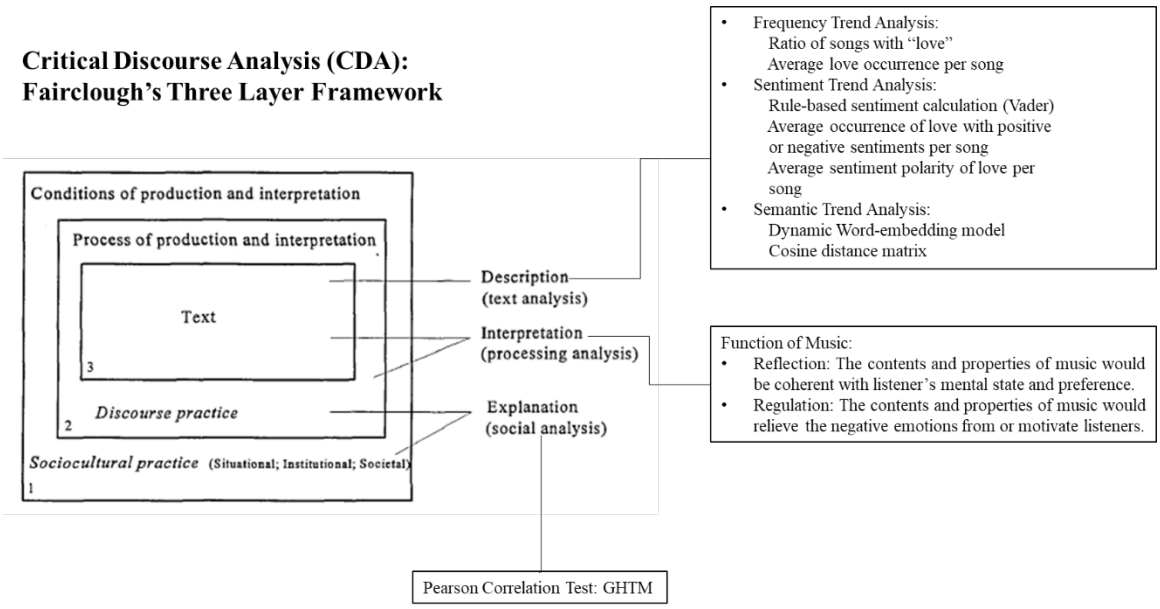

Figure 1: Critical Discourse Analysis (CDA) Framework

3.1 Data Description and Preprocessing

- Lyrics Data: The Billboard lyrics dataset used for text analysis in this research is from Kaggle[2], an online community of data scientists and machine learning practitioners under Google's family. The dataset contains lyrics of Billboard Hot 100 songs from 1965 to 2015. I manually checked the validity of the lyrics and filled up the vacancies where the lyrics are missing. To simplify our analysis, samples that are not in English[3] (13 items) and instrumental songs (32 items) excluded from the dataset. After preprocessing, the remained dataset contains 5055 songs. For lyrics in each sample, words annotating the structure of the song are also excluded, including "intro", "verse", "(pre/post-) hook", "(pre/post-) chorus", "bridge", "outro", "instrumental (break)" and "repeated to end/fade".

- Measurement of Socio-economic conditions: The socio-economic indices used in building the socio-economic context of the lyrics are derived from the General Hard Times Measure used in Terry's research. This indicator measures the hard degree of the overall socio-economic conditions by integrating unemployment rate, disposable personal income (annual change), consumer price index (annual change), death rate, birth rate, marriage rate, divorce rate, homicide rate as well as suicide rate (The detailed definition and source see Appendix). To calculate the final GHTM indicator, the sub-indices were firstly standardized and indices including disposable personal income, consumer price index, birth rate, and marriage rate are multiplied by (-1) to reflect the hard degree. Then the adjusted sub-indices are averaged for each year to produce the single GHTM indicator, where a higher score means a worse socioeconomic condition.

[2]https://www.kaggle.com/
[3]The languages of the lyrics are detected by langdetect package

3.2 Sub-Studies Design and Hypothesis

In this section I would describe the design of the three sub-studies for the analysis of the language use of love in lyrics, where related hypothesis based on environmental security hypothesis are tested or expanded:

3.2.1 Frequency Analysis

This sub-study explored the frequency of how the word "love" is used in billboard lyrics. Specifically, two measurements of frequency were tested at a yearly level in this part: the average ratio of songs containing word love each year and the average occurrence of word love per song each year. The relationship between the frequency statistics and socio-economic indices was measured by the Pearson Correlation Test.

According to terry's environmental security theories built from the Billboard Top songs, people prefer music having more meaningful and inspiring content in worse socioeconomic conditions. Given love is generally one of the meaningful contents in lyrics, which is supposed to obey the ESH, my hypothesis for this sub-study is: In worse socio-economic conditions (GHTM is higher), the average ratio of songs containing word love in Billboard HOT 100 would increase and the average occurrence of word love per song would also increase.

3.2.2 Sentiment Analysis

This sub-study tried to analyze the sentiments associated with the word love (not love itself) in lyrics. Specifically, the sentiment score for each instance was measured by the sentiment polarity of the sentence where the word love was embedded, using the Vader Sentiment Analyzer (Hutto and Gilbert, 2014). The Vader Sentiment Analyzer generates sentiment polarity scores using rule-based methods based on pre-defined lexicons. Elements like negations, comparatives would be identified and combined with their relative positions in the sentences, making Vader more sensitive than simple average sentiment algorithms. The sentiment score related to love in a lyric sample was calculated by averaging the scores of all love-embedded sentences in this sample, and the overall sentiment score for a lyrics group of the same year was calculated by averaging the polarity scores of all the lyric samples. The correlation between yearly sentiment scores and the GHTM is also measured with the Pearson correlation test.

Extending the ESH, I made the hypothesis for this study that in worse socio-economic conditions, the sentiment associated with love in Billboard HOT 100 tends to be more positive.

