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Network Warfare and Information Communication: the role and Challenge of New Media in the conflict in Ukraine

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Abstract: In the digital age, information warfare has become an important part of today's world wars. Taking the Ukrainian war in 2022 as the research object, this paper made an in-depth study on the role and challenges of new media in cyber warfare. Taking the war in Ukraine as an example, this paper systematically studied the strategy and role of new media in the war from the aspects of social media release, news reports and cyber attacks. Positive emotions on Twitter and TikTok accounted for the highest proportion, accounting for 60% and 65% respectively, which may indicate that the content on these two platforms is more likely to arouse users' positive response and resonance. Through a detailed analysis of the use of new media in the Ukrainian conflict, it was found that new media platforms such as Twitter and Facebook had significant advantages in the speed and scope of information dissemination. In addition, the interactivity of new media enables people to participate in information dissemination and discussion more directly, thus changing the strategy and execution mode of information warfare to some extent. This paper not only helps to understand the strategic role of new media in international conflicts, but also provides insights and suggestions for policy makers and scholars to meet the challenges of future information warfare. Through in-depth analysis of this phenomenon, this study reveals the complex role and challenges of new media in modern conflicts, and provides an important perspective and tool for understanding and coping with possible information wars in the future.

1. Introduction

In today's world wars, the speed and scope of information dissemination has become a decisive factor in determining the outcome of a war. The conflict in Ukraine provides an opportunity to explore the role of new media in contemporary wars. In this war, the two sides not only fire at each

other on land, but also launch a fierce information and psychological struggle on the Internet. This paper plans to take the Ukrainian war as the background, take the application of new media as the breakthrough point, and discuss the strategy and influence of new media under the war background by comparing two different types of new media applications. The research results of this paper expand people's understanding of information countermeasure strategy, and also provide important theoretical and practical guidance for the occurrence of similar incidents in the future.

This paper makes an in-depth study on the special role and challenges of new media in the Ukraine conflict. This paper discusses the influence of new media on public opinion and policy making from the speed and scope of new media. Then, the paper analyzes the function of new media in promoting or alleviating contradictions, especially how to effectively control and resist false information. At the same time, this paper also explores strategies to maintain the freedom and security of digital space under the high-intensity political background. On this basis, this paper makes a comprehensive study of the complex role of new media in contemporary wars.

This paper is mainly divided into the following parts: in the first part, the present situation of the use of new media in the Ukrainian war is briefly expounded to determine the research content and objectives of this paper. Then, this paper makes a detailed analysis of the various functions played by new media in this contradiction, including information disseminators, mood regulators and strategic tools. On this basis, this paper also explores the application of new media in future wars, and puts forward corresponding policy suggestions for the application of new media in wars. Through the detailed analysis of the above three aspects, it is hoped to have a deeper understanding and response to social contradictions in the Internet environment.

2. Related Work

In the contemporary social conflicts, the status of new media is becoming more and more important, and it is also paid more and more attention by academic circles. In recent years, academic circles have explored the role of new media in political mobilization, public opinion manipulation and information dissemination. Liu Yan believed that under the background of cyber warfare, the security of information country is facing many risks, and puts forward the countermeasures [1]. Liu Bin proposed a threat model of space network operations based on situational awareness [2]. Lin Ziqing studied threat intelligence perception for power network warfare [3]. Chen Xiaonan studied the evaluation of combat effectiveness in computer network warfare [4]. Cao Chen conducted a preliminary study on the development of air combat equipment based on network information system [5]. Although there is a basic understanding of the role of new media in existing studies, they often overlook the specific application and effectiveness of new media strategies in specific conflict contexts, especially in situations where new media is operated and utilized by different stakeholders in sustained conflict and unstable environments.

New media plays a double-edged sword role in conflict communication, which is also a hot research topic. On the one hand, new media can serve as a tool to promote transparency and democracy, and on the other hand, it may also become a channel for false information and propaganda. This type of research highlights the complexity and multidimensional impact of new media in modern warfare. Jing Jiwu discussed the development of network information security in China [6]. Lu Tongliang studied multi-layer network modeling of combat systems under information support [7]. Chen Xi conducted an evaluation of the collaborative effectiveness of information warfare command based on grey clustering [8]. Atrews R A studied the content of cyber warfare [9]. Serpanos D explored Ukraine's cyber warfare [10]. However, there is still a lack of in-depth exploration of ethical and legal issues in the use of new media in current literature, especially regarding the impact of information manipulation on civil liberties and international law.

