Analysis of New Media Communication Effect of Sports Advertisement Based on Audience Psychological Effect

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Abstract

In modern times, sports advertising has become a new challenge that cannot be met through the traditional media communication network. This challenge in communication and advertising has contributed to current difficulties in effective communication. This study investigates the mechanism and effect of new media advertisement communication, assists advertisers and producers in serving advertisements on new media platforms more efficiently, and enhances the communication effect of product/service advertisements. This study examines the methods for obtaining sports advertising from new media platforms, and the interaction style of sports advertising in the new media communication network (NMCN). Based on the frequency and similarity of information propagation, an NMCN communication model was built. A comprehensive evaluation technique was used to examine the impact of new media communication on sports advertising. The simulated mean capacity of our network nodes to transmit advertisement data corresponds to their actual capacity. At all prevalence levels, the simulated infection density of network nodes corresponds to that predicted by our model. The transmission scale of sports advertisements in the network continued to expand as the transmission rate increased; the transmission threshold lowered as the effect coefficient increased. The number of views was limited, and the click-through rate improved when the advertisement was shown on the new media. Based on the frequency and similarity of information transmission, an innovative communication model was developed for the new media communication network (NMCN). The optimal service of sports advertising on new media can enhance the audience's attention, cognition, interaction, and behavior. This research has theoretical and practical implications for sports advertising media communication literature and practice.

Keywords: audience psychological effect; sports advertisement; new media; advertisement communication

1. Introduction

Modernly, with the rapid development of the internet and mobile internet, the new media has challenged the traditional media with its easy access to information and multiple diffusion channels and has become an important front for advertising besides the printed media and television (Beattie et al., 2021; Ferraresi, 2019; Gruner et al., 2019; Nazir, Sulaiman, & Abid, 2021; Xu & Li, 2014; Yas et al., 2021) However, the helpful advertisement cannot be forced onto the audience in the network's sea of advertisements (Lai & Ren, 2016; Shin & Ju, 2013; Xu & Li, 2014; Yang, 2020; Zhang, 2021). The new media's audience, unlike traditional media, receives fragmented advertisement content in various tiny time pockets. After recognizing the tremendous advertising value of new media, businesses will move to new media exclusively to serve their advertisements (Chen & Wang, 2017; Huang, 2017; Manik et al., 2016; Manik, Gupta, & Jha, 2014; Pires, 2014). Businesses urgently require theoretical direction to actualize efficient advertisement communication on new media platforms. Media advertising is needed to target audiences (Gao, 2022) psychologically.

Zhang (2021) established an analysis model for new media advertisement communication based on the extension neural network, enhanced the fuzzy neural network to meet the needs of analyzing new media advertisement data, and developed a framework for an intelligent system to improve the effectiveness of new media advertising. The results of their experiments indicate that their model can examine the communication effect of new media advertisements. Gan and Tsai (2021) examined the creative characteristics and implementation of the communication strategy of outdoor interactive advertising. In light of the precision service and many forms of interactive advertisement on big data platforms, the theme concept and design of interactive advertising were examined. On this premise, a principle of the interactive design was proposed: emphasizing the themes' simplicity.

New media advertisement marketing differs significantly from traditional advertisement marketing in the Internet Plus era (Lee & Kim, 2022). Using the status quo of new media advertisement markets in the context of Internet Plus, Wu (2020) predicted the development prospect of advertisement marketing and developed countermeasures for the problems in new media advertisement marketing: enhancing the communicator's dominance, optimizing the internal structure of the new media industry, expanding advertising channels, and identifying the cultural characteristics of the target audience. According to a prior study on the construction of new media ontology,

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four ontology attributes must be taken seriously, including rule, structure, feature, and bias. Hung, Chan, and Chan (2018) expanded the research by surveying the occurrence of these characteristics in the new digital advertising media. Four prominent social media networks were examined, including Pinterest, Snapchat, and Instagram. It was determined that the four ontology attributes are appropriate for the new media of digital advertising and correlate to the ontology attributes of the new media ontology, thereby aiding in the creation of the new media.