3.2.3 Semantic Analysis

The method of semantic analysis performed here is different from what linguistics traditionally used (i.e., systemic functional analysis), which are highly dependent on the decomposition of sentence structures. The semantic of love was measured using word2vec models. Word2vec is one of the most popular words embedding methods to project the words in a corpus to a shared vector space, where words with high similarities tend to be close and words that are very different would become distant. Each word would gain a representative vector after the projection. Therefore, I am able to compare the semantic of love by calculating the cosine distances of their vectors and the vectors of other words. Moreover, the semantic change of the word love is quantitatively measured with a specially designed dynamic word embedding algorithm from Stanford NLP (Hamilton et al., 2016). The details of the algorithm are beyond the scope of this research, but briefly speaking, the algorithm would take in time-labeled text input and generate word2vec models for each of the time stamp. Therefore, it allows users to analyze the semantic change of a specific word by calculating

the distances between the vectors of this word in models of different years. The differences between GHTM in different years are measured in absolute values and are also compared to the semantic distances between word love in different years via Pearson correlation test. Based on ESH, the hypothesis here would be adjusted as when the differences between GHTM are smaller, the semantic distance of love tends to be shorter.

According to Terry's previous research, romantic contents are also found to occur more frequently in threatened socioeconomic conditions in Billboard Top songs. He viewed this as a need for affiliation and company in worse conditions, which is in line with ESH. So, I also examined the semantic distances between love and romance related words[4] and hypotheses that love tends to be closer to romantic contents in worse conditions.

4 Results and Discussions

In this section, the major analytical results of the above three sub-studies are reported and discussed, and some auxiliary analyses to further verify the main findings are also illustrated in this section.

4.1 Frequency Analysis

According to the results (see Figure 2,3), the average ratio of songs containing word love does not have a statistically significant relationship with the standardized GHTM ($r = 0.12, p = 0.41$). However, the average occurrence of word love per song shows a significant positive correlation with the standardized GHTM ($r = 0.41, p = 0.002$). An alternative measurable factor that can affect the occurrence of love might be the length of the lyrics. If lyrics tend to have more words in worse conditions, then the significance of more occurrence of love would be questionable because longer lyrics intuitively have more possibilities for word love to occur. To preclude this factor, the relationship between the average length of lyrics and the standardized GHTM was also examined. It was found that no significant correlations exist between them ($r = -0.04, p = 0.79$).

Though not completely consistent with my hypothesis, the results still provide us with useful hints of the regulation function of love in lyrics. Especially, this function of the word love is likely to be achieved by the occurrence of love per song rather than the ratio of love contained songs. To confirm this, I checked the average occurrence of love in songs having word love (to remove the inflation of songs without word love) and found a higher correlation (see Figure 4) with the GHTM ($r = 0.50, p < 0.001$). This finding supports that the increase of frequency is majorly related to the increase of word love in songs having love (depth) instead of the number of songs having love (broadness). But overall, the increase in average word frequency of love per song could be viewed as an application of the ESH to the micro-scope of the word love, where worse conditions are connected to more meaningful content (i.e., love).

For the insignificance of the ratio of songs containing word love, several possible reasons might be relevant. First, the yearly Billboard Top 100 is an inclusive chart without a focus on specific music genres, thus songs targeting any audiences are possible to be seen on it. For some special types of music like metal or indie, love is seldom a keyword in their lyrics, thus a certain number of songs each year can have no love in lyrics. Secondly, popular music can also function as a reflection of the external environment or the listener's mental state. Thus, in worse conditions, some people might prefer to listening music having less meaningful content instead of love-centered songs to echo their mood. Finally, other meaningful words or other elements like melody or rhythms, which are

[4]Romantic words: boy, girl, kiss, honey, baby, adore, sweet, lover, romance, romantic, referred to https://www.words-to-use.com/words/love-romance/

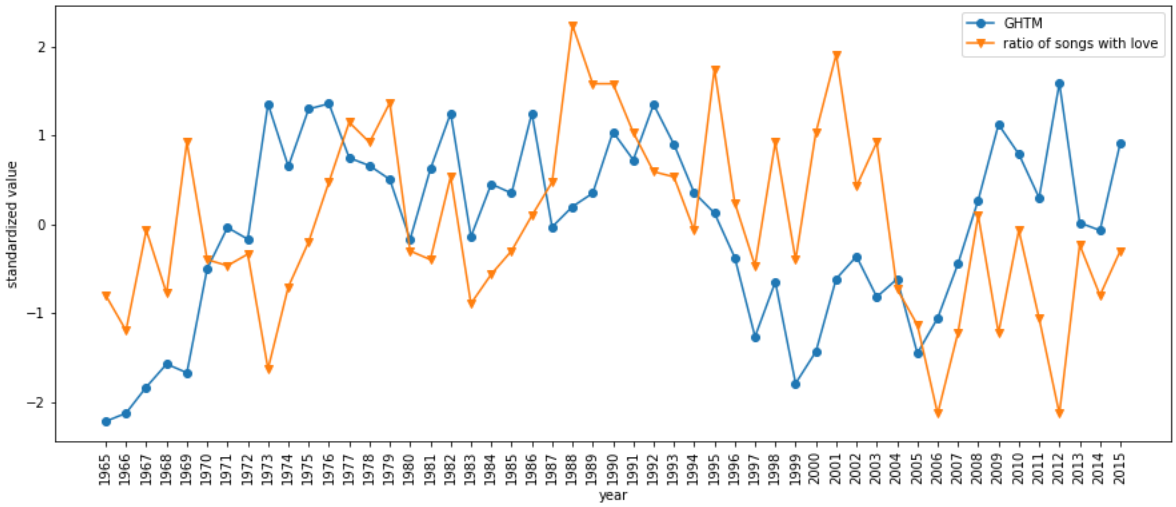

Figure 2: The Ratio of Songs with Love VS GHTM

not measured here can also contribute to the popularity of songs, deciding whether it can enter the billboard. Therefore, songs without word love might have other elements that captured audiences' preference.

4.2 Sentiment Analysis

From the results of sentiment analysis, we can see that love is generally associated with positive sentiments ($s \geq 0.05$) in lyrics (see Figure 5), and in most cases, the negative associations are almost neglectable. Thus, I further examined the relationships of the average positive love number per song and the standardized GHTM (see Figure 6), and the result shows a significant positive relationship ($r = 0.54, p < 0.001$). These results confirm and extend the regulation role of the word use of love in Billboard Hot 100 lyrics from a positive-negative perspective, which means that more use of love with positive sentiments tends to occur in Billboard songs of years in worse conditions. Combined with the findings in 4.1, though meaningful words are not necessarily positive, for the case of the word love, these two properties are close to each other due to the relatively stable positive sentiment associations of the word love.