3. Methods

3.1 New Media Content: Quantifying Information Dissemination Models in the Ukraine Conflict

In order to comprehensively understand the role of new media in the conflict in Ukraine, this study adopts a content analysis method. Firstly, by selecting key time points, relevant social media posts, news articles, and blog content are collected. Natural language processing tools such as sentiment analysis and topic recognition are used to evaluate the emotional orientation and topic focus of information. This analysis reveals the trends and changes in the dissemination of cyber warfare information at different time points, as well as how specific information affects public emotions and perspectives [11-12].

Data collection: Since the beginning of the conflict, data is selected, and major events and turning points are given special attention, such as periods of escalating combat or peace negotiations.

Preprocessing: Data is cleaned to remove irrelevant information, such as advertisements and spam, to ensure the accuracy of analysis.

Tool application: Text analysis software is used to encode collected data and predefined labels are used to classify information types.

Trend analysis: Through time series analysis, the main trends in information dissemination are identified, such as the increase or decrease in information dissemination after a specific event.

Network warfare information diffusion model [13]:

$$\frac{dI(t)}{dt} = \beta S(t)I(t) - \gamma I(t) \quad (1)$$

Among them, $I(t)$ represents the number of disseminators at time t; $S(t)$ represents the number of susceptible individuals at time t; β is the spread rate; γ is the recovery rate (the speed at which propagation stops).

3.2 Social Network: Mapping Information Flow and Influence Structure

Social network analysis is used to map the flow path and influence structure of information on the network. By identifying key information disseminators and influence nodes, this study evaluates the roles of individuals and organizations in disseminating key information in new media.

Node recognition: User interaction on social media is analyzed, such as forwarding, commenting, and liking, to identify key nodes in information dissemination.

Relationship mapping: An information flow network diagram is constructed to reveal how information propagates from one node to another.

Centrality analysis: The centrality of nodes in a network is calculated to determine which nodes play a core role in information dissemination.

Community testing: Through community testing technology, close groups of information sharing are identified, and these groups may play a key role in shaping public opinion.

Network attack impact model:

$$A(t) = 1 - e^{-k \cdot n(t)} \quad (2)$$

Here, $A(t)$ represents the network attack impact at time t; $n(t)$ is the attack intensity; k is a parameter that characterizes the attenuation of attack effectiveness.

3.3 Scenario Simulation: Evaluating the Impact of Information Warfare Strategies

This study constructs a series of agent based models to simulate the potential effects of different information warfare strategies. Through simulation, it is possible to foresee the possible consequences of adopting specific strategies in actual conflicts.

Model design: Models that include different types of agents (such as the public, government, opposition forces) are designed, with each agent responding based on its strategy and goals.

Strategy implementation: Specific information warfare strategies are set for each agent, such as spreading misleading information, enhancing information transparency, etc.

Simulation operation: It is operated in a controlled environment to observe and record the effects of various policies on information flow and public response.

Results analysis: The simulation results are analyzed and the effects of various information warfare are evaluated.

Information entropy (used to measure uncertainty and data complexity):

$$H(X) = -\sum_{i=1}^{n} P(x_i)\log P(x_i) \quad (3)$$

$H(X)$ is the entropy of the random variable X, and $P(x_i)$ is the probability of event x_i.

3.4 Intelligent Decision Support System: Optimizing Information Warfare Strategy Decisions

In order to improve the effectiveness and accuracy of decision-making, this paper plans to establish an intelligent decision support system based on big data. By comprehensively using historical data and real-time data, a more effective information countermeasure strategy is put forward.

System structure: An architecture integrating real-time data flow, historical data analysis and user feedback is established.

Algorithm development: Machine learning algorithms are developed to predict the influence of information diffusion and possible social reactions.

Real-time correction: According to the real-time data and forecast results, the information warfare strategy is timely adjusted to achieve the best information transmission efficiency.

Result evaluation: The implementation strategy is periodically evaluated to ensure that the adjustment of the strategy can achieve the expected purpose and achieve the actual effect.

On this basis, from the perspective of new media, this paper makes a comprehensive analysis of the multiple roles and challenges played by new media in the Ukrainian war, and puts forward strategic suggestions on how to deal with future wars. This study not only shows the complexity of new media information confrontation, but also provides feasible means and strategies for how to give full play to the advantages of information technology in future wars.

