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Gender convergence in the expressions of love: A computational analysis of lyrics

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Abstract

Love is a central theme in modern music, but do women and men differ in their expressions of love? Results from empirical studies on gender differences in love attitudes have evolved from showing consistent differences to more similarities over time and witnessed gender convergence in relationship expectations, housework responsibilities, and sexual attitudes. Independently, pop culture studies have shown how music can be used as a contextual artifact whose lyrics can reflect a culture's changing psychological processes and ideologies. We combine these two research areas to explore whether the gender convergence reported in psychological studies is mirrored in love songs. Using a corpus of lyrics and song metadata from 1960 to 2009, we present a computational analysis of the lexical distribution of lyrics across genre, gender and time. We show that love songs between vocalists who are men vs. women have become significantly more similar in their lyrical expressions of love.

Keywords: culture and cognition; love; gender; lyrics; computational analysis

Gender and romantic love

Love is a central theme in human culture, but do women and men differ in their expressions of love? Gender roles in romantic relationships can influence the expectations, behaviours, and levels of communicative intimacy between partners. Traditional gender roles employ different sexual scripts for men and women (Maxfield, Chafetz, Glazer-Malbin, & Waehrer, 1975; Cyranowski & Andersen, 1998; Cohen & Shotland, 1996), but over the past half century, gender convergence has been observed in housework responsibilities, sexual attitudes, and the labour market (Goldin, 2014; Altintas & Sullivan, 2016; Lottes, 1993). Here we explore whether the expressions of love show gender convergence as well, mirroring the other domains via a computational analysis of song lyrics.

Research has shown that music can serve as a lens into the "cultural changes in psychological processes" (Dewall, Pond, Campbell, & Twenge, 2011), so if songs and culture change in "harmony" will love songs also show gender convergence (illustrated in Table 1)?

Table 1: Excerpts of songs lyrics in 1950s and 2000s.

t	Sung by a Man	Sung by a Woman
50s	You ask how much I need you	As long as he needs me
00s	You are the love I need	I need you, you're my love supply

The psychological theories on the relationship between gender and love have evolved over time. In the 1970s, Lipman-Blumen and Tickamyer (1975) wrote a review on a decade of sex-roles where they referenced studies of "modern" American dual marriages. They stated that the studies showed how "men's needs would dominate the marriage" where the wife's needs were "sacrificed" (Lipman-Blumen & Tickamyer, 1975; Steinmetz & Holmstrom, 1973; Poloma & Garland, 1971). In the 1980s, Hendrik and Hendrik's empirical studies showed that there were "consistent" gender differences in love attitudes between men and women such that men were more instrumental in attitude and goal-oriented whereas women were more communal in attitude and relationship oriented (Bailey, Hendrick, & Hendrick, 1987; Hendrick, Hendrick, Foote, & Slapion-Foote, 1984; Hendrick & Hendrick, 1986). Despite these reported differences in love attitudes, Critelli et. al (1986) suggested that "sex role differences [in love] are being gradually eliminated". Their study shows that feminist-ideologies lead to nontraditional love-role definitions, and more experiments showed that high-masculine and high-feminine individuals succumbed to gendered dating scripts while feminists did not (Delucia, 1987; Rickard, 1989). Moving on to the 1990s, a study found no gender difference in other-orientation (focusing on others' needs) or sacrifice between men and women (Heiss, 1991), but showed that feminist men and women prescribe less other-orientation for women than non-feminists do (Heiss, 1991). In the 2000s, we see this continue as non-feminists are less likely to show egalitarian expectations and sexual assertiveness (Yoder, Perry, & Saal, 2007), whereas feminists have more egalitarian expectations for romantic relationships (Schick, Zucker, & Bay-Cheng, 2008). Finally, empirical results have shown that women today expect egalitarian intimate romantic relationships more than they had in the 1960s (Botkin, Weeks, & Morris, 2000; Ogletree, 2015), revealing that romantic love attitudes have been converging.