The polarity score comparison results provide us with more insights on the quantitative side of the regulatory role of the word love in these lyrics (see Figure 7, 8). The correlation test shows a significant positive relationship with the sentiment polarity of love with the GHTM ($r = 0.44, p = 0.001$), suggesting that when the overall socioeconomic conditions are worse, the average sentiment polarity associated with the word love in Billboard lyrics would also tend to increase besides the increase of connecting love to positive meanings. This result supports my hypothesis derived from the original ESH. When the overall conditions become more threatened (worse), love associated with more positive sentiment is likely to have the function to offset those negative feelings for target audiences or endowing them with motivations in real-life, thus the use of love with more positive sentiments are likely to be observed in Billboard lyrics in worse conditions. Additionally, to highlight that the sentiment polarity trend I captured is specifically related to word love instead of the entire lyrics, I also compared the average overall sentiment scores of lyrics and the GHTM,

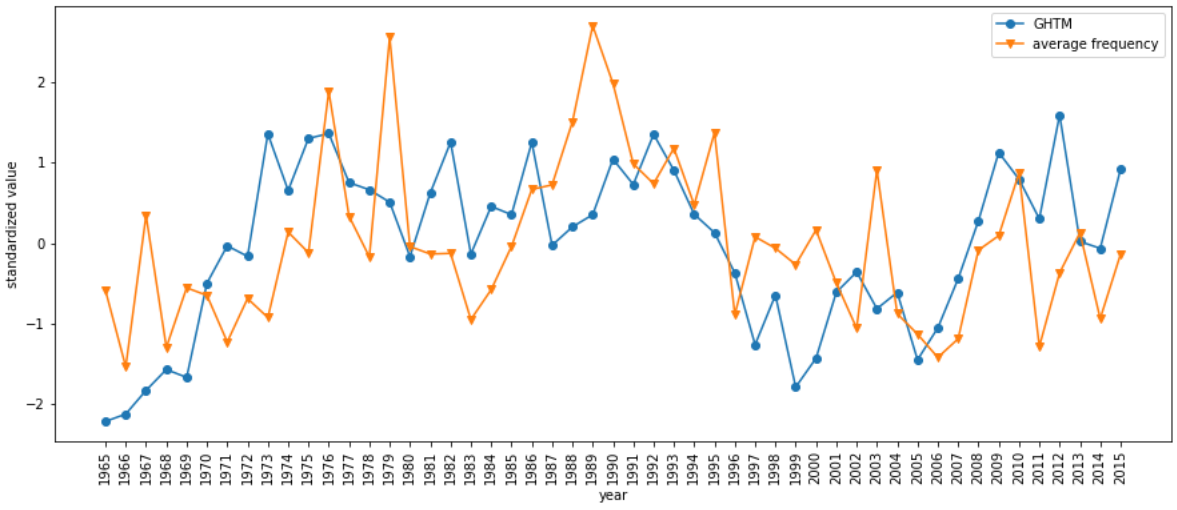

Figure 3: Average Frequency of Love Per Song VS GHTM

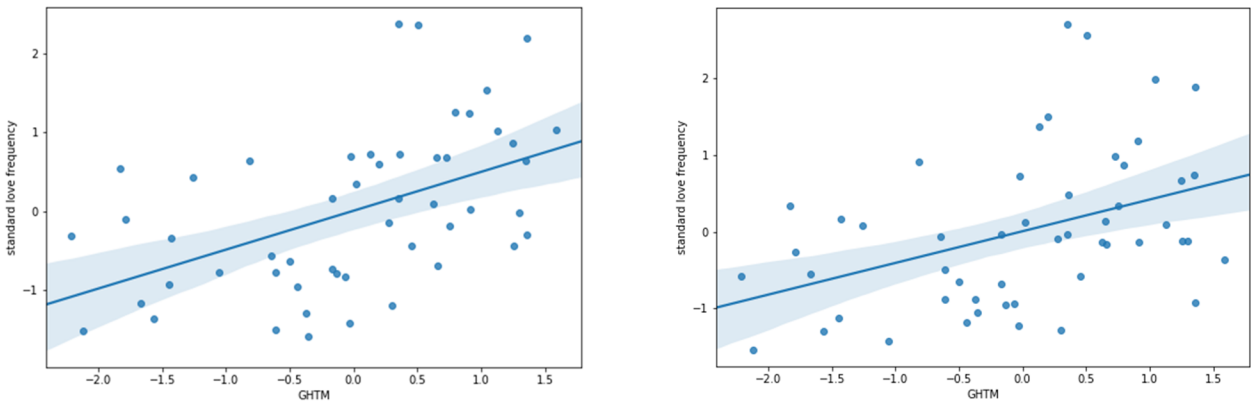

Figure 4: Correlation between The Average Frequency of Love Per Song and GHTM (Left: Songs with Love; Right: All Songs)

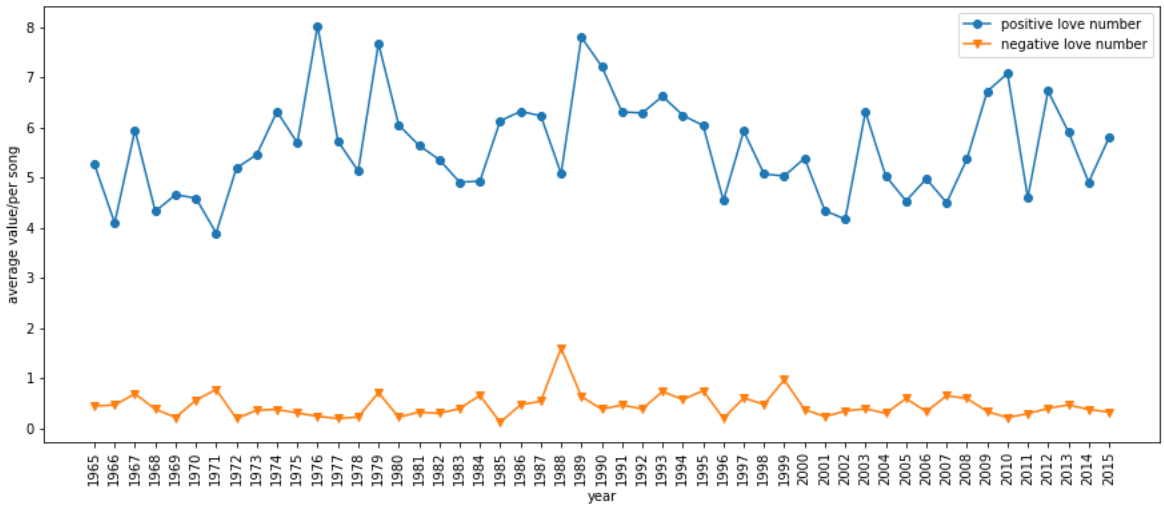

Figure 5: Comparison Between Average Number of Positive and Negative Love Per Song

and no statistically significant relationships are found ($r = 0.08, p = 0.60$), indicating the trend about the sentiment polarity of love was not a by-product of the trend of the overall lyrics' sentiment polarity.

