Postprint: Research on the WeChat Official Account Influence Evaluation Model

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[Method/Process] Based on information entropy theory, we construct theoretical and mathematical models for WeChat Official Account influence evaluation. An empirical study is conducted using 4,876 data samples from WeChat Official Accounts, with comparative analysis performed against the Qingbo Index and New Rank Index, culminating in proposed strategies for influence enhancement.

[Results/Conclusions] The model demonstrates complete evaluation dimensions with richer variables, can correct data deviations in influence metrics caused by article fraud, exhibits favorable evaluation performance, and more authentically reflects the value of WeChat Official Accounts.

Full Text

Preamble

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Research on the Evaluation Model of WeChat Official Account Influence

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Abstract

[**Purpose/Significance**] This study evaluates the influence of WeChat Official Accounts to help enterprises objectively assess their value and guide self-media accounts to adopt effective measures for continuous influence enhancement. [**Method/Process**] Based on information entropy theory, we construct both theoretical and mathematical models for evaluating WeChat Official Account influence. Using 4,876 WeChat Official Account data entries as samples, we conduct an empirical study and perform comparative analysis with the Qingbo Index and New Rank Index, finally proposing strategies for improving WeChat Official Account influence. [**Result/Conclusion**] The model features complete evaluation dimensions and richer variables, can correct data deviations caused by article fraud, demonstrates good evaluation performance, and more accurately reflects the true value of WeChat Official Accounts.

Keywords: Information Entropy; WeChat Official Account; Influence Evaluation Model
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Introduction

WeChat Official Platform, developed by Tencent in 2012, enables enterprises and organizations to apply for WeChat Official Accounts for self-media activities. These accounts utilize functions such as micro-push notifications, micro-payments, micro-events, and micro-sharing to deliver important announcements, product information, and news, enabling online sales and forming a mainstream model for brand communication and interactive marketing. According to the "2017 WeChat Data Report" released by WeChat, by the end of 2017, monthly active Official Accounts reached 3.5 million, a 14% increase from 2016, while monthly active followers totaled 797 million, representing a 19% increase from 2016. These figures demonstrate that WeChat Official Accounts constitute a vast ecosystem with numerous followers, serving as a primary arena for enterprise brand building and product marketing, as well as an important tool for self-media to disseminate positive energy and exert opinion leadership. Therefore, evaluating the influence of WeChat Official Accounts can help enterprises objectively assess their value and guide self-media accounts to implement effective measures for continuous influence enhancement.

Scholars both domestically and internationally have conducted relevant research in response to the flourishing development of WeChat Official Accounts. C.H. Lien [1] studied the relationship between WeChat service quality, satisfaction, stickiness, and usage intention, constructing a model of interaction quality, environmental quality, outcome quality, and WeChat user satisfaction, which was validated using structural equation modeling. The results confirmed that user satisfaction positively influences WeChat stickiness and usage intention. C.B. Zhang [2] built a model of WeChat user perceived value and continuous usage in-

tention based on user surveys, examining how network externalities affect users' social value, information value, emotional value, entertainment value, and other perceived values. R. Zhao [3] viewed WeChat as a tool for academic research and discovery, proposing the establishment of a WeChat index to evaluate WeChat's academic impact as a supplement to traditional citation metrics, providing new perspectives and methods for influence evaluation. Yan Yueming [4] drew on the concepts of H-index and R-index, incorporating read counts, like counts, and article numbers into the assessment of WeChat Official Account influence, constructing the WeChatIndex model and validating it through experimental methods. Duan Yaoqing [5] conducted research on the accessibility information characteristics of government WeChat Official Accounts from various dimensions of government information, providing a basis for improving government information quality and promoting its dissemination. Fan Mingyue [6] studied the influencing factors of social media information credibility based on the MAIN model using WeChat Official Accounts as an example, proposing a social media information credibility system and empirically verifying the positive impact of information content's usefulness, reliability, objectivity, and relevance on social media information credibility. Yan Yiwen et al. [7] constructed an evaluation index system for government WeChat Official Account information dissemination effectiveness from five dimensions—user cognition, emotion and attitude, user behavior, social influence, and the government WeChat Official Account platform itself—and validated the index system using BP neural networks.

