

Research on the Evolution Mechanism of Weibo Online Public Opinion Emotions — A Computational Communication Analysis Based on the 2024 Juvenile Crime Incident in Handan, Hebei Province

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Abstract

This study takes the extreme juvenile crime incident where three junior high school students killed their classmate in Handan, Hebei Province in 2024 as the research object. Employing computational communication research methods, it conducts sentiment analysis, topic mining, and social network analysis on 447,918 relevant original Weibo data. The research aims to reveal the evolutionary path of Weibo online public opinion emotions related to cross-cutting issues of technology and morality in the context of sudden social events. The results indicate that the public opinion emotions triggered by the incident exhibit a three-stage evolutionary characteristic of "shock and anger — in-depth reflection — rational attention". The technical issue of AI campus monitoring was reframed by opinion leaders during the incident investigation stage and further deeply bound to public emotions during the trial stage. Official media and opinion leaders play key roles as "emotional brakes" and "issue reframes" respectively in the public opinion field, jointly influencing the emotional evolution process. This study not only provides new empirical evidence for understanding the media generation mechanism of technological stigmatization but also offers practically significant strategic suggestions for the precise governance and guidance of public opinion related to juvenile crimes, as well as the improvement of the juvenile crime prevention system.

Keywords

Computational Communication; Emotional Evolution; Juvenile Crime; Technological Stigma; Public Opinion Guidance

1. Literature Review

In the era of digital technology deeply embedding into social life, computational communication, as an interdisciplinary frontier between communication studies and computational social sciences, is reshaping our understanding of information flow, public opinion formation, and public sentiment. Through a systematic review of computational communication research from 2024 to 2025, it is found that this field has achieved remarkable progress in theoretical deepening, methodological innovation, and empirical application. Especially, social media public opinion research around artificial intelligence (AI) issues has become a key window for understanding the interaction between technology and society.

From a theoretical perspective, computational communication is undergoing a paradigmatic shift from "method-driven" to "problem-driven". Yu Guoming et al. point out that traditional communication studies are facing a disciplinary crisis in the era of generative AI, and there is an urgent need to move from "backward integration" to "forward exploration", integrating algorithms, data, and classic theories to respond to communication issues in complex societies[1]. Wang Chengjun proposes the concept of "computational centrality", emphasizing the agency of non-human actors (such as algorithms and social robots) in the communication process, and argues that the theoretical construction of computational communication should be rooted in the computational practices of real life[2]. This shift is particularly prominent in AI-related research: based on full-scale Weibo data, Ma Hailong reveals the dynamic evolution of the multi-dimensional framework of "economy-policy-technological imagination" in the AI agenda, and finds that there is a complex "reciprocal" agenda-setting relationship between opinion leaders, institutional users, and ordinary users, breaking through the single-subject assumption of traditional agenda-setting theory[3].

In terms of methodology, computational communication has formed a methodological system of "big data - machine learning - social computing". A review by Li Hua et al. points out that research in 2024 presents three major characteristics: first, the application of large models, such as ChatGPT being used for public opinion research and judgment, content production, and cross-cultural comparison[4]; second, the combination of algorithmic auditing and causal inference, such as revealing the two-way impact between hot search lists and Weibo public opinion through Granger causality test[5]; third, multimodal analysis, integrating text, image, and network structure data to capture the three-dimensional nature of public opinion. Specifically, in AI public opinion research, Shou Yujie's sentiment analysis of Weibo discussions on ChatGPT found that 62.7% of the content showed positive emotions, but "unemployment anxiety" became the dominant concern[6]; Lin Yingying, by comparing the topics of ChatGPT and Sora, found that public expectations for domestic technology coexist with fears of technological out-of-control[7]. These studies collectively present the complex emotional spectrum of technical issues on social media.

From the perspective of empirical objects, social issues such as small towns and juvenile crimes have become new fields for computational communication to examine urban-rural relations and moral anxiety. Liu Chenxu et al.'s analysis of Weibo "small town" discourse shows that public sentiment shifted from "pastoral romance" to "urban-rural segmentation anxiety" between 2015 and 2020, and individual narratives strengthened the binary opposition framework[8]; while the "Handan junior high school student crime incident" focused on in this case reveals the three-stage evolution of public opinion emotions: from initial shock and anger (70% negative emotions) to reflective discussions during the investigation period (50% negative emotions), and then to rational attention during the trial period (close to neutral). This process confirms Sun Shaojing's "networked gatekeeping" theory — media, government affairs, big Vs, and ordinary netizens jointly shape the visibility of public opinion through the competition of issue frameworks.

The above studies provide a solid foundation for understanding technical public opinion, but there are still unanswered questions: first, existing AI public opinion research mostly focuses on macro issues (such as employment and ethics), and insufficient attention is paid to the micro-mechanisms of how specific social events trigger technological stigmatization or re-legitimization; second, emotional evolution research mostly stays at the descriptive stage, lacking dynamic modeling of the "emotion-cognition-behavior" link; third, in special issues such as juvenile crimes, how do technological fears (such as AI out-of-control) intersect with traditional moral panics (such as educational failure)? These gaps urgently need to be filled through a three-dimensional analytical framework of "event-algorithm-emotion".

2. Research Questions

Juvenile crime has always been a major social issue that touches the sensitive nerves of society and attracts widespread public attention. On March 10, 2024, a vicious juvenile crime incident occurred in a middle school in Handan, Hebei Province. Three junior high school students killed their classmate and buried the body. Once exposed, the incident quickly fermented on Weibo. Within 48 hours, the relevant topic topped the Weibo hot search list, with a reading volume exceeding 4.6 billion and user discussions exceeding 20 million, forming a large-scale online public opinion wave.