4.3 Semantic Analysis

From the correlation test result between the semantic distances of love and the differences of GHTM (see Figure 9), my hypothesis is largely supported ($r = 0.42, p < 0.001$) that the semantic differences tend to be smaller within years of more similar socioeconomic conditions (see Figure 10). This finding is coherent with the general ESH by mapping the similarity in the external conditions to the similarity of the semantics of certain lyrics, suggesting if the overall socioeconomic conditions vary a lot, the semantic change of love in Billboard lyrics might also be more different. However, this result alone is not sufficient to verify the ESH or the regulation role of the word love in the semantic domain. Because the reflection function of music could also explain this result, which means if we view semantic change as a reflection of the environment, similar environments might also lead to smaller semantic changes in certain words. Thus, more evidence is needed to verify the regulation role of the word love in semantics.

The analytical results (see Figure 11) between the semantic distance of word love and romance-related words provide some evidence of the validity of the ESH. By calculating the average cosine distances between love and selected romance words in each model and comparing it to the GHTM, I found a negative correlation between them ($r = -0.51, p = 0.001$). This result suggests (see Figure 12) that for worse conditions, the semantic of love tend to be more related to those romantic elements. This agrees with Terry's previous finding for the Billboard Top songs, where more romantic contents tend to occur in worse conditions. Thus, I assumed that his explanation there is also applicable for my result here that the closeness to romantic elements in lyrics comforting the listeners in bad times by offering a feeling of social affiliation and company. Thus, the regulatory role of the word love from the aspect of the semantic trend is largely verified from the aspect of closeness to romance. For other aspects like closeness to family, to substances, more investigations