Evaluation of network defense capability:

$$R = e^{-\lambda L} \quad (4)$$

Among them, R represents the network's resilience (i.e. the ability to function normally after attacks or interference); L is the degree of network interruption; λ is a coefficient that represents the stability of network connections.

4. Results and Discussion

4.1 Experimental Setup

When evaluating the effect of new media strategies in the conflict in Ukraine, this study uses a

variety of evaluation indicators to quantify and analyze the practical application effects of different strategies.These indicators include the speed and scope of information dissemination, the emotional response of information recipients, the accuracy of information, public participation, and the impact of strategies on conflict situations.

The experiment is conducted in a simulated network environment, which reproduces the use of Internet and social media platforms during the conflict in Ukraine. The following parameters are set for each experiment:

Information source: news reports and social media posts from different channels.

Communication media: covering mainstream social media platforms such as Facebook and Twitter, as well as regional social applications such as Telegram and Vkontakte.

User group: including the general public, government officials, media workers, and social influencers.

Information types: factual reports, misleading information, propaganda, and appeal information.

Scenario setting: revolving around specific conflict events, such as territorial disputes, political statements, or international intervention.

4.2 Results

(1) Speed test

The speed test results are shown in Figure 1 (Figure 1 (a) is a factual report; Figure 1 (b) shows misleading information; Figure 1 (c) shows promotional information; Figure 1 (d) shows the appeal message. The required time is from publishing to reaching a specific number of users (such as 1000 followers) in minutes.

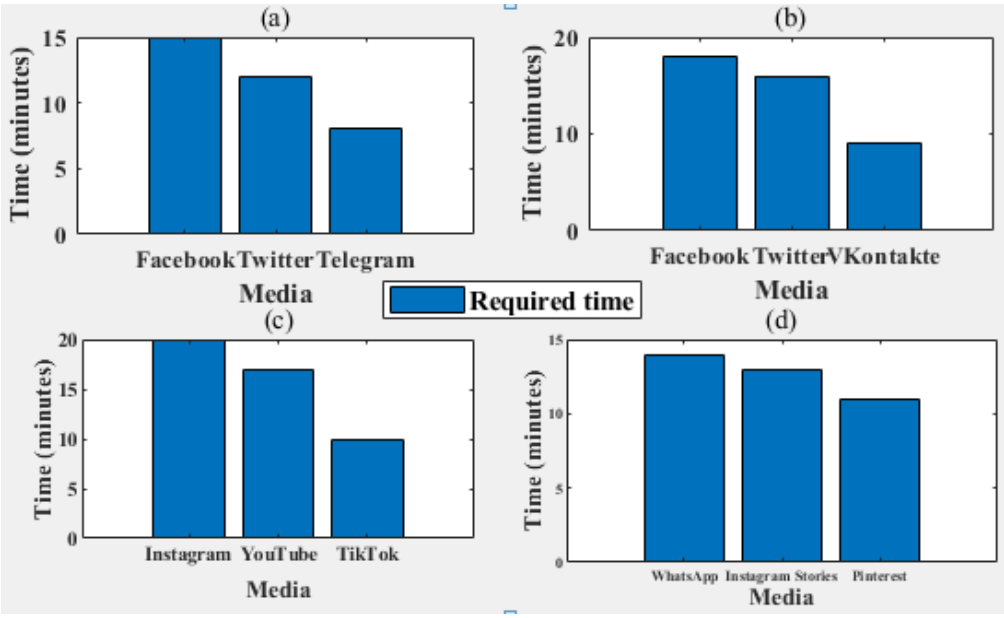

Figure 1. Speed test results

The fact that reports spread the fastest on Telegram, reaching 1000 followers in just 8 minutes, demonstrates Telegram's advantage in instant messaging. The dissemination speed of misleading information on VKontakte is also relatively fast, indicating that the platform may have relatively weak ability to identify misleading information.

The dissemination speed of promotional information on TikTok exceeds that of Instagram and YouTube, reflecting the high acceptance and activity of TikTok's young user group towards new things. The dissemination speed of appeal information on Pinterest is relatively fast, which may be

related to its platform characteristics, that is, users pay more attention to visual content and are more likely to resonate with the visual presentation of appeal information.

In summary, the dissemination speed of different types of information on different social media platforms varies. This suggests that when conducting information dissemination, it is necessary to choose the appropriate platform based on the type of information to maximize the effectiveness of information dissemination.