Evidently, scholars have conducted rich and fruitful research on WeChat and WeChat Official Accounts. However, research findings in the field of WeChat Official Account influence remain limited. Some scholars have proposed influence evaluation methods based solely on article read counts, like counts, or WeChat tags. If we can categorize articles more granularly, consider article information content, and quantitatively evaluate WeChat Official Account influence based on information entropy theory, we can more accurately reflect the true value of WeChat Official Accounts and effectively guide their development. Accordingly, this research addresses three key questions: (1) How to determine the evaluation dimensions for WeChat Official Account influence? (2) How to construct a WeChat Official Account influence evaluation model using information entropy theory? (3) How to validate the constructed model?

2. Related Theory

2.1 WeChat Official Account Influence

The concept of influence was initially proposed by sociologist N. Triplett [8] and social psychologist R.B. Cialdini [9], who defined it as "the result of changes in an individual's thoughts, behaviors, attitudes, and emotions during interactions with other individuals or groups." In management, the concept of influence has been extended to the ability to affect and change others' psychology and behavior [10]. The essence of influence is a form of control, and information influence manifests as the guiding and controlling effect of information producers

on information consumers in terms of cognition, opinions, tendencies, beliefs, attitudes, and behaviors [11]. Building on this, F. Riquelme et al. [12] defined new media influence as the ability to influence the behavior and attitudes of new media audiences and other individuals. As a typical representative of new media, WeChat Official Platform's primary information source is WeChat Official Accounts. To achieve their intended information dissemination goals and effects, these accounts utilize the WeChat Official Platform to deliver information to followers and other users, thereby influencing individuals or society. Essentially, this influence enables audiences to obtain information, and the degree to which a WeChat Official Account affects audience cognition, viewpoints, attitudes, beliefs, and behaviors through information dissemination is what we call WeChat Official Account influence [13].

WeChat Official Account influence can be evaluated through various metrics, including graphic indicators such as total article count and publication frequency; reading indicators such as total reads, average reads, and headline article reads; and like-related indicators such as total likes, average likes, maximum likes, and like rates [14]. Influence metrics for academic journal WeChat Official Accounts include function quantity, article push quantity, article read quantity, article push frequency, article update time, article-function matching degree, function evaluation, article like quantity, value-added services, and article push time [15]. The communication influence of university library WeChat Official Platforms can be evaluated through metrics such as follower count, new follower count, push article count, push frequency, information read count, and like count [16]. While these WeChat Official Account influence evaluation theories can reflect their impact on audience behavior and attitude from a macro perspective, they fail to analyze the differential roles of headline and non-headline articles in influence formation at a more micro level. Research indicates that WeChat headline articles feature precise topic coverage, content closely aligned with users, strong timeliness, and extended services that can significantly enhance article influence [17-18]. Therefore, quantitatively evaluating WeChat Official Account influence based on user behavior data from both headline and non-headline articles can more accurately reflect their true value.

2.2 Information Entropy

The concept of information entropy was first proposed by C.E. Shannon [19] in 1938, primarily to solve the problem of measuring information content. The definition of information entropy for an information source is shown in Formula (1):

$$H = -\sum_{i=1}^{n} P_i(X_i) \log_{\alpha} P_i(X_i) \quad 0 \le P_i \le 1, i = (1, 2, ...)$$

where H represents the information entropy of the source, Xi denotes the random event of message symbols or information primitives appearing from the source,

and Pi is the probability of the event occurring. Information entropy is positive, and its unit is determined by α in Formula (1). When $\alpha = 2$, it indicates that the information source has two random events, and the unit of information entropy is bit. When $\alpha = 10$, the unit is dit. Similar to the thermodynamic entropy concept in thermodynamic systems, information entropy introduces uncertainty and disorder to measure information content during information propagation. The difference is that Pi in information entropy need not be equal probability.

Initially, information entropy was successfully applied in communication fields and could measure communication system performance through indicators such as coding rate, transmission rate, information capacity, and signal-to-noise ratio [20]. From an information measurement perspective, based on the fact that information is an entity that reduces random uncertainty, the amount of information entropy reduction caused by the information source obtaining information is the information quantity. When information entropy is 0, the entropy change is the commonly referred information quantity (bit) [21]. Uncertainty, disorder, and chaos are characterized by information entropy, while certainty and order are represented by information quantity. Information quantity can effectively eliminate uncertainty and disorder, and the information quantity obtained by the information source equals the information entropy lost by it—information is negative information entropy [22].