Overall, relevant domestic research rarely addresses new media advertising and never the communication strategy of new media advertising. The study significantly lags behind the explosion of new media advertising. There are two distinct definitions of audience psychology: From a macro perspective, an audience is a huge group; from a micro perspective, the audience is a highly diversified collection of individuals. With the continuing evolution of media communication, the psychological requirements of the audience are in a permanent state of flux. Humanistic theory, symbol interaction theory, possible self-theory, crowd mentality theory, and collective unconsciousness theory are audience psychology theories. It would be extremely advantageous to build on previous research findings and investigate the mechanism and effect of new media advertisement communication in depth. The experience of exceptional communication examples may aid advertisers and producers in serving advertisements on new media platforms more successfully, enhancing the communication effect of product/service advertising.

This study assesses the new media communication effect of sports advertising based on audience psychology effect analysis. It discusses the ideal serving abilities for targeted sports advertising in real-world information technology applications. The primary content addresses the following topics: Section 2 analyzes the interaction mode of sports advertising in the new media communication network and outlines the methods for acquiring sports advertisements from new media platforms (NMCN). The third section develops a communication model for the NMCN based on the information dissemination frequency and similarity. Considering the mediating influence of audience psychology and the versatility of new media sports advertising, Section 4 uses the complete evaluation approach to evaluate the effect of new media sports advertising on communication. Experiments were conducted to confirm the efficacy of

our model and disclose the actual serving effect of sports advertisements on the NMCN. This work is conceptually and practically significant since it improved the new media sports, advertising model.

2. NMCN for Sports Advertisement

Through a survey, this report describes the methods for acquiring new media sports advertising. According to Figure 1, 75 percent of the 1500 respondents claimed they had received recommendations for sports advertisements from video portals. Approximately 65.4% of respondents accessed the relevant advertising via social networks or official websites to sell sporting goods. Nearly 45 percent of sports advertisement information was accessed via mobile devices. Additionally, many respondents were exposed to and seen sports advertisements via digital television or digital newspapers/magazines. According to the survey results, new media has become a new means for the audience to access sports advertisements and has been welcomed by most viewers.

Examining the transmission of sports advertising across the NMCN and investigating the influence of the NMCN structure on different information dissemination processes are of tremendous practical importance. The premise and foundation for preventing the spread of infectious illnesses is a thorough comprehension of their transmission behavior. Similarly, a study on the information dissemination on the NMCN helps to comprehend the norms of sports advertisement dissemination on the internet, creating the groundwork for a vast and effective advertisement marketing environment. Analyzing the distribution of fake sports advertisements on the internet makes it possible to prevent their network-wide propagation.