(2) Emotional analysis

The average scores of social media platforms with different types of information and emotional intensity are shown in Table 1.

Table 1. Social media platforms with different types of information and average scores of emotional intensity

Information type	Social media platforms	Average score of emotional intensity (1-5 points)
Factual reporting	Twitter	3.8
Factual reporting	Facebook	3.6
Misleading information	Telegram	1.8
Misleading information	VKontakte	2.2
Promotional information	Instagram	3
Promotional information	YouTube	2.9
Appeal Information	WhatsApp	3.5
Appeal Information	TikTok	4

Firstly, the average emotional intensity scores of factual reports on Twitter and Facebook are relatively high, with scores of 3.8 and 3.6, respectively. This indicates that users have a more positive response to factual reports, possibly because the content of factual reports on these platforms is more accurate and objective, which can resonate with users.

Secondly, on Telegram and VKontakte websites, the emotional intensity of misleading information is 1.8 and 2.2, respectively, indicating that users have a negative attitude towards emotional intensity; these negative emotions may be caused by these, which can easily cause users' suspicion, dissatisfaction or anger.

This promotional message is 3.0 and 2.9 on Instagram and Youtube, respectively. This may indicate that the acceptance of promotional messages on these platforms is average, neither completely positive nor completely negative.

Finally, the average emotional intensity score of appeal messages on WhatsApp and TikTok is relatively high, especially reaching 4.0 on TikTok. This may be because appeal messages can stimulate emotional resonance among users, encouraging them to participate and share more actively.

The proportion of positive/neutral/negative emotions on different social media platforms is shown in Figure 2.

Twitter and TikTok have the highest proportion of positive emotions, at 60% and 65%, respectively, which may indicate that content on these two platforms is more likely to elicit positive reactions and resonance from users. Telegram and VKontakte have the highest proportion of negative emotions, reaching 70% and 55% respectively, which may be because the content or discussions on these two platforms involve more controversies or negative topics.

Facebook, Instagram, and WhatsApp are relatively balanced, with little difference in the proportion of positive, neutral, and negative emotions. This may mean that the content on these

platforms is more diverse, attracting users with different emotional tendencies.

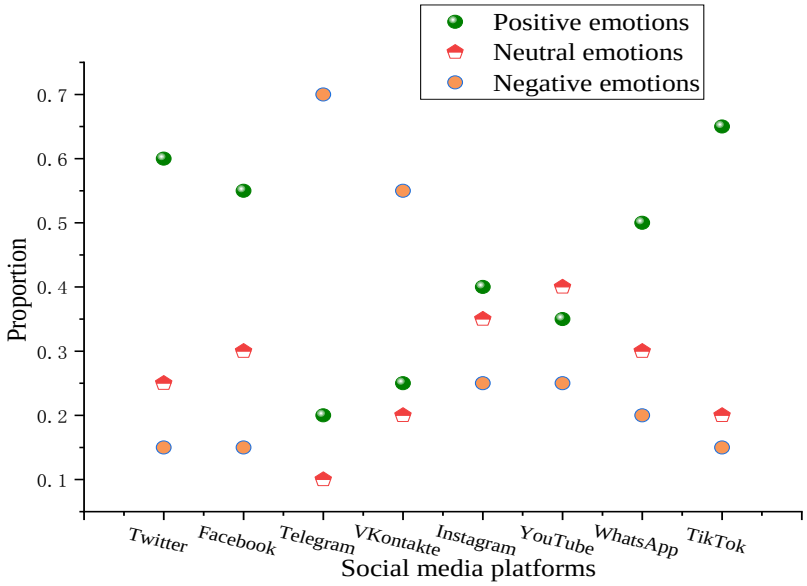

Figure 2. The proportion of positive/neutral/negative emotions on different social media platforms

The proportion of positive, neutral, and negative emotions on YouTube is roughly equal, but the proportion of neutral emotions is the highest, reaching 40%. This may indicate that the content on YouTube is relatively neutral, or that users have a more diverse emotional response to video content.

Overall, the emotional distribution on social media platforms reflects the characteristics of platform content and differences in user groups. Understanding these differences can help platform operators better manage content and enhance user experience.

(3) Accuracy evaluation

The accuracy evaluation data of information is shown in Table 2.

In general, there is a significant positive correlation between the accuracy of information and people's trust. If the user can correctly understand this information and re-transmit it to the user, then the accuracy score and trust of the user can be higher. For example, in the first message, if the user correctly interprets "the Ukrainian army won a major victory" and converts it into "the Ukrainian army won a great victory", then the accuracy and credibility of the message have reached more than 4 points, indicating that the user has a high degree of trust in the message.