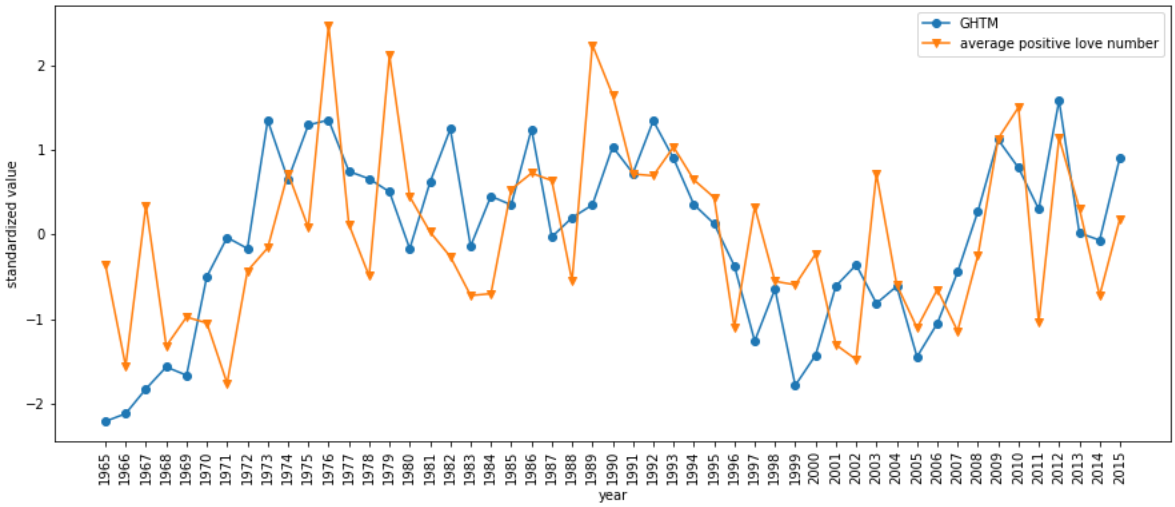

Figure 6: Average Positive Love Frequency VS GHTM

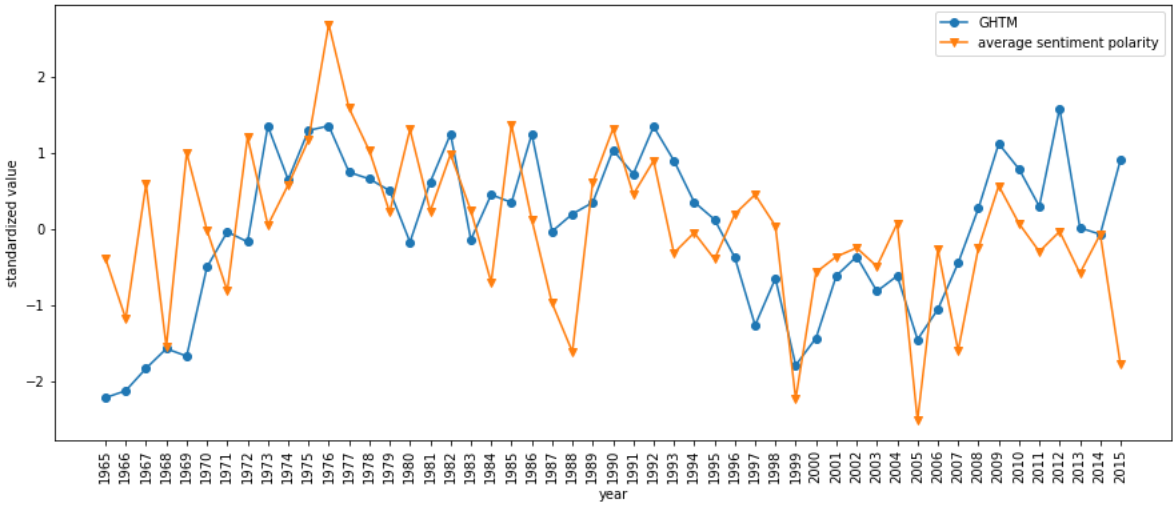

Figure 7: Average Sentiment Polarity Associated with Love VS GHTM

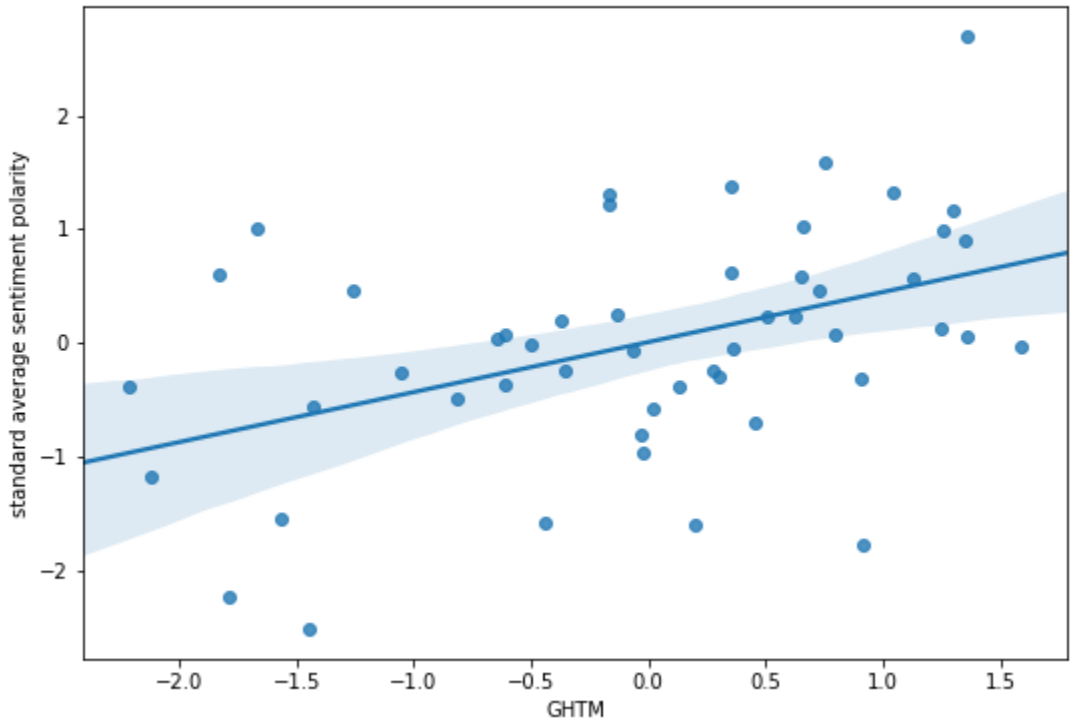

Figure 8: Correlation between The Average Sentiment Polarity Associated with Love and GHTM

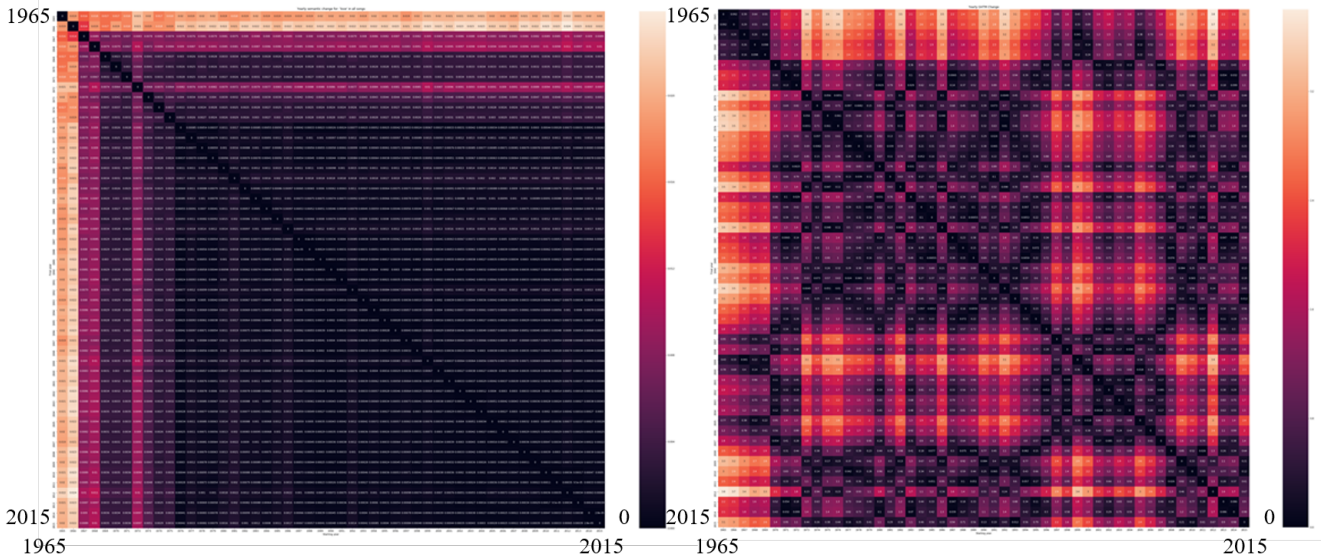

Figure 9: Semantic Distances of Love (Left) VS Absolute Differences of GHTM (Right)

are in demand.

5 Conclusion

In this research, to check the socio-psychologic role of love in Billboard Hot 100 lyrics, I examined how the language use of love varies according to different socioeconomic conditions from a socio-linguistic perspective. Especially, Fairclough's approach of critical discourse analysis is chosen as the basis for the entire process. By integrating this traditional framework with advanced computational linguistic methods like sentiment polarity analysis and word embeddings, the research reveals the compatibility of socio-linguistic frameworks with highly quantitative methods. Most traditional CDA studies focus on a small number of works or discourses to suit their research goals and avoid large-scale analysis because of the inability to decompose a large volume of texts by hand and the difficulty to filter out useful information. Using this integrated model, I show that highly computational methods could help to explain or explore linguistic patterns and trends in corpora of large volumes, which brings new potential for socio-linguistic analysis to a broader scope.