For new media sports advertising communication, the interactive mode can be viewed as a closed communication loop. To gain a deeper understanding of the further media communication of sports advertising, it is required to clarify several crucial topics in the closed loop and their particular modes of operation. The topics include the advertiser, the audience, new media, traditional media, and advertisement intervention. The advertiser serves the ad according to its product/service marketing strategy. Under the influence of an effective advertisement, the advertisement's audience produces consumption willingness and behavior (Figure 2).
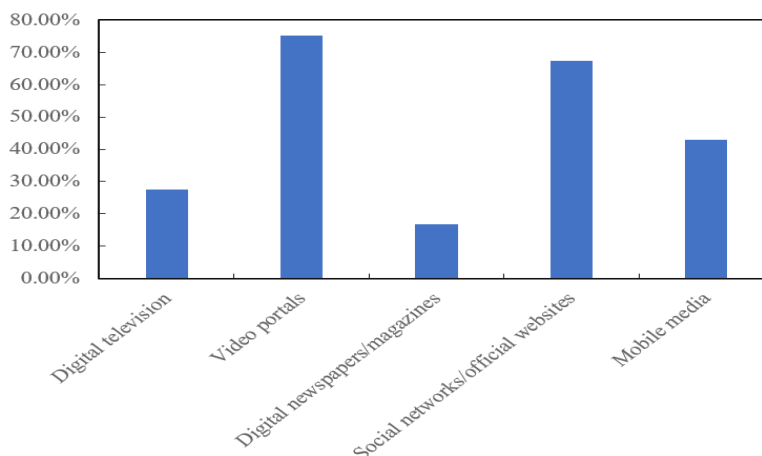
Figure 1. Acquisition methods for new platform sports advertisement
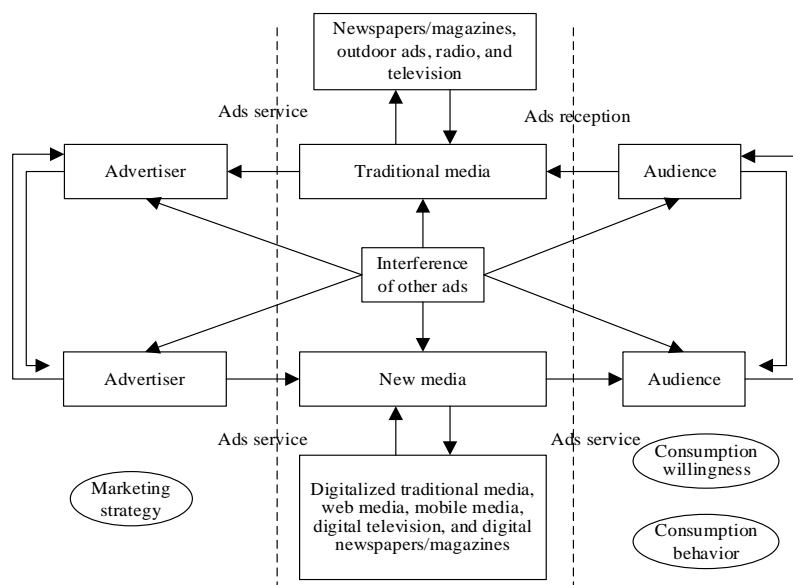

Figure 2. Interaction mode of the NMCN for sports advertisement

As a unified network architecture, this study selects a network that mimics the real-world NMCN characteristics in terms of its theoretical value. The selected network has a particular degree of information dissemination prevalence and similarity. The first stage in revealing the impact of the NMCN structure on sports advertisement communication is to construct an NMCN communication model based on the frequency and similarity of information dissemination.

3. Sports Advertisement Communication Model

Infectious diseases spread via physical contact while information propagates on the social network. A dynamic model on a multi-layer network can precisely depict the interplay between disease spread and information communication. The research on the transmission mechanism of infectious diseases helps to understand the spread paths and laws of advertisement, laying the basis for an efficient and safe communication environment for advertising. From

time and space dimensions, this section builds a partial differential equation model for infectious disease propagation in the NMCN. In terms of space, sports advertisement communication is similar to heat diffusion. Let $\delta(w, o, k)$ and $S(w,o)$ be the infection density and virus transmission ability of the network node with the coordinates of (w,o) at time t, respectively. Then, the heat diffusion equation can be established as follows:

$$\frac{\partial \delta(w,o,k)}{\partial k} = \frac{\partial}{\partial w}\left(S(w,o)\frac{\partial \delta(w,o,k)}{\partial w}\right) + \frac{\partial S(w,o)}{\partial o}\frac{\partial \delta(w,o,k)}{\partial o}\frac{1}{w^2}$$

$$+S(w,o)\frac{1}{w}\frac{\partial \delta(w,o,k)}{\partial w} + S(w,o)\frac{\partial^2 \delta(w,o,k)}{\partial o^2}\frac{1}{w^2} \quad (1)$$

This paper uses a logistic model to characterize the growth of sports advertisements in the time dimension. The growth rate $\partial \delta(w,o,k)/\partial k$ of infected network nodes is proportional to the density $\delta(w,o,k)$ of the infected network nodes, and the density 1- $\delta(w,o,k)$ of the susceptible network nodes. Let ρ be the constant infection rate; $\rho S(w, o)$ be the infection rate of the network node with the polar coordinates of (w, o). Then, the growth rate of the infected network nodes can be calculated by:

$$\frac{\partial \delta(w,o,k)}{\partial k} = \rho S(w,o)\delta(w,o,k)\big(1 - \delta(w,o,k)\big)$$
(2)