2.3 WeChat Official Account Influence Based on Information Entropy

Early applications of information entropy theory were widespread in physics, statistical mechanics, and computer science [23]. In recent years, with the deepening of research in the information science field, information entropy theory has also been applied to library consortium risk analysis, Weibo opinion leader identification, personalized recommendation, and network node influence in new media environments [24-26]. These studies have laid the foundation for the in-depth application of information entropy theory in information science. As discussed earlier, the essence of enhancing WeChat Official Account influence is the process by which accounts reduce their information entropy by publishing high-quality information, effectively eliminating the uncertainty and disorder of information needed by WeChat audiences, thereby continuously improving their influence.

As described in Section 2.1, WeChat Official Account influence can be evaluated through metrics such as headline average reads, headline average likes, headline maximum reads, headline maximum likes, non-headline average reads, non-headline average likes, non-headline maximum reads, non-headline maximum likes, overall maximum reads, overall maximum likes, overall average reads, overall average likes, and total headline articles in the past week. Combining this with information entropy theory from Section 2.2, the influence formation process based on information entropy is illustrated in Figure 1 [Figure 1: see original paper].

As shown in Figure 1, when WeChat Official Accounts publish high-quality original information, their information entropy decreases while their influence increases. During information transmission, information is transformed into specific signals that match the channel in form and is affected by noise. Noise causes WeChat Official Account information entropy to increase and influence to decrease. When information receivers obtain the signals, they perform reading, liking, and forwarding behaviors, which again reduce the account's information entropy and increase its influence. Through this cyclical process, WeChat users' information needs are continuously satisfied. Additionally, because WeChat Official Account information is mostly pushed through a follower mechanism, an increase in follower count expands the information dissemination scope, continuously reducing information entropy and enhancing influence. Moreover, the "fast-food culture" of WeChat users' information consumption places higher demands on information quality and publication frequency. More original articles, higher information value density, and appropriately reduced publication frequency can improve WeChat Official Account information entropy and influence.

3. Model Construction

3.1 Research Framework

This study designs a research framework for evaluating WeChat Official Account influence based on information entropy, as shown in Figure 2 [Figure 2: see original paper]. The framework comprises three components: model construction, sample selection and data acquisition, and empirical research. In the model construction phase, we first determine the theoretical foundation for model construction based on information entropy, influence evaluation, and information dissemination theories. We then construct the theoretical model, derive its mathematical expression, clarify relevant parameters and variables, and provide explanations. For the constructed model, we select information sources, determine WeChat Official Account samples, acquire data through open platform access or web crawler methods, perform data cleaning and processing, and finally establish training and test datasets. In the empirical research phase, we use SPSS to test the data, implement the mathematical model through Matlab programming, utilize Excel to assist in chart drawing, and finally conduct comparative analysis of the empirical research results.

3.2 Influence Evaluation Theoretical Model

Based on domestic and international scholars' relevant research and the preceding discussion, this study proposes an information entropy-based theoretical model for evaluating WeChat Official Account influence, as shown in Figure 3 [Figure 3: see original paper]. The influence evaluation model comprises two dimensions—information influence and contextual influence—which combine to form the comprehensive influence of WeChat Official Accounts. Information influence includes 13 elements: headline average reads, headline average likes,

headline maximum reads, headline maximum likes, non-headline average reads, non-headline average likes, non-headline maximum reads, non-headline maximum likes, overall maximum reads, overall maximum likes, overall average reads, overall average likes, and total headline articles in the past week. Contextual influence includes two elements: follower count and average article publication time. The interaction between these two dimensions and composite influence is determined based on information entropy theory.

