Analyzing the Relationship Between Time Orientation and Subjective Well-Being Based on Weibo Big Data

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Abstract

The preferred temporal direction in people' s thinking or actions influences behavior to a certain extent, and behavior affects life circumstances. Accordingly, we aim to investigate whether time orientation is associated with individuals' subjective well-being. This study leverages Weibo big data, collecting Weibo posts from 64,160 active users between 2010 and 2017. Through keyword extraction and data analysis, we found a moderate correlation between subjective well-being and future word frequency ($r = 0.404$, $p < 0.01$), and weak correlations with present and past word frequencies. After grouping users by time orientation word frequency, the high-frequency group exhibited significantly higher subjective well-being than the low-frequency group ($t = 67.442$, $p < 0.001$). Additionally, we observed a declining trend year by year in both subjective well-being and time orientation word frequency. The findings demonstrate that future time orientation can serve as a predictive indicator of subjective well-being, and this study provides a novel direction for utilizing Weibo big data to predict mental health.

Full Text

Temporal Orientation and Subjective Well-Being: A Big Data Analysis of Weibo

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Abstract: The temporal direction that individuals prefer in their thinking and actions influences behavior to a certain extent, and behavior subsequently affects life circumstances. Based on this premise, we sought to investigate whether temporal orientation is associated with subjective well-being. Utilizing large-scale Weibo data, this study collected posts from 64,160 active users between 2010 and 2017. Through keyword extraction and data analysis, we found a moderate correlation between subjective well-being and future-oriented word frequency ($r = 0.404$, $p < 0.01$), and weak correlations with present and past word frequencies. After grouping users by temporal orientation word frequency, the high-frequency group exhibited significantly higher subjective well-being than the low-frequency group ($t = 67.442$, $p < 0.001$). Additionally, we observed a declining trend in both subjective well-being and temporal orientation word frequency across years. These findings suggest that future temporal orientation can serve as a predictor of subjective well-being, providing a new direction for using Weibo big data to predict mental health.

Keywords: Temporal orientation, Subjective well-being, Weibo, Big data, Temporal trends

1 Introduction

The temporal direction that individuals prefer when thinking or acting is referred to as "temporal orientation" or "time perspective." The formation of temporal orientation is influenced by social, educational, and cultural factors, and is closely related to the development of various personality traits, playing a significant role in how individuals cognitively process real-life experiences and form motivational decisions. Subjective well-being primarily refers to individuals' overall emotional and cognitive evaluation of their quality of life, which can be used to assess emotional responses and life satisfaction over extended periods, with personality factors serving as important predictors. This study leverages Weibo big data to obtain users' temporal orientation word frequencies and subjective well-being scores through text analysis, investigating the relationship between temporal orientation and subjective well-being through correlation analysis.

1.1 Temporal Orientation

Individuals often exhibit cognitive orientation or bias toward a particular temporal direction. Some people habitually review the past and dwell on bygone events, others value the present and live in the moment, while still others emphasize the future and look forward to what lies ahead. This individual preference in thinking or action is termed "temporal orientation" or "time perspective" [1]. In the formation of temporal orientation, not only do social interaction, modeling, education, culture, and other environmental factors play crucial roles [2], but dynamic situational factors such as entertainment, complacency, and stress also shape temporal orientation [3, 4]. Once formed, temporal orientation exerts significant influence on individuals' emotions and cognition.

Recent research has revealed close relationships between temporal orientation and certain psychological traits. For instance, in studies on procrastination, Specter and Ferrari [5] demonstrated that procrastination is negatively correlated with future temporal orientation and positively correlated with past temporal orientation, while showing no significant correlation with present temporal orientation. Other research indicates that temporal orientation also plays an important role in personality traits such as self-efficacy [6], self-regulation [7], and delay of gratification [8]. Domestic research has similarly found at the cognitive construction level that temporal orientation influences individual self-confidence construction, with the future temporal orientation group showing significantly higher confidence judgments than past and present orientation groups [1].

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1.2 Subjective Well-Being

Subjective Well-Being (SWB) refers specifically to evaluators' holistic assessment of their quality of life based on self-determined criteria, representing a crucial comprehensive psychological indicator for measuring individual quality of life. Diener [9] posits that subjective well-being possesses three characteristics: subjectivity, relative stability, and holism. Numerous studies on subjective well-being have been conducted both domestically and internationally, yielding various measurement scales such as the widely-used 29-item Oxford Happiness Questionnaire (Revised) developed by Argyle, which employs a 0-3 four-point scoring system with a single dimension where the sum of all items constitutes the total happiness score, with higher scores indicating greater individual well-being [10].