Based on the diffusion term in formula (1) and the growth term in formula (2), the sports advertisement communication model on the new media can be characterized by the following partial differential equation through the prevalence and similarity optimization:

$$\frac{\partial \delta(w,o,k)}{\partial w} = \frac{\partial}{\partial w}\left(S(w,o)\frac{\partial \delta(w,o,k)}{\partial w}\right) + \frac{\partial S(w,o)}{\partial o}\frac{\partial \delta(w,o,k)}{\partial o}\frac{1}{w^2}$$
$$+ S(w,o)\frac{1}{w}\frac{\partial \delta(w,o,k)}{\partial w}$$

$$+ S(w,o)\frac{\partial^2 \delta(w,o,k)}{\partial o^2}\frac{1}{w^2} + \rho S(w,o)\delta(w,o,k)\big(1 - \delta(w,o,k)\big),$$
(3)

Formula (3) shows that the new media communication model for sports advertisement can be regarded as a polar heat diffusion model with an internal heat source. Let $g(w, o)$ be the distribution function of sports advertisement publishers. When $k=0$, the distribution of infection sources, i.e., sports advertisement publishers, satisfies an initial condition:

$$\delta(w,o,0) = g(w,o), 0 \le w \le W, 0 \le o \le 2\pi$$
(4)

The sports advertisement do not propagate outward on the boundary of w=0 and w=W, that is, the change rate of infection density $\delta(w,o,k)$ at the boundary is 0. Thus, the boundary condition can be configured as follows:

$$\delta_w(0,o,k) = 0, \delta_w(W,o,k) = 0$$
(5)

Suppose $\delta(w,o,k)$ is radially symmetric:

$$\frac{\partial \delta(w,o,k)}{\partial o} = 0$$
(6)

Let $\delta(w, k)$ be the infection density of the nodes in a network with radius w at time k; $s^*(w)$ be the mean degree of network nodes whose distance from the disk center is w. The mean degree characterizes the mean ability of sports advertisement communication of network nodes. Combining formulas (6) and (3), the radially symmetric sports advertisement communication model can be expressed as the following partial differential equation:

$$\frac{\partial \delta(w,k)}{\partial k} = \frac{\partial}{\partial w}\left(s^*(w)\frac{\partial \delta(w,k)}{\partial w}\right) + s^*(w)\frac{1}{w}\frac{\partial \delta(w,k)}{\partial w} +$$
$$\rho s^*(w)\delta(w,k)\big(1 - \delta(w,k)\big)$$
(7)

The above formula can also be regarded as a combination of heat diffusion and source terms. When k=0, the distribution of sports advertisement publishers satisfies an initial condition:

$$\delta(w,0) = g(w), 0 \le w \le W$$
(8)

The boundary condition can be configured as follows:

$$\delta_w(0,k) = 0, \delta_w(W,k) = 0$$
(9)

Referring to the two states of infectious diseases (the susceptible and inflected states), two states were defined for the network nodes: sports consumption willingness and sports consumption behavior. Drawing on the transmission mechanism of infectious diseases, the new media communication model of sports advertisement consists of two processes. In the first process, the susceptible become infected at the infection rate ρ, after accepting the recommendation

from the infected. In the second process, as the advertisement is played, the infected may be willing to repurchase the product/service and return to the susceptible state at the probability of v. Note that the infection rate depends on the degree of network nodes. In contrast, the transition probability to the susceptible state does not depend on the node degree.

Introducing the healing term $v\delta(w,o,k)$ to formula (3), the model can be updated as:

$$\frac{\partial \delta(w,o,k)}{\partial k} = \frac{\partial}{\partial w}\left(S(w,o)\frac{\partial \delta(w,o,k)}{\partial w}\right) + \frac{\partial S(w,o)}{\partial o}\frac{\partial \delta(w,o,k)}{\partial o}\frac{1}{w^2}$$
$$+ S(w,o)\frac{1}{w}\frac{\partial \delta(w,o,k)}{\partial w}$$

$$+ S(w,o)\frac{\partial^2 \delta(w,o,k)}{\partial o^2}\frac{1}{w^2} + \delta S(w,o)\delta(w,o,k)\big(1 - \delta(w,o,k)\big) - v\delta(w,o,k)$$
(10)