Several pop-culture studies have explored the relationship among gender, music, and love, but none has found gender convergence in the expressions of love across time. In one of the earliest studies on love in popular music, Wilkinson (1976) studied the most popular 200 songs between 1954 and 1968. They found that although some songs agreed with sex-role stereotypes, but women were almost as active as men, men were dependent on women, and men were more posses-

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sive of their partners than women were.

Although Wilkinson's work is not longitudinal, studies that followed found no change in the quality of love expression in hit songs between genders across time (Dukes, Bisel, Borega, Lobato, & Owens, 2003; Gallee, 2016). Furthermore, Kreyer (2015) found that songs on romantic topics from the top 50 albums of 2011 were "surprisingly similar" in word use across genders. Although Krause and North (2019) found that men and women performers had different lyrical themes, these findings were not specific to love and did not examine on how the expression of love has evolved as a function of time.

To preview our study, we confirm Kreyer's (2015) findings that lexical uses in the love songs from 2011 were similar between genders. We also confirm Wilkinson's (1976) findings that in the 1960s, men were portrayed as dependent on women in love songs and both groups were portrayed as active components of the relationship. Since our focus is on the expression of love, we focus on the way in which love is communicated, but not the images, stereotypes, or depictions of femininity and masculinity in popular music. Although studies have found portrayals of feminine and masculine stereotypes in popular music (Avery, Ward, Moss, & Üsküp, 2016; Rasmussen & Densley, 2016; Freudiger & Almquist, 1978; Cooper, 1985), these studies are not specific to love, and their focus was not on the temporal shift in the expression of romantic love. Furthermore, although songs may be written by men for women vocalists and vice-versa, lyrics and the gender of their performers still reflect the expected cultural lyrical expression of the time.

Our study extends work in psychology and pop culture as follows. For the above-mentioned psychological studies, (1) none of the studies analyzed how love is expressed in a natural setting. Participants were asked to give ratings and answer surveys for hypothetical scenarios or personal experiences, but we have had no account for how love is communicated and expressed in an emotionally-laden context, (2) none of the cited studies has explored how love attitudes for both, men and women, have developed over time. For the cited pop culture studies, (1) analyses have only explored popular songs, which may be a better representation of what is selling rather than of how love is expressed, (2) many of the datasets used are sparse and depend on a small number of songs ($<= 4,000$ songs), (3) several studies do not separate songs by genre, although linguistic styles differ greatly among genres, (4) none of the aforementioned studies has considered songwriter information as a possible confounding factor.

We analyze 13,564 love songs from 1960-2009 across the genres of Pop, Country, Alternative, R&B Soul, and Rock. By studying the gender differences in lexical and phrase-based distributions as a function of genre and time, we gain a better understanding of how love expression has changed as a function of gender and time.

Our hypothesis

We hypothesize that romantic song lyrics between men and women should become more similar through time, reflecting gender convergence in the expressions of love.

Since our emphasis is on the expressions of love, we focus on the way in which love is communicated, but not the images, stereotypes, or depictions of femininity and masculinity in popular music. We also do not postulate what the artists were feeling about love at the time, but rather, how love, and cultural and psychological ideologies in relation to love, are being expressed through lyrics.