1.3 Weibo and Mental Health

Weibo is a social networking site launched by Sina Corporation that provides microblogging services. Users can post messages or upload images through web pages, WAP pages, mobile clients, SMS, or MMS. Users can write a sentence or post a picture about what they see, hear, or think, and share it with friends anytime and anywhere via computer or mobile phone for joint discussion and sharing; they can also follow friends to instantly view information posted by them. Recent research indicates that the intensity of social media usage such as Weibo correlates with individuals' life satisfaction, and that social media use affects both positive and negative emotions [11].

2 Methods

2.1 Variables

We investigated the relationship between temporal orientation and subjective well-being, with temporal orientation as the independent variable and subjective well-being as the dependent variable, while also examining whether variables

such as year correlate with the dependent variable. The data collection methods for the main variables are as follows:

Temporal Orientation: We calculated the annual frequency of temporal orientation words in each Weibo user' s posts. By crawling Weibo text and analyzing it using "TextMind," a system developed by the Computational Cybernetics Laboratory at the Institute of Psychology, Chinese Academy of Sciences, we could obtain keyword frequencies in specified texts. The Chinese lexicon used by TextMind references the classic LIWC2007 and Traditional Chinese C-LIWC dictionaries [12]. LIWC has been widely used by psychology researchers for over 20 years due to its good reliability and validity, while C-LIWC is its Traditional Chinese version, initially developed and refined by Taiwanese scholars Huang Jinlan et al. [13]. TextMind, meanwhile, is based on Simplified Chinese text analysis [14], making it most suitable for this study.

In this research, temporal orientation words were divided into three categories: past, present, and future. Past words included 24 terms such as "once," "before,""at the beginning,""in those years,""at that time,""ancient times,""past,""bygone," "the year before last," "previous life," "the day before yesterday," "last year,""former days,""old days,""previously,""already,""before,""in the past,""originally," "yesterday," "yesterday," "last week," "last week," and "last week." Present words included 20 terms such as "at this moment," "at this time," "currently," "on that day," "right now," "immediately," "today," "today," "tonight," "tonight," "recently," "currently," "nowadays," "at this stage," "nowadays," "presently," "now," "in the process of,""this week," and "this week." Future words included 20 terms such as "three days from now," "another day," "the day after tomorrow," "soon," "in the future," "will," "next," "from now on," "next life," "afterlife," "next year," "tomorrow," "tomorrow," "in the future," "from now on," "future," "later," "next week," "next week," and "next week." Details are provided in Appendix Table 1 . We input Weibo text into the TextMind system, which tokenized the text line by line and categorized different types of words (e.g., "last week," "before") into the same feature (e.g., past), thereby obtaining the count of temporal orientation words in Weibo text. Any Weibo post containing the aforementioned vocabulary was counted cumulatively. To make temporal orientation words more representative, we used word frequency as the independent variable in actual analysis: past word frequency = (number of past words) / (number of Weibo posts), present word frequency = (number of present words) / (number of Weibo posts), future word frequency = (number of future words) / (number of Weibo posts). Simultaneously, we introduced "temporal orientation word frequency" as an additional independent variable, calculated as temporal orientation word frequency = (past words + present words + future words) / (number of Weibo posts).

Subjective Well-Being: Subjective well-being scores were derived from a research model developed by the Computational Cybernetics Laboratory at the Institute of Psychology, Chinese Academy of Sciences. The fundamental principle involves predicting subjective well-being for social media users at the individ-

ual level by partitioning different feature sets: demographic information, user Weibo behavioral characteristics, and user Weibo content characteristics, with subjective well-being as the target variable. Machine learning algorithms including StepWise, LASSO, Support Vector Regression, and Multivariate Adaptive Regression Splines were employed for modeling, achieving prediction accuracy comparable to the best predictive accuracy levels attained by other researchers using objective statistical indicators such as per capita income and education level. The correlation coefficient between predicted scores from the model and assessment scores obtained from psychological scales reaches 0.6. In this study, we used this established model to calculate subjective well-being scores for each Weibo user.