The corresponding initial condition and boundary condition can be respectively expressed as:

$$\delta(w,o,0) = g(w,o), 0 \le w \le W, 0 \le o \le 2\pi$$
(11)

$$\delta_w(0,v,k) = 0, \delta_w(W,o,k) = 0$$
(12)

Under the hypothesis of radial symmetry, the new media communication model for sports advertisement can be established as follows:

$$\frac{\partial \delta(w,k)}{\partial k} = \frac{\partial}{\partial w}\left(s^*(w)\frac{\partial \delta(w,k)}{\partial w}\right) + s^*(w)\frac{1}{w}\frac{\partial \delta(w,k)}{\partial w}$$
$$+ \rho s^*(w)\delta(w,k)\big(1 - \delta(w,k)\big) - v\delta(w,k)$$
(13)

The corresponding initial condition and boundary condition can be respectively expressed as:

$$\delta_w(0,k) = 0, \delta_w(W,k) = 0$$
(14)
$$\delta(w,0) = g(w), 0 \le w \le W$$
(15)

4. Evaluation of Advertisement Communication Effect

The audience of the new media, like that of old media, seeks spiritual fulfillment. According to the research, the primary psychological needs of the new media audience are novelty, speed, information, truth, aesthetics, communication, and engagement. In contrast to traditional media, the audience psychology of new media is characterized by an emphasis on individual existence, i.e., the new media audience craves involvement, engagement, and personalization. The communication of the new media occurs between individuals. The new media audience seeks self-identity and presence in this setting. Therefore, audience contact is a crucial aspect of further media communication. Simultaneously, the vast volume of information delivered by the new media accelerates the pace of life and shapes distinct audience psychology: simplicity and speed take precedence.

To fully and objectively reflect the actual dissemination and publicity effects of sports advertisements on the new media, this paper fully considers the mediating effect of audience psychology and the diversity of new media sports advertisements. It employs comprehensive evaluation

to assess the impact of sports advertisement communication on the new media. The exhaustive assessment integrates numerous evaluation techniques. Let w1, w2, w3, and w4 represent four distinct weights (w1+w2+w3+w4 = 1), and let ATT, COG, ID, and ACT represent the audience's attention, cognition, interaction, and action, respectively. The following evaluation formula can therefore be established:

$$WLG = \gamma_1 \times ATT + \gamma_2 \times COG + \gamma_3 \times ID + \gamma_4 \times ACT$$

(16)

Let $\sigma1$, $\sigma2$, and $\sigma3$ be three different weights assigned by the advertiser in consultation with the new media platform ($\sigma1+\sigma2+\sigma3=1$); AF, AM, and AT be the display frequency, display mode, and duration of the advertisement, respectively. AF and AT can be calculated from the mean usage duration of new media per unit (Figure 3). The correction coefficient AC for audience attention to new media sports advertisement can be defined as:

$$AC = (\sigma1 \times AF + \sigma2 \times AM + \sigma3 \times AT) \times 100\%$$

(17)

Let AV be the view count of sports advertisements. Then, the audience's attention to new media sports advertisements can be expressed as:

$$ATT = AV \times AC$$

(18)

Let BT be the mean view duration of sports advertisements. Then, the correction coefficient CC for audience cognition of new media sports advertisement can be defined as:

$$CC = BT \times 100\%$$

(19)

Let KN be the click rate of sports advertisements. Then, the audience cognition of new media sports advertisement can be expressed as:

$$COG = CC \times KN$$

(19)

Let IT be the number of interactions between the audience; CBN is the number of audience consumption behaviors. Through the above analysis, the evaluation formula for the new media communication effect of sports advertisement can be expressed as follows:

$$WLG = \gamma_1 \times AV \times AC + \gamma_2 \times CC \times KN + \gamma_3 \times IT + \gamma_4 \times CBN$$
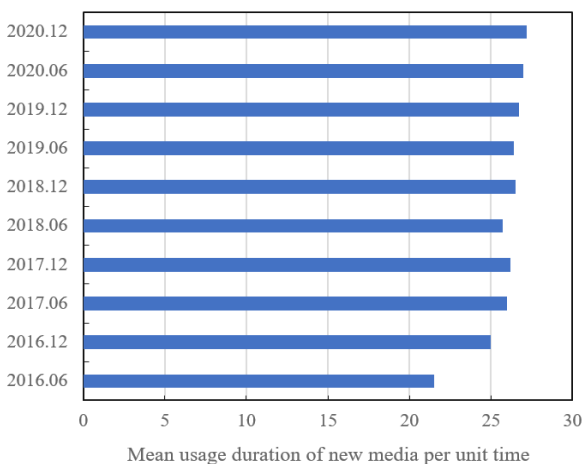
(20)

Figure 3. Mean usage duration of new media per unit of time

5. Experiments and Results Analysis

This part creates, through experiments, the advertisement communication model corresponding to a real-world new media network for information transmission and uses the real network to validate the efficacy of our model, which is founded on the theory of contagious illnesses. Specifically, the Hypermap technique was used to map an actual social network of Weibo, including 4,511 network nodes, into a hyperbolic space. The network's mean node degree was then linearly fitted. Figure 4 displays the network simulation and fitting results. As observed, the linearly fitted mean node degree was extremely compatible with the simulation outcome. In other words, the simulated mean capacity of the network nodes to transmit advertisement data corresponds to their actual capacity. Next, the fitting equation was inserted into the model constructed in the previous part to generate the advertisement communication model for that network.
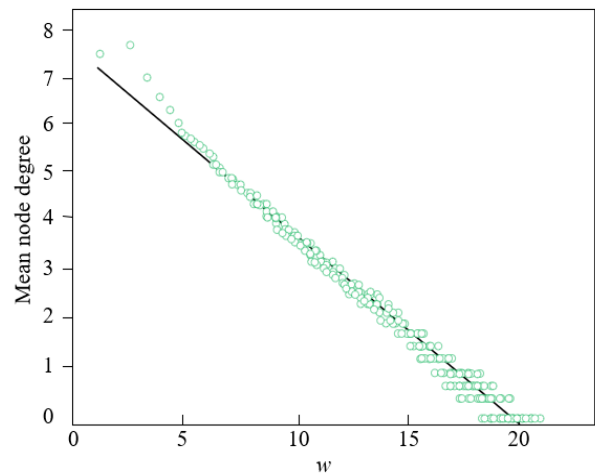

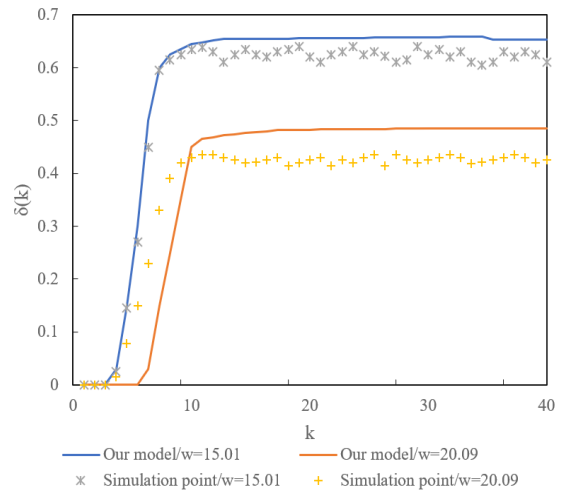*Figure 4.* Simulation and fitting results of mean node degree

Figure 5. The density of infection at different
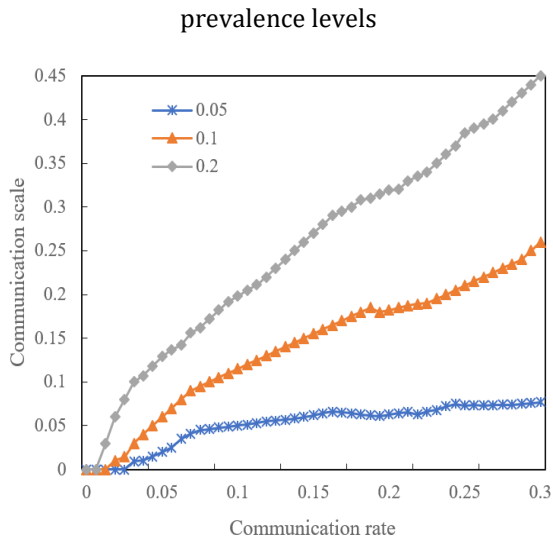
prevalence levels