However, if users misunderstand or distort the original information, it reduces the credibility and accuracy of users. Taking the message number 3 as an example, the original message is "The United Nations calls for a ceasefire between the two sides", but it is misinterpreted by users as "The United Nations did nothing", resulting in a significant decrease in accuracy and credibility.

Therefore, in order to improve people's trust in information, it is necessary to ensure the correctness of information and reduce misreading and misinterpretation of information. To achieve this goal, information censorship and control must be strengthened to improve citizens' information cultural literacy, and strengthen self-discipline and accountability of media and social platforms.

(4) participation analysis

The information types, social media platforms and average comment length under different information numbers are shown in Table 3.

Table 2. Information accuracy evaluation data

Information number	Original information content	User understanding after receiving	User re dissemination of content	Accuracy score (1-5)	Trust score (1-5)
1	The Ukrainian army achieved a significant victory	Victory of Ukrainian army	The Ukrainian army achieved a great victory	4	4.5
		The Ukrainian military has made progress in the conflict	Progress made by the Ukrainian military	3	4
		The Ukrainian army has been defeated	The Ukrainian military suffered significant losses	1	2
2	Russian aid supplies arrive in Ukraine	Russia provides assistance	Russian aid supplies arrive	4	4.2
		Ukraine receives international aid	Ukraine receives assistance	3	3.8
		Russia's invasion of Ukraine	Russian military in Ukraine	2	2.5
3	The United Nations calls for a ceasefire on both sides	The United Nations calls for peace	The United Nations demands that both sides cease the conflict	5	4.8
		United Nations inaction	The United Nations failed to prevent conflicts	2	2.2
4	Ukrainian civilians fleeing the war zone	Ukrainian refugees fleeing	Ukrainian refugees seeking asylum	4	4.3
		Ukrainian military retreat	Ukrainian army leaving the theater of war	3	3.5
		Ukrainian civilians persecuted by Russian military	Russian military persecutes Ukrainian civilians	1	1.8

Table 3. Information types, social media platforms and average comment length under different information numbers.

Information number	Information type	Social media platforms	Average comment length (in characters)
1	Factual reporting	Twitter	100
1		Facebook	120
2	Misleading information	Telegram	80
2		VKontakte	90
3	Promotional information	Instagram	70
3		YouTube	150
4	Appeal Information	WhatsApp	110
4		TikTok	60

First of all, it is found that on Twitter, the fact report has 100 characters, and Facebook has 120 characters. This shows that users' evaluation of real stories is relatively high, probably because these contents can arouse users' deep thinking and discussion. Twitter is a widely used social media platform, and its short comments affect the depth of its comments. Facebook allows longer messages, so everyone's messages are longer.

Then, it is found that on the Telegram website, the average reply length of misleading information is 80 characters, and VKontakte is 90 words. Compared with the fact report, the length of these opinions is shorter. This may indicate that users respond more directly to misleading information, or it may be because the information itself is not deep enough, leaving users with nothing to talk about. In addition, because Telegram pays attention to privacy and security, it also limits users' evaluation.

The promotional message is 70 characters on Instagram and 150 characters on YouTube. Messages on Instagram have become shorter, probably because the platform pays more attention to visual content and reduces text comments. Youtube is a video sharing platform, which allows users to write more comments under videos, so its average reply time also increases. Among these lengthy messages, there may be some detailed feedback, discussion and even debate about this video.

Finally, WhatsApp messages have an average of 110 characters, and TikTok has 60 characters. WhatsApp is an instant messaging tool, and its users may prefer to use longer messages to express their approval or disapproval. TikTok is a short video platform, and its user evaluation is often shorter and more intuitive, because people are watching videos more.

Generally speaking, on different social media platforms, the average length of comments can reflect the difference in user participation and interaction quality. The longer the comment, the deeper the user thinks about this message. At the same time, short comments show a more direct or simple response. This data has important reference significance for social media platforms and content creators, and can help them better evaluate the quality of content and user fit.

The results of statistical likes, shares and comments are shown in Figure 3.