Treatment of data

The Musixmatch dataset (MXM) is the official lyrics dataset of the Million Song Dataset (MSD) and has the "largest clean lyrics collection available for research" (Bertin-Mahieux, Ellis, Whitman, & Lamere, 2011). We classified the artist name as either that of Women or Men using python's gender-guesser package (https://pypi.python.org/pypi/gender-guesser/) which has a 2.6% misclassification error when disregarding unknowns (Santamaría & Mihaljević, 2018). The package implements a wrapper around a database of over 45,000 names with gender annotations. After using gender-guesser, one human annotator verified the package's performance and corrected its misclassifications. Example inferences are shown in Table 2. The intersection of the lyrics and year-gender subsets leaves us with 48,012 songs that contain lyrics, year, and singer gender information. We characterize a love song as any song that contains the word *love*; once we excluded bands (using python's spaCy Named Entity Recognition) and non-English song titles, we had a total of 13,962 love songs across the most populated genres from 1960-2009 (Pop: 5,630; Rock: 3,715; Country: 2,052; R&B/Soul: 1,430; Alternative: 1,135). As a final step, we retrieved the full syntactically-structured lyrics and songwriter information from Genius.com (www.genius.com), in order to conduct a more fine-grained analysis on the dataset.

Table 2: A sample of artist names and inferred genders.

Name	Inferred gender
Barbra Streisand	W
Barry Manilow	M
Céline Dion	W
Charlie Daniels	M
Duncan James	M
Dusty Springfield	W
Fiona Apple	W
Francis Dunnery	M
Keith Sweat	M
Kelly Price	W

Computational methodology

We analyzed the difference between the bag-of-word and phrase-based lexical distributions of songs sung by men (M) and women (W) from 1960 to 2009 across the genres $pop, rock, country, r\&b/soul$, and $alternative$. For each

genre g and decade t, we randomly sampled 20 songs with replacement from each gender w and m, and computed the *Jenson-Shannon Divergence* (*JSD*) between the normalized frequency distributions of the words used within each sample. We repeated this process 1,000 times and computed the mean JSD between the gendered lexical distributions at every decade and genre.

Bag-of-word distributed representation of lyrics

Our bag-of-word approach summarizes a (love) song in terms of a binary vector x of size $|V|$, where V is the total vocabulary of all songs within the decade t and genre g. As such, each song can be expressed as a binary vector where the presence of a word gives 1 in that vector, and 0 otherwise. This is a type-based representation. We can thus distinguish between songs sung by women x_W and those sung by men x_M. Similarly, we can incorporate temporal t and genre g information and obtain a finer grained specification of both gender and time: $x_W^{g,t}$ and $x_M^{g,t}$.

In a sample of n songs, a continuous variant of this simple representation is to express each unique word by its normalized average frequency (0-1) across n songs. More frequent words in the gender sample will be given higher values than less frequent words. This is a token-based representation for the lexical distribution $P_W^{g,t}$ and $P_M^{g,t}$ of each sample of n songs.

Phrase-based representation of lyrics

We also consider how the dependency of verbs might have changed as a function of gender and time because verb phrases (e.g., *I need* vs *you need*) can inform love attitudes at a fine-grained level. For the phrase-based vector representation of lyrics, we retrieved the 31 most frequent verbs used across all genres and constructed giving/other-centric phrases and receiving/ego-centric phrases by manipulating the subject (I, you) and object (you, me) of each verb (see examples in Table 3). Every line in the song was treated as its own phrase, and we used SpaCy's dependency parser (www.spacy.io) to transform every line with the target verb into a subject, verb, and object component.

Table 3: Examples of phrase-based representations of the 31 most frequent verbs.

Lyrics line	Parsed phrases	Label
"but all I ever said, I need you"	I need, need you	receiving + ego
"I will wait for you"	I wait, wait you	giving + other
"and I can't stay here long"	I stay -neg	not included

Quantification of distance between distributions

We use the Jenson-Shannon Divergence (JSD) to measure the distance between the lexical probability distributions across gender groups. For the probability distributions P and Q, $0 \leq JSD(P \parallel Q) \leq 1$ where JSD converges to 0 as P and Q the become more similar:

$$JSD(P \parallel Q) = \frac{1}{2}D(P \parallel M) + \frac{1}{2}D(Q \parallel M) \qquad (1)$$

where $D(Q \parallel M)$ is the Kullback–Leibler divergence and $\mathrm{M} = \frac{1}{2}(P+Q)$.