Figure 6. Relationship between communication scale and communication rate under different influence coefficients
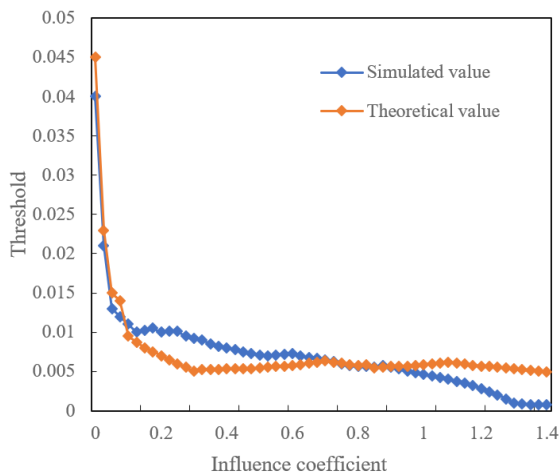

Figure 7. Simulated and theoretical thresholds at different influence coefficients

Figure 5 compares the simulated infection density of network nodes to our model's infection density at various prevalence levels. Note that the w value was successively set to 15.0 and 20.09. Observably, the numerical solution of our model was extremely near to the simulated outcome. This further supports the efficacy of our infectious disease theory-based sports advertisement communication approach. Figure 6

illustrates the link between communication scale and rate of communication under varying influence factors (0.05, 0.1, and 0.2). The parameter values for transition probability, mean node degree, and temperature were all fixed. As the transmission rate increased, the transmission scale of sports advertising in the network continued to expand; the transmission threshold reduced as the effect coefficient increased. Therefore, the bigger the influence coefficient of similarity over sports advertisement communication, the easier it is to propagate poor or fake advertisement information in the existing Weibo social network.

Figure 7 contrasts the theoretical and simulated thresholds for various effect coefficients. Note that the likelihood of transition, average node degree, and temperature parameters were all fixed. The academic thresholds are compatible with the simulation results, as observed. This indicates a negative correlation between the threshold and the influence coefficient. Moreover, the minor difference between theoretical and simulated thresholds validates the accuracy of our theoretical analysis conclusions.

Whether the target audience is accurate or not, and regardless of whether the suggested material is appropriate, the service of sports advertising in traditional media is prone to a high level of wasted advertising costs. The optimal service of sports advertisement on the new media connects the audience with advertisement content based on psychological effect analysis of the audience, maximizing the utility of the advertisement while minimizing the service cost for the advertiser. Table 1 analyzes the effects of several advertisement-serving optimization approaches. The optimal service of sports advertising on the new media has been found to boost the audience's attention, cognition, interaction, and behavior. Figure 8 depicts the effect of serving advertisements. Before serving sports advertisements on new media, the advertisement-serving development of conventional media was characterized by a high view count and a low click rate, indicating that the advertisement cannot significantly increase the audience's consumption propensity. In contrast, the number of views was limited, and the click-through rate increased when the advertisement was displayed on new media. This is because sports advertisement is exposed to a more targeted demographic.

Table 1

Comparison of advertisement serving effects of different optimization methods

Period	AV	AC	CC	KN	IT	CBN
2020.04.01-04.08	326.85	22	4628	20	33	3
2020.04.09-04.15	452.18	13	4182	25	41	7
2020.04.16-04.22	263.74	24	5293	17	24	5
2020.04.23-04.29	126.59	26	8196	83	88	9
2020.04.30-05.06	224.71	31	9283	77	95	13
2020.05.07-05.13	152.19	29	7195	92	78	15