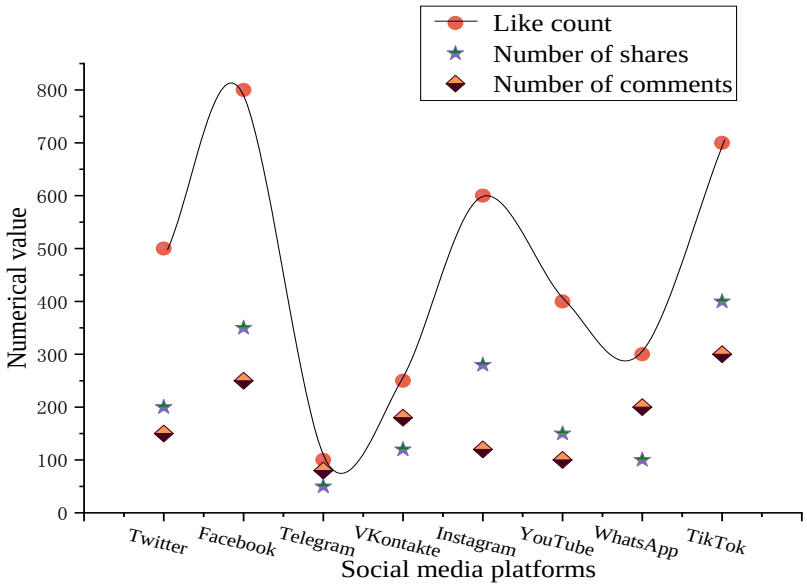

Figure 3. Statistical results of likes, shares, and comments

Firstly, from the perspective of information types:

Fact reporting: On Twitter and Facebook, fact reporting receives a considerable amount of interaction. The likes, shares, and comments on Twitter are 500, 200, and 150 respectively, while on Facebook, these numbers are higher at 800, 350, and 250, respectively. This indicates that factual reports have a high popularity on social media, possibly because they provide valuable information and perspectives.

Misleading information: Misleading information on Telegram and VKontakte receives relatively little interaction. The number of likes, shares, and comments on Telegram is 100, 50, and 80, respectively, while the number on VKontakte is slightly higher at 250, 120, and 180. This may be due to the low credibility of misleading information on social media, resulting in low user engagement.

Promotional messages: The promotional messages on Instagram and YouTube receive moderate level of interaction. The number of likes, shares, and comments on Instagram is 600, 280, and 120 respectively, while the number on YouTube is slightly lower. This may be due to differences in the content and quality of promotional information, resulting in varying levels of acceptance by users.

Appeal information: WhatsApp has 300 likes, 100 shares and 200 comments, while TikTok has 700, 400 and 300 respectively. This may be because the call-up message can resonate with users' emotions, thus encouraging them to participate in the interaction more actively.

Secondly, taking the social media platform as an example, this paper analyzes the attraction of different platforms to all kinds of information. For example, Facebook prefers real reports, while TikTok prefers appealing news. This difference is mainly caused by the user groups, user habits and algorithm recommendation of each platform.

5. Conclusions

This paper took the role and challenges played by new media in the conflict in Ukraine as the starting point, and comprehensively applied methods such as new media content, social network interaction, scenario simulation, and intelligent decision-making assistance to systematically study the role and challenges faced by new media in the conflict in Ukraine. This paper evaluated the role of new media in contemporary warfare from both quality and quantity perspectives, and explored its

effectiveness and limitations in adversarial warfare. Research has shown that new media greatly accelerates the spread of information, expands its coverage, but also increases the risk of false and misleading dissemination. Experiments have shown that new media platforms have the characteristics of fast speed, wide coverage, and high participation. In addition, the research and application of this topic have important practical significance for improving the effectiveness and effectiveness of information warfare strategic planning.

The research in this paper has great potential for development and certain limitations. Firstly, due to the limitations of data acquisition and collection, it is not possible to fully record social media behavior and user interaction behavior. Secondly, the accuracy of sentiment analysis and social network analysis is limited by the tools and algorithms used, which may affect the interpretation of the results. Finally, although simulation experiments can provide valuable insights in controlled environments, their extrapolation from actual scenarios may be limited. Future research can overcome these limitations by expanding data sources and improving data analysis tools. With the development of artificial intelligence technology, future research can develop more accurate models to simulate information flow and user behavior, in order to better understand the role of new media in complex conflict environments. In addition, it is necessary to explore the legal, ethical, and psychological impacts of new media strategies, especially in combating false information and enhancing transparency of information sources, in order to enhance the public's discernment of new media information and more effectively utilize these platforms to serve the goals of peace and security.

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