Results

We first explore how the lexical distribution of songs has changed as a function of gender, genre and time and test our findings against time and love-topic null hypotheses. We further explore the effect of songwriter distributions on lyrical content and a more fine-grained phrase-based analysis of lyrics.

Gender convergence in the lyrics of romantic love

In accordance to our hypothesis, we see that songs sung by men and women across all genres become more similar over time. In Figure 1a, we observe a decrease in mean JSD across time for all genres, thus revealing that songs across genders have become more similar in their lexical distributions.

We assert that time of release, topic of love, and gender of vocalist are drivers of gender convergence through running time-attested, love-attested, and gender-attested experiments. In Figure 1b, we shuffle the sampled love songs across time while maintaining gender and genre. When calculating the mean JSD in the time-shuffled experiment, the downward JSD trend goes away, revealing that the trend seen in Figure 1a is due to temporal shifts in word use. The one-tail t-test between the shuffled and non-shuffled cases reveals that the decreased JSD in love songs is significant (Table 4).

Table 4: Results of time shuffled tests (all tests have p-values < 0.001).

Genre	t-value
Pop	-27.6850
Rock	-51.9427
Country	-56.1833
R&B/Soul	-45.3853
Alternative	-33.5944

In order to test whether gender convergence is specific to love, we run the JSD analysis on songs that do not contain the word "love" at a sample size of $n = 12$ (finding the mean JSD across 1000 samples) per gender due to data sparsity in earlier decades. We observe that non-love songs for the genres $pop, rock$, and $r\&b/soul$ become more different over time, and that non-love songs have a generally higher JSD than love songs do. These results may be due to topical variability and are consistent with Krause and North's (2019) work which shows differences in lyrical themes between men and women. Finally in Figure 1d, we shuffle love songs across singer gender while maintaining the correct decade, and observe that the downward trend also disappears; thus revealing that time, gender, and love are driving factors for the convergence in JSDs. Figure 2 is a qualitative analysis of the top 10 content words whose difference in relative frequencies between genders has changed the most across flanking decades.

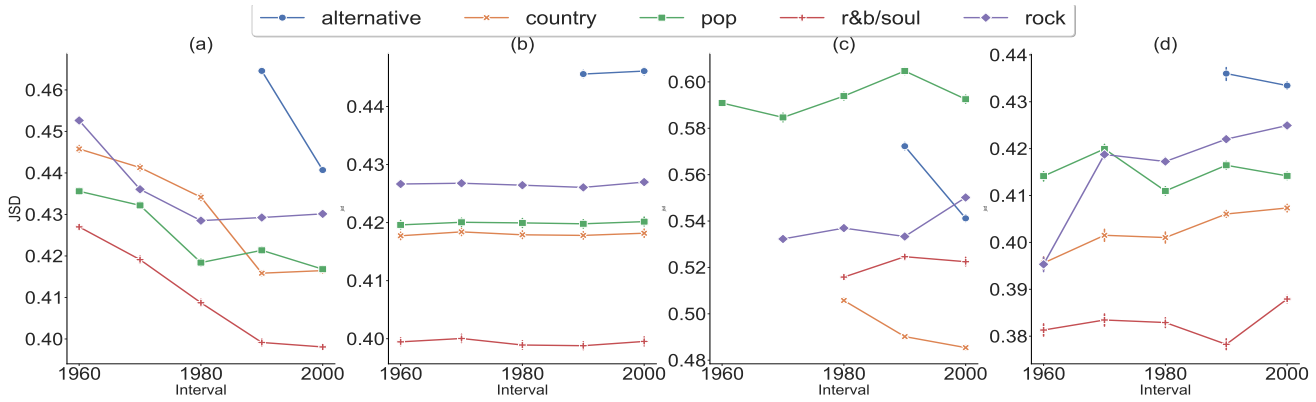


Figure 1: Bag-of-word analysis of love songs across time. a) Mean JSD of love songs performed by men vs. women across genre and time. b) Time-shuffled love song analysis. c) Non-love JSD analysis. d) Gender-shuffled JSD Analysis.