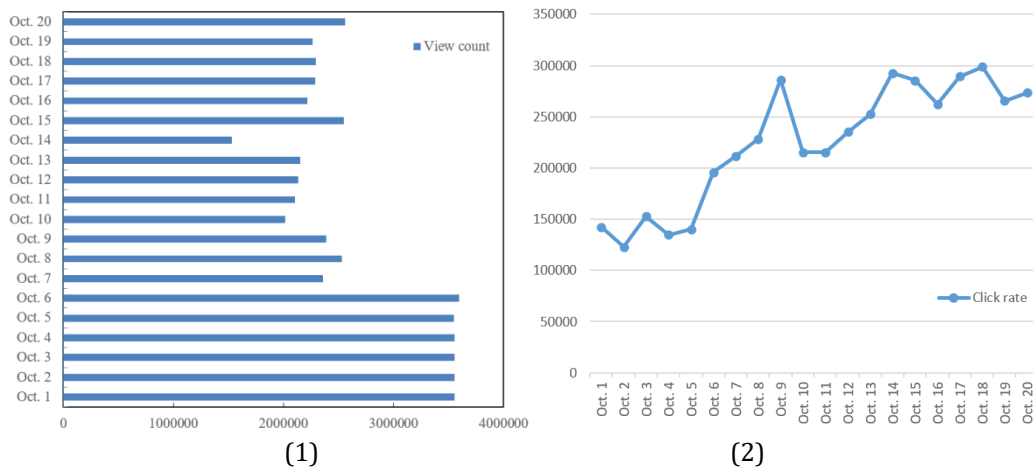(1)   (2)

Figure 8. Advertisement serving effect

Comparing the numerical solution to the suggested advertisement communication model with the simulation result of the Monte-Carlo random simulation algorithm illustrates the validity of our model. It was also demonstrated that network nodes with a high prevalence level are susceptible to infection; the prevalence of communication is nonlinearly connected with infection density for network nodes.

6. Conclusion

Based on an investigation of the psychological effect on the audience, this research provides a detailed evaluation of the communicative impact of sports advertisements in new media. After compiling the methods for acquiring sports advertisements from new media platforms, the authors evaluated the interaction mode of sports advertisements in the NMCN. They developed a communication model based on information transmission frequency and similarity. The effect of new media communication on sports advertising was then thoroughly analyzed. Based on this, the authors created the advertisement communication model corresponding to a real-world new media network for information transmission. They used the entire network to validate the efficacy of our model, which is founded on the theory of contagious diseases. By linearly fitting the mean node degree of the network, it is determined that the simulated mean ability of network nodes to communicate advertisement information corresponds to their actual ability. In addition, the authors compared the simulated infection density of network nodes with that of our model at different prevalence levels. They plotted the relationship between communication scale and communication rate under different influence coefficients, thus validating the efficacy of our sports advertisement communication model based on the theory of infectious diseases. Finally, the advertisement serving effects of various optimization approaches were examined in depth, demonstrating that the optimal service of sports advertisements on the new media may significantly enhance the audience's attention, cognition, interaction, and action.

7. Implications of the Study

Theoretically, this work has given a model of communication based on new media that was not elaborated in these dimensions by any previous study. This study has determined that the communication of sports advertising is necessary; nevertheless, the impact of communication must be considered for this advertisement to achieve the desired objectives. Meanwhile, this communication model has significant theoretical implications as it explains how future research could be enhanced. This study also shows that it is possible to disseminate information when every communication component is improved to enhance sports advertising.

This research has boosted the development of media communication and advertising, which is essential for the modern communication system. Indeed, this study has provided new characteristics crucially necessary for a better understanding and advancement of sports from a psychological standpoint. On the other hand, the communication model proposed by this study might be valuable for improving corporate performance through a better understanding and augmentation of information. In the meantime, the communication system developed by this study would be applicable to all types of sports advertising to enhance communication performance and increase the advertisement's reach.

8. Future Directions

Despite attaining certain outcomes, this study requires additional investigation in several areas. Based on the current study's findings, the next study will concentrate on a few topics. Future research should explore sports advertisement communication based on big data analysis. Second, future research should investigate the transmission of sports advertising through multilayered networks in depth. Future

research should focus on the synergistic evolution and feedback mechanism between the advertising communication network and communication dynamics. These future directions are essential for enhancing the body of literature by researching more unexplored areas for contribution.

Funding

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