3.3 Influence Evaluation Mathematical Model

The expressions for WeChat Official Account information influence (HI) and contextual influence (HE) are shown in Formulas (2) and (3), where Pi(Xi) = Xi / ΣXj, meaning the probability of a random event is the ratio of the current event's occurrence frequency to the total occurrence frequency of all similar events. During calculation, we first determine the values of each event in Figure 3, then solve for their occurrence probabilities, and subsequently calculate the corresponding information entropy using the appropriate formulas under the premise of determining αi, βi, and γi values. Specifically, when Pi = 0, HI = 0.

$$HI = -\sum_{i=1}^{13} \alpha_i P_i(X_i) \log_{10} P_i(X_i) \quad 0 < P_i \leq 1, i = (1, 2, \ldots, 13)$$

$$HE = -\sum_{i=1}^{2} \beta_i P_i(X_i) \log_{10} P_i(X_i) \quad 0 < P_i \leq 1, i = (1, 2)$$

Subsequently, the composite influence C of WeChat Official Accounts can be calculated using Formula (4):

$$C = \lambda + HI + HE$$

4. Empirical Research

4.1 Data Collection and Sample Description

This study accessed the WeChat Official Platform through programming methods, supplemented by web crawler techniques after obtaining appropriate authorization, to acquire relevant WeChat Official Account data. Simultaneously, we obtained corresponding WeChat Official Account influence ranking data from Wewen (wewen.io) and monthly ranking data from Qingbo (gsdata.cn) and New Rank (newrank.cn). As of 2:23 on May 7, 2018, we had collected 5,052 WeChat Official Account data entries. After data cleaning, 4,876 samples were retained. The final sample data fields and descriptive statistics are shown in Table 1 . To determine model parameters, we excluded one data entry without influence ranking and randomly selected 1,000 entries as the training set, with the remaining 3,875 entries serving as the test set.

4.2 Influence Calculation

4.2.1 Determine Model Parameters To determine model parameters, we first assembled an expert team comprising two information science scholars, two WeChat Official Account operators, and two ordinary users. We then randomly selected 1,000 samples, had the expert team score the influence of these samples, and used the mean values as sample influence scores. Finally, based on Formula (4) and using SPSS under a 95% confidence interval, we obtained the parameter values shown in Table 2 . The resulting information entropy-based WeChat Official Account influence model is:

$$C = 0.0098 - 4.4p_1 \log_{10} p_1 - 6.4p_2 \log_{10} p_2 - 85.4p_3 \log_{10} p_3 - 3.0p_4 \log_{10} p_4 - 6.8p_5 \log_{10} p_5 - 0.1p_6 \log_{10} p_6 - 15.4p_7 \log$$

4.2.2 Influence Calculation Using Matlab programming, we calculated the information influence, contextual influence, and composite influence of the sample data. The data distributions are shown in Figures 4-6 [Figure 4: see original paper][Figure 5: see original paper][Figure 6: see original paper], and the top 100 influential accounts are listed in Table 3 . Through data fitting, we found that all influence metrics follow a power-law distribution. The top 100 rankings for each influence metric are generally consistent but show minor differences.

4.3 Discussion and Analysis

4.3.1 Influence Model Comparison Analysis The Qingbo Index (WCI) and New Rank Index (NRI) are currently authoritative WeChat Official Account influence indices. The Qingbo Index's primary indicators include reading index and liking index, weighted at 80% and 20% respectively. Its secondary indicators include total reads, average reads, maximum reads, total likes, average likes, and maximum likes, weighted at 40%, 45%, 15%, 40%, 45%, and 15% respectively, using entropy method for standardization. The New Rank Index (NRI) divides indicators into total reads, maximum reads, average reads, headline reads, and total likes, weighted at 75%, 5%, 10%, 5%, and 5% respectively, also using entropy method with Ln calculation for standardization.

After processing our composite influence data to maintain consistent units with the above indicators, we compared the top 10 accounts across the three models, with results shown in Table 4 . The comparison reveals that our model's evaluation results for highly influential WeChat Official Accounts are relatively close to those of the Qingbo and New Rank indices, demonstrating the model's validity to some extent.

To further compare differences between our model and the aforementioned models, we compared the influence results of all data across the three models, as shown in Table 5 . Interval accuracy refers to the ratio of consistent account names within a ranking interval when sorted by influence across the three mod-

els. Ranking consistency rate refers to the ratio of accounts with identical names and ranking positions across the three models.

