Study of the Correlation and Impacts Between Title and Lyrics Understanding Based on Natural Language Process

Abstract

Nowadays, people have various ways to get relaxation and entertainments. Usually, songs are chosen as one of the most popular ways for people to get enjoyments. Both melody and words are equally considered by the public who enjoy songs by understanding meanings and rhythm. Although people might get a sense about the meaning of songs by simply reading their lyrics, it could bring misunderstandings comparing to its counterpart. In general, there are four parts that could contribute to enhancing the understanding of songs' contexts, such as melody, rhythm, title and words' structure. In this research, we first design an experiment which illustrates our assumption about the relationship between title and people's understanding. Next, we make a survey on the impact of title to the understanding of lyrics. And then we apply natural language process methods to transfer the lyrics into vectors. Finally, we adopt statistical analysis to examine the relationship between lyrics and title.

1. Introduction

In January 2018, there are 70 million paying subscribers playing songs using Spotify, a popular music streaming service originally found in 2006 in Swede which shows the booming market of music. This phenomenon proves that the increasing worldwide market of music which implies higher expectations and demands from the user side. It is also happening in Asia, especially in Japan. Japanese digital download revenue in the music industry has been increasing continuously for 4 years. From this result, we could conclude that people would expect more from different aspects of the music industry, such as lyrics, melody, culture, and accessibility. With this background, we could identify the importance of analyzing factors which influence people's understanding of songs. In this paper, we would like to focus on the value of lyrics towards user experiences.

There are several previous pieces of research focusing on lyrics analysis and people's reflections about music and lyrics. Those papers help us to enriches our background information about this topic and build a solid foundation for further researches. In a research about lyrics analysis, the author illustrates music websites may offer fitter suggestions when the matching rate of users' expectations and lyrics is high(). Therefore, if we find a method to raise the matching rate, we would propose a better approach to music websites. We realize users prefer to select songs according to their interested keywords. These keywords always match users' understanding of lyrics. Therefore, it's critical to consider the relationship between the meaning of lyrics and users' interpretation. Murakami also argued the overlap between lyrics and title makes it easier for people to understand and remember the meaning of lyrics(). Consequently, we assume that the existence of title could affect people's awareness of the lyrics.

From above-mentioned researches, it is intuitive for we to hypothesize title would promote the accuracy of people's interpretation. Our goal in this article is to offer evidence of the relationship between title and lyrics. This evidence consists of the correlation and similarity between lyrics and title. Additionally, we expect to prove title could be a positive factor.

2. Approach

To get the original data about people's understanding of lyrics, we construct an experiment to determine the degree of people's understanding of grouping methods and control variate techniques. In our experiment, we divide participants into two groups, in which one of them has been offered the title for one round, and vice versa. We calculate and name the difference between title-known group and the title-unknown group as δ ($G_{know} - G_{unknown} = \delta$). From this design, we let the set of results represents the degree of people's understanding of lyrics for different songs in our song set. With this set, we could check whether the impact from the title to participants' understanding of the lyrics does exist or not. Our experiment's standards are followings:

a) $\delta \neq 0$, we would argue the title affects participants' understanding of the lyrics.

b) $\delta = 0$, we would conclude title does not have effects on participants' understanding of the lyrics.

By using natural language process methods, we could transfer lyrics into data and calculate the similarity between lyrics and title. According to statistical rules, we examine the correlation between the degree of people's understanding of lyrics and the similarity mentioned above.

3. Experiment

In order to verify the degree of people understanding about lyrics, we design a questionnaire that let participants do self-evaluation about their understandings and categorize them into four distinctive options as following:

a) completely understanding the lyrics;

b) general understanding of the lyrics;

c) poor understanding of the lyrics;

d) lack of understanding the lyrics.

Participants were asked to read the lyrics and select the answer as their degree of understanding about lyrics. Title of the song was the hint which offers to one group of participants. We assumed title has a positive influence on the lyrics because title could be a key that leads people to imagine the point of lyrics. While title repeatedly appearing in the lyrics, it could help participants understand lyrics that are difficult to convey meaning.

3.1 Preparation

For ensuring the accuracy of the experiment, participants and songs are selected randomly and impartially. We get 10 volunteers from Junior and Senior students of Nihon University. All of these volunteers are majoring in Information Science and allocated in the same age group which guarantees that they share similar backgrounds. With comparable educational level, experiences and social status, participants should provide us an unbiased response within the group. To approach the reality, since many foreign students are studying at Nihon University, we choose to add international students into our population sample. Therefore, we select 8 Japanese native speakers and two Chinese students whose Japanese are relative to the same level.