2.2 Participants

Our data were derived from valid Weibo posts containing keyword descriptions made by 10,000 Weibo users between January 1, 2010, and December 31, 2017, spanning eight years. Since our data were crawled annually and yearly means were calculated, data from the same user across different years were recorded as new users to explore temporal trends in the variables. During data cleaning, we removed data points falling beyond three standard deviations for number of Weibo posts, subjective well-being, and total temporal orientation word frequency, resulting in a final sample of 64,160 participants.

2.3 Statistical Methods

We primarily used SPSS 24.0 for data processing. First, descriptive analysis was conducted to calculate means and standard deviations for all variables. Next, correlation analysis was performed between subjective well-being and each temporal orientation word frequency. Based on preliminary analysis results, we grouped participants by the median temporal orientation word frequency and conducted independent samples t-tests on subjective well-being scores between the two groups. Finally, we considered the influence of temporal trends by calculating median temporal orientation word frequency for each year, grouping participants accordingly, and conducting year-by-year independent samples t-tests and correlation analyses.

3 Results

We conducted simple descriptive statistics on selected variables, removing participants whose values for number of Weibo posts, temporal orientation word frequency, and subjective well-being fell beyond three standard deviations from the mean. The final analytical sample comprised 64,160 participants. Descriptive statistics for each variable are presented in Table 1. From 2010 to 2017, Weibo users' temporal orientation word frequency was 0.104 ± 0.094, indicating that temporal orientation words appeared approximately once every ten posts on average. Present words occurred most frequently at 0.052 ± 0.059, followed

by past words at 0.031 ± 0.039, while future words were least frequent at 0.020 ± 0.029.

Table 1. Descriptive Statistics of Subjective Well-Being and Temporal Orientation Word Frequency for Weibo Users (N = 64,160)

To investigate the relationship between subjective well-being and the three types of temporal orientation word frequencies, we conducted correlation analyses between these variable pairs. Since none of these variables followed a normal distribution, Table 2 reports Spearman correlation coefficients. Correlation analysis revealed a moderate-strength correlation between subjective well-being and future word frequency ($r = 0.404$, $p < 0.01$), and weak correlations with present and past word frequencies, as well as with overall temporal orientation word frequency. Additionally, temporal orientation word frequency showed significant strong correlations with all three temporal orientation word frequencies, while the three temporal orientation word frequencies demonstrated moderate-strength intercorrelations.

Table 2. Correlations Between Subjective Well-Being and Temporal Orientation Word Frequency

Given the difficulty of grouping participants by the three temporal orientations under the existing data structure, and considering that the frequency of each temporal orientation word type was highly correlated with overall temporal orientation word frequency, coupled with frequency analysis revealing that 16.3% of Weibo users had a temporal orientation word frequency of zero (i.e., no temporal orientation words appeared in their posts), we sought to further examine the relationship between temporal orientation word frequency and subjective well-being. Therefore, using the median temporal orientation word frequency as a cutoff, we divided users into a high temporal orientation word frequency group (high-frequency group) and a low temporal orientation word frequency group (low-frequency group) for independent samples t-tests. As shown in Figure 1 [Figure 1: see original paper], the high-frequency group exhibited significantly higher subjective well-being than the low-frequency group (110.81 ± 32.89 vs. 95.75 ± 22.81, $t = 67.442$, $p < 0.001$). Considering temporal effects, we calculated median temporal orientation word frequency for each year, grouped participants using the same method, and conducted year-by-year independent samples t-tests. As shown in Figure 2 [Figure 2: see original paper], the high-frequency group consistently demonstrated significantly higher subjective well-being than the low-frequency group across all years ($p < 0.01$).

ANOVA analysis of Weibo users' annual past, present, and future word frequencies revealed significant differences among the different temporal orientation word frequencies each year ($Fs > 475.932$, $ps < .001$). Post-hoc analyses indicated that present word frequency was significantly higher than past word frequency, which in turn was significantly higher than future word frequency ($ps < .001$). Similarly, subjective well-being also showed significant differences across years ($ps < 0.001$). Correlation analyses between subjective well-being

and each temporal orientation word frequency, as well as total word frequency, yielded specific correlation coefficients presented in Table 3 .