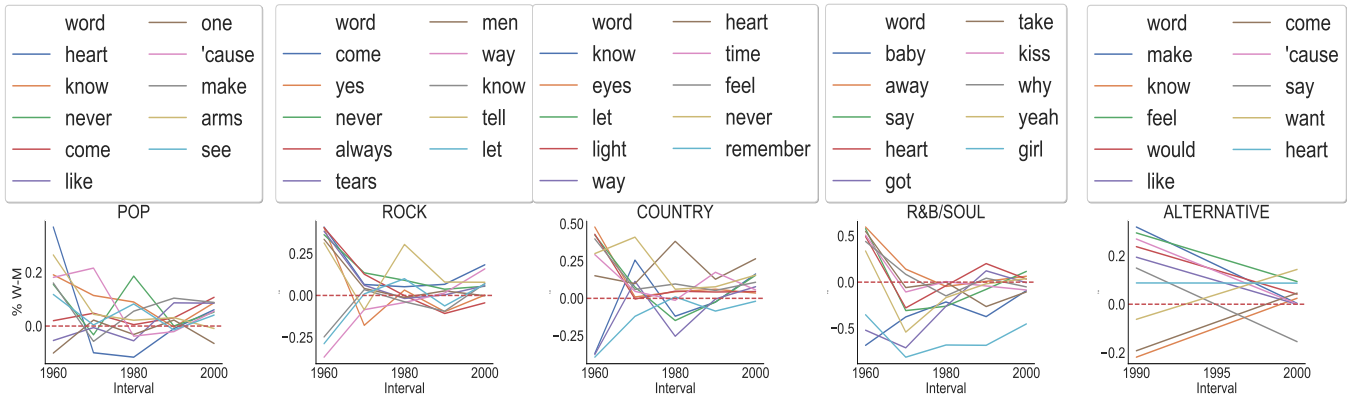


Figure 2: Difference in word frequency between genders as a function of decade and genre where difference $d(word, gender, time, genre) = P(word|W, time, genre) - P(word|M, time, genre)$.

The difference in word use between genders of the top changing words converges to 0, revealing that words are being used more similarly across time.

Songwriter gender as a confounding factor

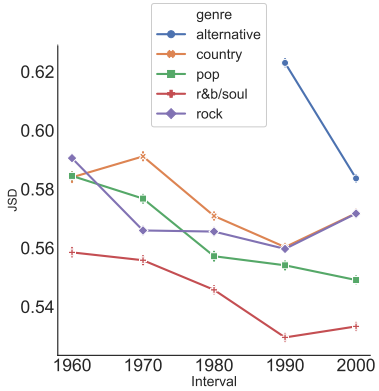


Figure 3: Mean JSD for songs written by men songwriters across 1000 samples of n=5 per vocalist gender.

Love song similarity across time may be an effect of a more similar gender distribution in songwriters rather than a change in cultural ideologies. We retrieved a sample of the songs that contain songwriter information (50% of the songs) from *www.genius.com* in order to understand the changes in gender distribution among lyricists (summarized in Table 5). When examining how the proportion of same-gendered songwriting teams changed over time, we observed an increase in the number of songwriters who are women writing for singers who are women. Although we did not observe a change in the distribution of songwriters writing for singers who are men, we noted that men songwriters are writing more similarly for vocalists who are women and men over time (Figure 3).

Table 5: Gender Distribution for same-gender songwriting groups. a) Songwriter distribution writing for women vocalists. b) Songwriter distribution writing for men vocalists.