Table 5 shows that when sorted by our model's composite influence, the accuracy rates calculated against the Qingbo and New Rank indices are relatively high in the 1-10 interval. However, as the interval expands, the differences between our model's ranking results and those of the Qingbo and New Rank indices increase. Analyzing the inconsistent data reveals that this discrepancy stems from the Qingbo and New Rank indices placing greater emphasis on total reads and average reads with higher weights. Our model, in contrast, distinguishes user behavior data between headline and non-headline articles at a more micro level, with model parameters determined based on expert scoring of numerous samples, better aligning with user cognition and theoretically ensuring the model's scientific validity. From a practical perspective, some top-ranked WeChat Official Accounts may employ methods violating platform operation agreements to artificially inflate specific content's reads and likes for profit. Our model minimizes the impact of such inauthentic data on influence evaluation results. Additionally, adjusting the average publication time coefficient can correct deviations in influence evaluation caused by spam information. Therefore, these differences in final results reflect the advancement of our constructed model to some extent.

4.3.2 Discussion on Influence Enhancement Strategies Examining the model parameter coefficients reveals that non-headline maximum likes, overall maximum reads, and headline maximum reads have relatively large coefficient values, while average publication time is -0.1, and non-headline average likes, total headline articles in the past week, and headline maximum likes have smaller coefficient values. This suggests that for top-ranked WeChat Official Accounts, the focus should be on publishing high-quality articles and strengthening fan interaction to increase headline reads and overall maximum reads, using high-read articles to drive influence enhancement. For ordinary accounts with fewer followers, emphasis should be placed on non-headline maximum likes, as only when fan users recognize and appreciate articles can "viral" forwarding effects occur. After influence increases, these well-liked articles can be set as headlines to further boost reads.

From the perspective of average publication time, the current prevalence of information overproduction through "bombardment" reduces users' information consumption experience. WeChat Official Accounts should conduct in-depth research on target users, analyze their reading, liking, and forwarding behaviors, and develop information publication strategies for different time periods and themes. The relatively low coefficient value for total headline articles in the past week also reflects this issue.

The mean values of information influence (Figure 7 [Figure 7: see original paper]) and contextual influence (Figure 8 [Figure 8: see original paper]) indicate considerable room for improvement in contextual influence, particularly through

increasing follower counts to enhance WeChat Official Account influence. As WeChat marketing models evolve, offline QR codes, events, and marketing can drive traffic online, expanding the online follower base. Subsequently, online activities, points, shopping vouchers, and product promotions can drive offline product sales and create an offline brand-building environment, forming a virtuous cyclical influence enhancement process.

Conclusion

This study investigates WeChat Official Account influence evaluation based on information entropy theory. By reviewing domestic and international literature, we demonstrate the necessity and cutting-edge nature of this research, establishing the theoretical foundation for model construction. Through analyzing the influence formation process of WeChat Official Accounts, we propose a theoretical research framework and construct an influence evaluation theoretical model. Based on information entropy theory, we derive the mathematical expression of the theoretical model. We then select WeChat Official Account samples, acquire data through programming and web crawlers, determine model parameters using SPSS, calculate influence for the test set, conduct comparative analysis with Qingbo and New Rank index data, and finally propose strategies for enhancing WeChat Official Account influence.

At the theoretical level, this study innovatively applies information entropy theory to WeChat Official Account influence evaluation, expanding the application of information entropy theory in information science. By introducing multiple micro-level elements, the model's expression is enriched, effectively avoiding evaluation bias caused by data fraud in a few articles. At the practical level, this research can effectively guide relevant enterprises and self-media in using WeChat Official Accounts for brand building, product sales, and cultural communication, and can also assist relevant departments in strengthening online public opinion management and control.

This study did not select all WeChat Official Account data for empirical research, which may cause research bias. The lack of article forwarding data leads to missing data in influence evaluation empirical research. In terms of cognitive influence dimension evaluation, due to the absence of offline data, we only studied it as a model parameter, which is also a limitation. Future research will combine online and offline data, incorporate more scholars' cutting-edge research findings, improve the model, and conduct empirical research to address these limitations.

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Author Contributions

Zhang Haitao: Proposed research proposition and ideas, paper writing;
Zhang Huiran: Paper writing and final version revision;
Wei Ping: Data collection and processing;
Yin Huizi: English literature collection and abstract translation.

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