From the analytic results, I found that the language use of love in Billboard lyrics is coherent with the environmental security hypothesis (regulation function) from the perspective of frequency, sentiment and semantic, and does not reveal a significant sign of the reflection role. Under the environmental security hypothesis, popular music should have more meaningful, positive contents in worse socioeconomic conditions (bad times) to make listeners feel relieved, comforted or motivated. The findings of the tendency of increased use of word love, especially the love with positive sentiments, in worse socioeconomic conditions and the tendency of smaller semantic distances under more similar conditions support the validity of environmental security hypothesis for word love in Billboard lyrics. Moreover, the increasing sentiment polarity scores and closeness to romantic contents in worse conditions further extend the regulation role of word love in the aspects of sentiment polarity and semantic change, suggesting that, during worse times, Billboard lyrics tend to express word love in a more positive way, and also relate love to general romantic elements more closely as a sign calling for closer social affiliation. According to these linguistic trends I have explored and

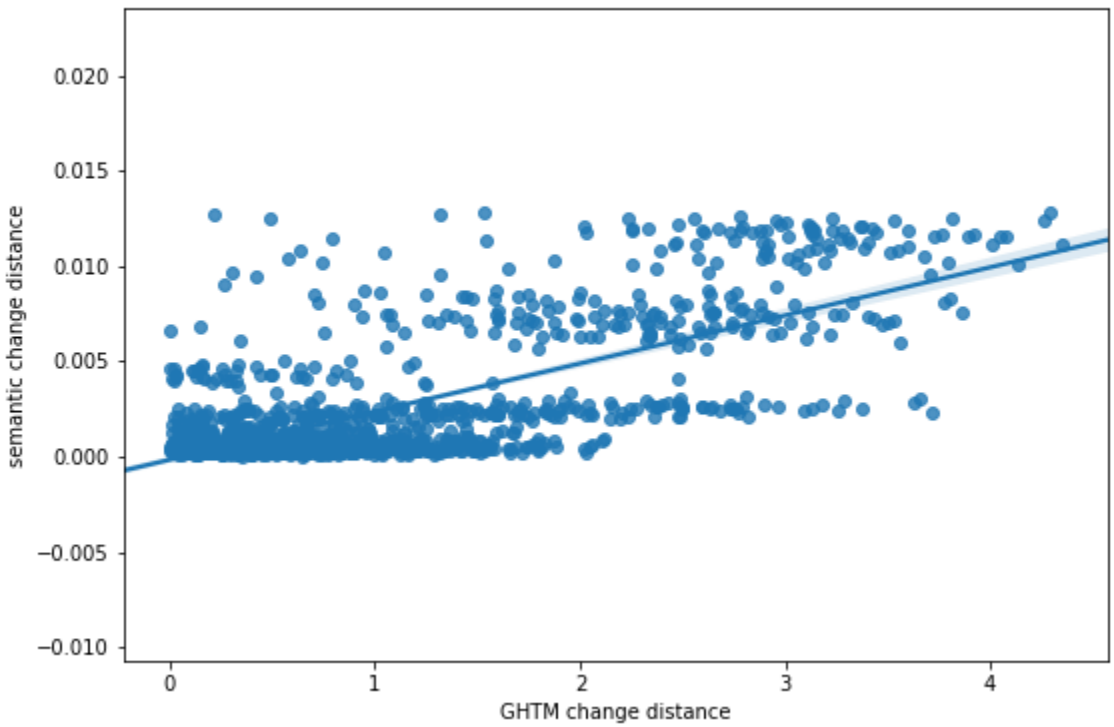

Figure 10: Correlation between Semantic Distances of Love and Absolute Differences of GHTM