(a)

Decade	%W	%M
1960s	40.97	59.03
1970s	35.38	64.62
1980s	42.82	57.18
1990s	52.55	47.45
2000s	65.36	34.64

(b)

Decade	% W	% M
1960s	1.72	98.28
1970s	0.41	99.59
1980s	1.24	98.76
1990s	2.57	97.43
2000s	1.54	98.46

Lexicon size as confounding factor

Lexicon size can be characterized as the number of unique words found in a corpus, and thus the size of the continuous bag-of-word vectors input into our JSD analysis at each decade and genre. The Jenson-Shannon Divergence (JSD) tends to grow proportionally to the size of its input probability vectors. Since lexicon size of songs increases across decades (Table 6), the decreasing JSD results reported are not driven by the *size* of the vocabulary but rather by the content of the vectors.

Table 6: Lexicon size per genre and decade.

Genre	Lexicon size in 1960s	Lexicon size in 2000s
Pop	1,861	4,043
Rock	1,539	3,583
Country	1,123	3,024
R&B/soul	1,243	2,865
Alternative	60	3,286

Fine-grained assessment of gender convergence

We perform a similar set of analyses with bag-of-phrase vectors, and observe a substantial *JSD* decrease and gender convergence in the lexical distribution of phrases over time (Figure 4). To better understand how the phrase usages have changed, we analyze the giving/receiving ratio of verbs by gender, time and genre. We observe that the use of verbs has become more similar (Figure 5a) for all genres such that the difference in ratio distributions between genders in the earlier decades is greater than that in the most recent (see Table 7 for significance tests). For instance, for *pop* in Figure 5b, "need" by vocalists who are women was used as giving 50% of the time and receiving 50% of the time in the 1960s. However, "need" was used in a receiving phrase (I need, need you) 90% of the time with singers who are men, showing that (in accordance to Wilkinson, 1976), men were expressing their love in terms of receiving love from their partner and women were portrayed as active as well. Moving on to the 2000*s*, we observe that in *pop*, both genders agree on the distribution of "need". This shift is also true for other terms such as *feel*, *want*, *hold*, *walk*, and *call* where we see a convergence in both genders' proportions of giving to receiving over time. This is not to say that expression of love was polar however, since songs sung by women expressed love in receiving terms as well. With regards to terms such as *fall (for)*, *hear*, *say*, *let*, and *make*, songs by men in the *pop* genre were expressing love in more giving terms than those by women were.

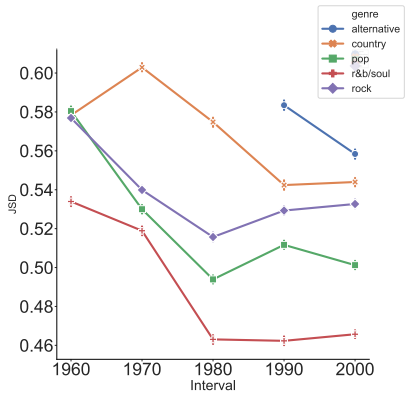


Figure 4: Mean JSD for bag-of-phrase vectors at 1000 samples of n=20 per vocalist gender.

Table 7: Results of giv/rec difference tests from Figure 5a across time (all tests have p-values < 0.01).

genre	t($diff_{2000s}$, $diff_{1960s}$)
Pop	-4.6658
Rock	-4.0514
Country	-4.4303
R&B/Soul	-2.9053
Alternative	-3.4078

Conclusion

Our study shows a parallelism between the psychological changes in love attitudes and the love songs across time. The fine-grained analyses further suggest that the expressions of love have converged on the level of giving, receiving, and other-orientation. Our study is limited to love songs from 1960 to 2009 which have been sung by individuals, and excludes bands and duets.

Through our analysis of lexical distribution, we have witnessed gender convergence in the expressions of love and shown how music, a form of self-expression timestamped in its context, unfolds the empirical and psychological changes that the literature has revealed.