[Figure 1: see original paper]

[Figure 2: see original paper]

Table 3. Descriptive and Correlation Statistics of Subjective Well-Being and Temporal Orientation Word Frequency by Year

4 Discussion

Temporal orientation words are associated with psychological characteristics such as emotion and personality. Our study shows that from 2010 to 2017, the frequency of temporal orientation words in Weibo posts averaged 0.104 occurrences, with present-related words appearing most frequently, followed by past and future words. As a platform for expressing personal states and discussing current events, Weibo naturally features the highest occurrence of "present" -related words, a finding consistent with common sense. Overall correlation analysis further reveals that future word frequency demonstrates the strongest correlation with subjective well-being, reaching moderate correlation strength, suggesting that the use of future-oriented words can to some extent reflect users' subjective well-being.

Analysis after grouping by temporal orientation word frequency shows that the frequency of temporal orientation word usage also influences subjective well-being levels, with the high-frequency group significantly outperforming the low-frequency group. This may be because individuals with higher subjective well-being are more willing to express time-related content, which partially explains why both present and past word frequencies also show positive correlations with subjective well-being.

As shown in Table 3, Weibo users' subjective well-being rose sharply from 2010 to 2011, then continued to decline thereafter. However, since the subjective well-being measure used here was not obtained through direct assessment but rather through machine learning calculations, further research evidence is needed. Additionally, it is evident that past, present, and future word frequencies all declined continuously from 2012 to 2017, indicating that Weibo users mentioned temporal orientation words with decreasing frequency in recent years. A plausible explanation for this phenomenon is that from 2010 to 2012, Weibo usage patterns more closely resembled blogs, with posting and browsing heavily dependent on computers. After 2013, however, the popularization of smartphones and Weibo clients enabled users to post and browse anytime and anywhere, enhancing the immediacy of Weibo and reducing the need to explicitly indicate when recorded events occurred through textual cues. Moreover, with the rise of alternative platforms such as WeChat Moments, Weibo' s function as a daily event record gradually diminished, with users more inclined to post current moods and states without explicit temporal markers.

Correlation analyses revealed that the correlation coefficient between present word frequency and subjective well-being was consistently slightly lower than those for past and future word frequencies, while past and future word frequencies remained roughly equivalent across multiple years, generally showing low-level positive correlations. This suggests that whether mentioning past, present, or future, Weibo users tend to present positive states, exhibiting higher levels of subjective well-being.

5 Conclusion and Outlook

This study utilized Weibo big data to explore the relationship between temporal orientation and subjective well-being, analyzing the temporal trends of both subjective well-being and temporal orientation word frequency across years, thereby providing a new direction for using Weibo big data to predict mental health. Due to limitations of Weibo data, our analysis did not incorporate demographic factors such as age, gender, region, or socioeconomic status. Additionally, subjective well-being scores were obtained through model calculations, making them less accurate than direct measurements; thus, our findings require further validation. Future research could employ questionnaire surveys and other methods to collect more comprehensive and accurate data to analyze the relationship between temporal orientation and subjective well-being.

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Jing Haiyang: Literature collection, writing of background section
Mao Zhefei: Literature collection, writing of methods section
Zhu Tingshao: Supervised research ideas and process management

Appendix Table 1: Temporal Orientation Keywords

Past orientation (24 words): 'once' , 'before' , 'at the beginning' , 'in those years' , 'at that time' , 'ancient times' , 'past' , 'bygone' , 'the year before last' , 'previous life' , 'the day before yesterday' , 'last year' , 'former days' , 'old days' , 'previously' , 'already' , 'before' , 'in the past' , 'originally' , 'yesterday' , 'yesterday' , 'last week' , 'last week' , 'last week'

Present orientation (20 words): 'at this moment' , 'at this time' , 'currently' , 'on that day' , 'right now' , 'immediately' , 'today' , 'today' , 'tonight' , 'tonight' , 'recently' , 'currently' , 'nowadays' , 'at this stage' , 'nowadays' , 'presently' , 'now' , 'in the process of' , 'this week' , 'this week'

Future orientation (20 words): 'three days from now' , 'another day' , 'the day after tomorrow' , 'soon' , 'in the future' , 'will' , 'next' , 'from now on' , 'next life' , 'afterlife' , 'next year' , 'tomorrow' , 'tomorrow' , 'in the future' , 'from now on' , 'future' , 'later' , 'next week' , 'next week' , 'next week'

Note: Figure translations are in progress. See original paper for figures.