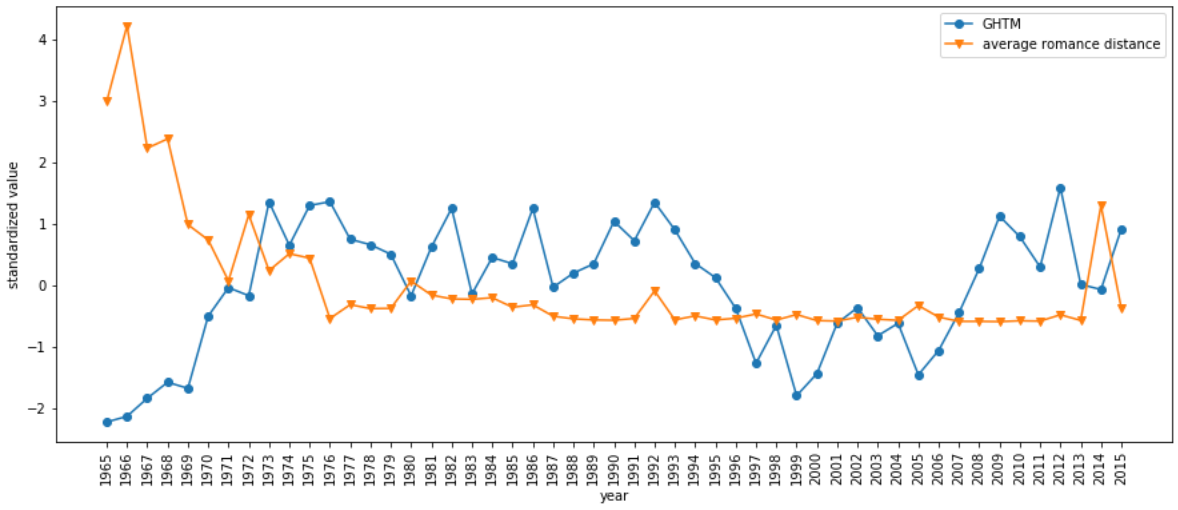

Figure 11: Average Semantic Distance between Love and Romantic Content VS GHTM

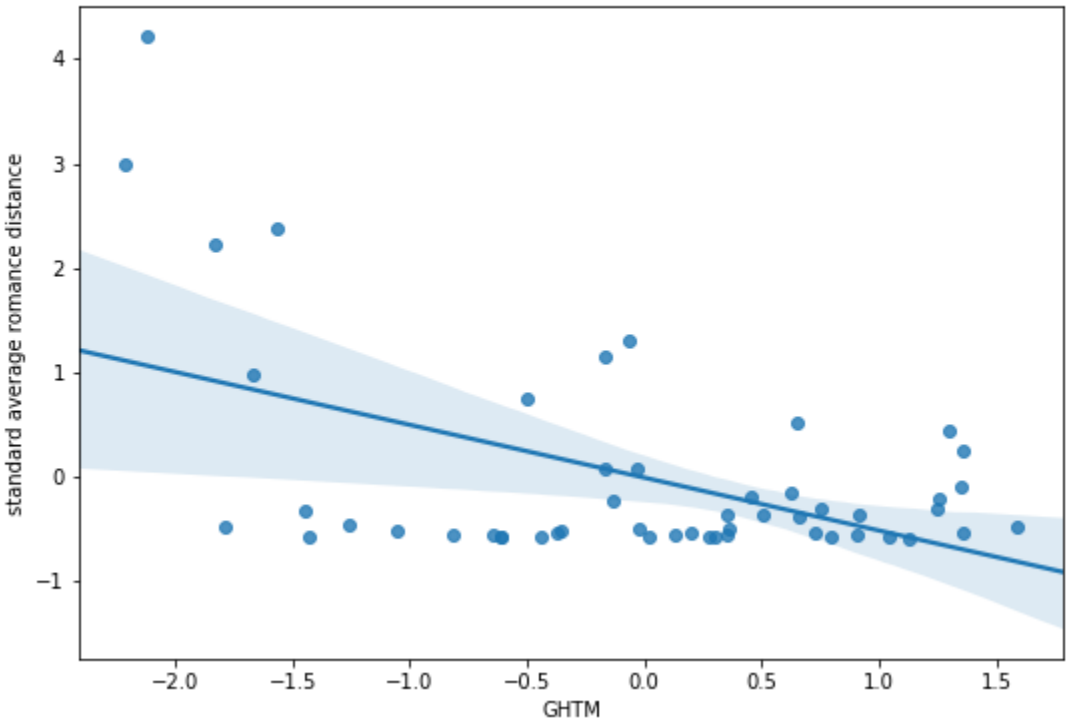

Figure 12: Correlation between The Average Semantic Distance between Love and Romantic Content and GHTM

the environmental security hypothesis, the word love in Billboard lyrics plays the role to relieve or lift audiences' mood in bad times. But this result does not necessarily mean that the word love would not have other socio-psychologic functions (e.g., the reflection function) in other linguistic dimensions that are not covered in this research. That is to say the word love is still possible to play multiple roles in these lyrics. Also, the result is more suggestive than decisive because the interpretation of the socio-psychologic could be flexible due to the different theories or different social aspects being focused on. If we performed the test on other single socio-economic indicators other than the GHTM, it is not impossible to have different results and different interpretations.

Additionally, the whole analytical process could also be viewed as a verification of Terry's ESH, which highlights the overall socioeconomic condition, on the linguistic trend of word love in Billboard Hot 100 lyrics. The roles of other words could also be examined using the same logic to check the generality of the ESH, helping to improve the validity of this theory from a macro-micro level.

6 Limitations and Further Work

Besides the points mentioned in conclusion part, I acknowledge that there is still room for improvement from the current research and from a long-term perspective. In this research, the regulation role of love was inferred from the result of Pearson correlation test. Though I yielded multiple statistically significant results from the three aspects, and excluded the possibilities of other measurable factors like the length of lyrics in frequency analysis and the overall sentiment trend in the sentiment analysis, there are still other unmeasured factors that are likely to influence the result. For example, the acoustic properties might play a role in it. If the expression of love in lyrics are largely associated with bright chords and upbeat tempos, then it would take more efforts to tell whether the regulation role is played the word love or the acoustics. The exploration of these non-textual elements of music is a possible direction for future analysis.

Another limitation is that we do not seriously take music genres into considerations in this research. As I mentioned in Section 2, the Billboard Hot 100 chart is a mixed chart with songs in different music genres, which do not have very uniform music traits. However, some music genres like country, metal, or Hip-Hop have quite distinctive music characteristics. Some previous research (Eastman and Pettijohn, 2019, 2015) have found their difference in the musical and lyrical trend under different socio-economic conditions. It is unsure whether the language use of love in those lyrics would play a role in regulation or reflection. Thus, it is valuable for both media analysts or linguists to check the coherence of the lyrical role of love in a cross-genre way.

Besides, the GHTM indicator used in this research is not guaranteed to be a perfect indicator of the overall socio-economic conditions. Terry originally developed this indicator simply because no other single or combined indicators are suitable for this measurement, thus the selection of the sub-indices is likely to be quite subjective. In order to test the sensitivity of the indicator, I replaced the indicators of homicide rate and suicide rate by the overall crime rate during one replication and found out the significance of the results is maintained. However, it is better to test on more combinations of socioeconomic indices to verify the robustness of the results in the future. Also, the theories I used in this research to explain the role of love in lyrics (ESH) might not be the only suitable candidates. Some scholars suggest interpreting the relationship between cultural products like music from a production-consumption perspective, which might also bring us new insights into similar issues in lyrics.

Finally, the generality of the findings also needs more examination. This research itself generalizes the original ESH to a certain degree from Billboard Top 1 Songs to Top 100 songs, with a

focus on the word love. However, whether these findings are applicable to more general song lyrics like those are not on the billboard year list is uncertain. Billboard songs are assumed to be more representative of the cultural preference of the public, but general songs might have more individualized or specialized music traits, which could be different from what has been revealed about the Billboard Chart songs. Apart from this, I only examined the role of love in lyrics with different socioeconomic conditions in the U.S, the situations for other English-speaking countries are unclear. Thus, more generality checking work is expected to be performed based on the framework in this research.