We divided participants into two groups (group A and group B), each group includes 4 Japanese students and 1 Chinese student. We decide the test group as the group which is given the title and the control group should not be exposed to the title.

To prevent participants from familiarizing with or remembering testing songs, we choose 10 old Japanese songs which all of them have complicated lyrics. So as to keep the randomness and accuracy, all of those songs are difficult to understand at the same level.

3.2 Processing

First, we set to group A as the test group, group B as the control group. The test group should read 5 songs' lyrics, and the control group is asked to read other 5 songs. Second, we change group B to be the test group and repeat the experiment while giving new materials for both the test group and the control group. Through the cross comparison, we could eliminate error due to grouping from

experimental results. After two round of experiments, each song obtains 10 answers which including 5 answers are from the test group and 5 answers are from the control group.

We collect all of the results for each song, then denote the sum of the test group's 5 answers as G_{know}, and denote the sum of the control group's 5 answers as $G_{unknown}$. Then the difference between the test group and the control group is denoted as $\delta = G_{know} - G_{unknown}$.

3.3 Results

Table 1 shows the results of each song's δ.

There are 7 results are positive, one negative value and two results equal to zero. Even it is hard for us to explain the exact meaning of the quantitative result, we could analyze the distribution of those results and make reasonable explanations. We find that 8 out of the 10 experimental results are not 0, which could be considered that the evidence of title as a keyword and it affects participants' performance when they try to get the meaning of lyrics.

Experiment results	
num_songs	delta
1	4
2	1
3	-2
4	0
5	0
6	1
7	1
8	2
9	1
10	3

Table 1. Experiment results

To make further and more direct explanation with our experiment results, we draw a graph as following to illustrate out point. In Fig 1, there are two variables and two lines. The X-axis represents the number of testing songs, and the Y-axis means the value of δ. If there is no impact from title towards participants' understanding, there should be generally no difference between the test group and the control group. Therefore, the expectation value of δshould remains zero as the orange line in Fig. 1. The blue line shows us δ for every tested song. Clearly, there exist huge differences between two lines. Although there are two intersect points, we could not conclude that it would make a significant difference to the trend. This graph helps us to visualize data and proves our assumption above. With this result, we would like to make further analyses about the relationship between title and lyrics in the following sections.

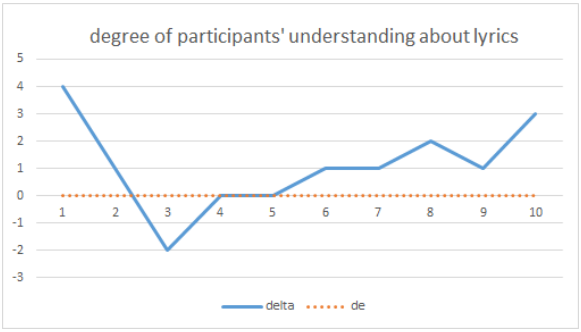

Fig.1. the degree of participants' understanding about lyrics

4 Correlation

From the conclusion above, we want to investigate whether the title is a positive factor towards people's performance of getting the meaning of lyrics or not. When title occurs repeatedly in the lyrics, we would expect it to be the keyword when people construct their understanding about lyrics. After setting this ground rule, we start to calculate the similarity between title and lyrics. Through statistical rules, we examine the correlation between δ and the similarity. If the correlation is positive, we could affirm that title is beneficial for people's understanding of lyrics.

4.1 Cosine similarity

Before conducting our calculation the vector space, we use natural language process methods to extract words from lyrics and rearrange them into sentence vectors. Also, we vectorize the title before we create

the vector space. In vector space, we apply cosine similarity for computing the analogy between two sentence vectors. The process is illustrated with following steps.

First, instead of treating the title and the whole lyrics bag as subjects, we divide every song into many lines and then compute the similarity of title and each line. Since there are various grammar patterns and special paragraph structures in lyrics, it is important for us to analyze the case by case. Therefore, chopping lyrics into segments might be helpful when we vectorize and analyze testing lyrics in our experiment.

Second, we sum up the similarities to get a set of results for every song in our testing lyrics set and determine the arithmetic mean as the similarity of every song.

4.2. Word embedding

Word embedding is a technique that expresses the distribution of words in a multidimensional space through a neural network and can express words using low-dimensional vectors. In this paper, we use "word2vec", a widely used tool for word embedding, to acquire vector of each word(). The "word2vec" would train a word based on its related words. "Word2vec" consists of 3 layers of neural networks, and we use CBOW(continuous bag of words) vectorized word. We put the vector of context words into the input layer and set one-hot vector of the target word in the output layer. With training corpus which includes a large number of words, through repeatedly adjusted and calculated, and the middle layer would obtain a low-dimensional vector represent the target word.