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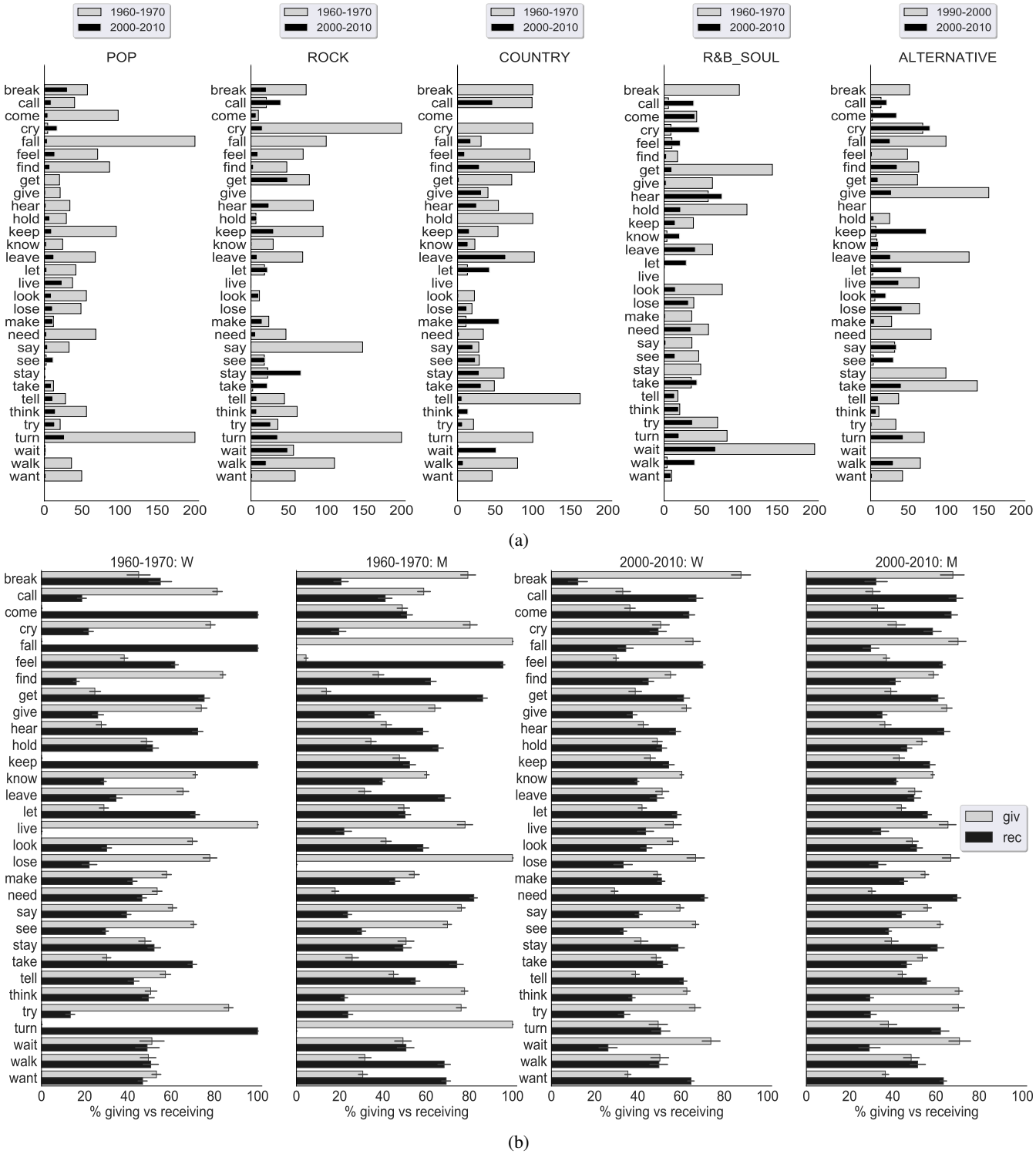


Figure 5: Phrase-Based Fine Grained Analysis: (a) Absolute Difference of giving-receiving ratio between W and M over time. (b) Pop genre's mean giving to receiving ratios.

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