7 Appendix

Indices	Measurement
birth rate	births per 1000 people
death rate	deaths per 1000 people
marriage rate	per 1000 population
divorce rate	per 1000 population
homicide rate	age-adjusted death rates by homicide per 100000 people
suicide rate	age-adjusted death rates by suicide per 100000 people
disposable personal income	average annual change in percent
consumer price index	average annual change in percent
unemployment rate	percentage of the labor force

Data Source: The U.S Statistical Abstracts Series, CDC WONDER online database

Table 1: Socioeconomic Indices List

References

Alvaro, R. N. (2017). *The social evolution of the expression of love through music: a contrastive analysis of transitivity in hit songs in english and spanish (1950-2009)*. http://purl.org/dc/dcmitype/Text, Universidad Complutense de Madrid. 1, 2.1, 2.1, 2.2

Anderson, J. R. (2010). *Cognitive psychology and its implications*. Worth Publishers, New York, 7th ed edition. OCLC: ocn503631026. 2.1

Arif, M. and Triyono, S. (2018). What Lies Beneath Baby Shark Song?: A Critical Analysis On Korean Society. *PAROLE: Journal of Linguistics and Education*, 7(1):44. 2.2

Bourdieu, P., Thompson, J. B., and Raymond, G. (2003). *Language and symbolic power*. Harvard Univ. Press, Cambridge, reprinted edition. OCLC: 839786527. 2.1

Buss, D. M. (2003). *The evolution of desire: strategies of human mating*. Basic Books, New York, revised ed edition. 2.3

Dijk, T. A. v. (1993). *Elite discourse and racism*. OCLC: 872665675. 2.1

Eastman, J. T. and Pettijohn, T. F. I. (2015). Gone country: An investigation of Billboard country songs of the year across social and economic conditions in the United States. *Psychology of Popular Media Culture*, 4(2):155–171. 1, 2.2, 6

Eastman, J. T. and Pettijohn, T. F. I. (2019). Good times and endless love: Billboard R&B/Hip Hop songs of the year across social and economic conditions. *Psychology of Popular Media Culture*, 8(3):243–250. 1, 2.2, 6

Eggins, S. (2004). *An introduction to systemic functional linguistics*. Continuum, New York, 2nd ed edition. 1, 2.1

Fairclough, N. (2003). *Analysing discourse: textual analysis for social research*. Routledge, London ; New York. 1

Fairclough, N. (2009). A dialectical-relational approach to critical discourse analysis in social research. *Methods of Critical Discourse Analysis*, pages 162–186. 2.1

Filardo Llamas, L. and Iglesias (2010). Song vs. violence. response to september 11 in the american song. the case of the black eyed peas. *Journal of Linguistics and Applied Languages, ISSN 1886-2438, NO.5, 2010, pags. 29-40*, 5. 1

Gee, J. P. (2008). *Social linguistics and literacies: ideology in discourses*. Routledge, London ; New York, 3rd ed edition. OCLC: ocm83609555. 1

Halliday, M. A. K. (1978). *Language as social semiotic: the social interpretation of language and meaning*. University Park Press, Baltimore. 1

Hamilton, W. L., Leskovec, J., and Jurafsky, D. (2016). Diachronic Word Embeddings Reveal Statistical Laws of Semantic Change. In *Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pages 1489–1501, Berlin, Germany. Association for Computational Linguistics. 3.2.3

Herman, H. (2019). Critical Discourse Analysis on âWe are the World 25 for Haitiâ Song Lyrics. *Loquen: English Studies Journal*, 12(1):24. 2.2

Hutto, C. J. and Gilbert, E. (2014). VADER: A Parsimonious Rule-Based Model for Sentiment Analysis of Social Media Text. In *ICWSM*. 3.2.2

Janks, H. (1997). Critical Discourse Analysis as a Research Tool. *Discourse: Studies in the Cultural Politics of Education*, 18(3):329–342. 1, 2.1

Knobloch, S. and Zillmann, D. (2002). Mood Management via the Digital Jukebox. *Journal of Communication*, 52(2):351–366. 2.3

Lin, A. (2014). Critical Discourse Analysis in Applied Linguistics: A Methodological Review. *Annual Review of Applied Linguistics*, 34:213–232. 2.1

Machin, D. (2010). *Analysing popular music: image, sound, text*. SAGE, Los Angeles. OCLC: 759207692. 1

McArthur, L. Z. and Baron, R. M. (1983). Toward an ecological theory of social perception. *Psychological Review*, 90(3):215–238. 2.3

McNamara, L. and Ballard, M. E. (1999). Resting arousal, sensation seeking, and music preference. *Genetic, Social, and General Psychology Monographs*, 125(3):229–250. 2.3

Pettijohn, T. F. and Sacco, D. F. (2009). Tough times, meaningful music, mature performers: popular Billboard songs and performer preferences across social and economic conditions in the USA. *Psychology of Music*, 37(2):155–179. 2.2, 2.3

Pettijohn, T. F., Williams, G. M., and Carter, T. C. (2010). Music for the Seasons: Seasonal Music Preferences in College Students. *Current Psychology*, 29(4):328–345. 2.3

Pettijohn II, 2), T. . . and Jungeberg, B. . . . (2004). Playboy Playmate curves: Changes in facial and body feature preferences across social and economic conditions. *Personality and Social Psychology Bulletin*, 30(9):1186–1197. 1186. 2.3

Qiu, L., Chan, S. H. M., Ito, K., and Sam, J. Y. T. (2020). Unemployment rate predicts anger in popular music lyrics: Evidence from top 10 songs in the United States and Germany from 1980 to 2017. *Psychology of Popular Media*. 2.2

Rothenbuhler, E. W. and Dimmick, J. W. (1982). Popular Music: Concentration and Diversity in the Industry, 1974â1980. *Journal of Communication*, 32(1):143–149. 2.2

Sacco, Donald F., T. F. P. (2009). The Language of Lyrics: An Analysis of Popular Billboard Songs Across Conditions of Social and Economic Threat - Terry F. Pettijohn, Donald F. Sacco, 2009. *Journal of Language and Social Psychology*. 2.3

Tlili, Z. (2016). A critical chronotopic approach to lyrics of top-ranking popular songs in the UK. *Critical Discourse Studies*, 13(2):228–246. 2.1

van Dijk, T. (2009). Critical Discourse Studies: A Sociocognitive Approach. *Methods of Critical Discourse Analysis*. 2.1

Wodak, R. and Meyer, M., editors (2001). *Methods of critical discourse analysis*. Introducing qualitative methods. SAGE, London ; Thousand Oaks [Calif.]. OCLC: ocm48570222. 2.1

Yasaman Madanikia and Kim Bartholomew (2014). Themes of Lust and Love in Popular Music Lyrics From 1971 to 2011. 1, 2.2