After vectorizing each word of lyrics, we sum up each vector of each line as the vector of row.

It is necessary to prepare a training corpus to vectorize lyrics and titles using the distributed representation of words. Then we establish two training corpora. The first one is the "Corpus of Newspaper Articles" which contains a large number of words. The merit of "Corpus of Newspaper Articles" for learning corpus is containing words from various fields. We use the articles of "Mainichi Newspaper" for the whole year of 2002. We remove words that are not related to the article (e.g., interjections and conjunctions). Although the newspaper article corpus can handle most of the vocabulary, we suspect it would not deal with some lyrics-specific expressions well (such as verbal language).

The second one is the "Lyrics corpus" which is closer to the content of this experiment. We expect that it is good for resolve lyrics-specific expression with the "lyrics corpus". We collect 1000 Japanese songs from the Website and exclude something title contain word are not in Japanese. However, compared with the “Corpus of Newspaper Articles”, the "lyrics corpus" contains kinds of words are sparsity.

Taking into account the advantages of the two corpora, we use them separately for the training corpus of word embedding to generate vectors of title and lyrics.

4.3. Correlation

Correlation refers to the relationship between two values, with one increasing and the other changing accordingly. In this paper, we concern the correlation between δ (the degree of participants' understanding about lyrics) and the cosine similarity of lyrics and title. We use two corpora to vectorize the lyrics and title of testing songs and calculate the cosine similarity of lyrics and title respectively. Then the results are shown in Table 2.

	δ	δ Ranking
Newspaper article corpus	-0.15	-0.54
Lyrics corpus	-0.18	-0.20

Table 2. Correlation Values

We detect the results of correlation between δ and the cosine similarity are both negative and insignificant. In view of the experiment, subjects are too little, the result is not significant. Therefore, we try to sort the δ and check up the correlation. From the criteria of Pearson product-moment correlation coefficient, we find out the correlation between sorted δ and the cosine similarity calculated based on newspaper articles corpus reaches the criterion only. As the correlation is negative, we could conclude title

has a negative effect on participants' understanding about lyrics.

5. Analysis

From the results of negative correlation, we know that when title occurs many times in lyrics, the remaining space for representing other contents will be greatly reduced, thereby making the overall content of the lyrics more ambiguous. In other words, the lyrics do not contain a large number of titles, the meaning of the overall content of the lyrics is more abundant and complete.

From the result, which contradicts our assumption, we could generate several reasons to explain this consequence.

First, the testing population and subject songs might allow system error during our experiment. There are only 10 participants which may not be sufficient for us to generate a universal conclusion.

Second, there might be confirmation bias during participants self-evaluation. Since people have different standards and definitions for one thing and many people would like to hold their own thoughts. Therefore, it is generally hard for us to measure an objective variable.

Third, the "Lyrics corpus" contains a few kinds of words which is too small to vectorize target words. This situation limits the accuracy of vectorization.

6. Further Studies

With the supposition above, we consider several options to improve this experiment. First of all, we could expand the testing population and testing subjects. Since there are only 10 songs and 10 students in our experiment, we deduce that the result might be more universal and accurate when we get more samples involved.

Other than that, we should initiate an experiment to determine the baseline of participants' comprehension level. Some of those participants might be overconfident about their understanding, therefore, they could have a higher average score on every test. By doing this, we could eliminate unsuitable participants and prevent outliers.

In further studies, we could introduce more data into the lyrics corpus. Additionally, we get an alternative result comparing to our assumption. In the future, we could study how does title disturb people's understanding about lyrics.

7. Conclusion

In this paper, we propose a hypothesis that the song title has a positive influence on the understanding of the lyrics and validate the hypothesis using statistical rules. First of all, we make an experiment to examine whether the title affects people get meaning from the lyrics using a questionnaire. After quantifying the questionnaire answers, we conclude that song title has an impact on people understanding of lyrics. Then, according to the experimental results, we compute the correlation and conclude that the title has a negative influence on people get the meaning of lyrics.

However, the deficiencies of this experiment are few testing songs and participants, and insufficient data in Lyrics corpus, so that the correlation is insignificant. In the future, we would like to collect an amount of lyrics data for expanding the "Lyrics corpus". We prefer to seek whether title contained in lyrics many times is the factor that influences people understanding about the lyrics.

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