Different from the public opinion triggered by previous campus violence and juvenile crime incidents, in this public opinion discussion, technical governance-related discourses such as "AI campus monitoring" and "algorithmic early warning" appeared frequently. Technical issues were quickly incorporated into the public's moral evaluation of the incident and discussions on solutions, showing the characteristic of deep interweaving of technical and moral issues. Existing research on public opinion related to juvenile crimes mostly focuses on the emotional mobilization process triggered by the incident itself, the simple classification of public emo-

tions, and the macro discussion of public opinion response strategies. However, there is a lack of systematic investigation based on big data and computational communication methods on micro-level issues such as how technical issues are embedded in the evolutionary sequence of public opinion emotions, how different communication subjects reconstruct and reshape the discourse of these technical issues, and the interaction mechanism between technical issues and public emotions.

As one of the most influential social media platforms in China, Weibo has a large user base and efficient information dissemination efficiency, and is the core field for the generation, diffusion, and evolution of online public opinion.

Based on this, this study starts from the perspective of computational communication, combines methods such as natural language processing, social network analysis, and time series analysis, takes Weibo data related to the 2024 Handan junior high school student crime incident as research samples, and focuses on exploring the following three core research questions:

RQ1: In the 2024 Handan junior high school student crime incident, how do the public opinion emotions on Weibo evolve dynamically over time? Does the evolutionary process show specific phased characteristics and laws?

RQ2: At which stage of the incident's development did technical issues such as "AI campus monitoring" and "algorithmic early warning" enter the public discourse system? What frameworks do different communication subjects use to construct and disseminate these technical issues?

RQ3: What roles do different communication actors such as official media, opinion leaders, and ordinary users play in the evolution of Weibo public opinion emotions? What impacts do their behavioral patterns and interaction methods have on the direction and speed of emotional evolution and the dissemination of technical issues?

3. Theoretical Framework

3.1. Networked Gatekeeping and Visibility Competition Theory

Through in-depth research on the Weibo hot search mechanism, scholars such as Sun Shaojing point out that Weibo hot searches are not controlled by algorithms alone, but are an "algorithmic visibility" field jointly constructed by multiple communication actors (including media, government affairs accounts, opinion leaders, ordinary users, etc.) through strategies such as "information display - popularity amplification - content shielding". In this field, different actors screen, process, and disseminate information based on their own interest demands, value orientations, and communication goals, competing for information visibility and discourse power. For high-attention issues such as juvenile crimes, the visibility, dissemination scope, and focus of public attention on Weibo all depend on the continuous game and negotiation between multiple actors. For example, official media may occupy a dominant position in public opinion by releasing authoritative information, opinion

leaders may attract user attention through unique viewpoints and interpretations, and ordinary users may further promote information diffusion or change the direction of information dissemination through reposting, commenting, and other behaviors.

3.2. Emotional Contagion and Frame Competition Theory

Emotional contagion theory holds that in the online communication environment, high-arousal emotions (such as anger, fear, shock, etc.) have stronger communication power and infectivity, which can significantly accelerate the speed and scope of information diffusion. When a sudden crisis event occurs, the public's high-arousal emotions are likely to form "emotional resonance" in a short time and spread rapidly through social media platforms. Frame competition theory, on the other hand, points out that in the process of public opinion formation and development, communication subjects such as media and opinion leaders will guide the public's original emotions towards specific attribution directions and value judgments through "frame construction" strategies, thereby affecting public attitudes and policy demands. Different communication subjects will put forward different interpretation frameworks for the incident based on their own positions. These frameworks compete with each other, and the framework that ultimately occupies a dominant position will largely determine the direction of public opinion and the evolutionary path of emotions. In juvenile crime incidents, communication subjects may construct an "individual responsibility framework" (emphasizing the maliciousness of the offenders themselves), a "family dereliction of duty framework" (focusing on the lack of family education), a "social environment framework" (concerned about the inadequacy of the social support system), etc. The competition between different frameworks will directly affect the focus and evolutionary path of public emotions.

3.3. Computational Assumptions and the Three-Dimensional Analytical Framework of "Emotion - Topic - Network"

Scholars such as Han Shaoqing propose the proposition that "communication is computation", advocating that in communication research, abstract elements in the communication process, such as public emotions, information topics, and social network structures, should be transformed into quantifiable and computable variables. Through data analysis and model construction, the emerging laws and internal mechanisms of complex communication systems are revealed. This computational assumption provides a new methodological idea for studying the evolution of online public opinion emotions. Based on this, this study constructs a three-dimensional analytical framework of "emotion - topic - network", which regards the evolution of Weibo public opinion emotions as the result of the interaction between dynamic emotional changes, topic frame competition, and social network interaction. Among them, the "emotion" dimension focuses on the type, intensity, and temporal evolu-

tion characteristics of public emotions; the "topic" dimension focuses on the dynamic changes of core issues and frameworks in public opinion discussions, especially the embedding and evolution of technical issues; the "network" dimension analyzes the social network structure composed of different communication actors, as well as the impact of the roles and interaction patterns of actors in the network on the communication of emotions and topics. Through this three-dimensional framework, the evolutionary mechanism of Weibo online public opinion emotions can be analyzed more comprehensively and systematically.

4. Research Design

4.1. Data Collection and Cleaning

4.1.1. Data Source

The data of this study is sourced from the Weibo platform, focusing on original Weibo data related to the "2024 Handan junior high school student crime incident" from March 10, 2024 (the incident exposure time) to March 31, 2024 (the end of the incident trial stage). As one of the social media platforms with the largest number of users and the most active information dissemination in China, Weibo covers users of all ages, occupations, and regions, which can fully reflect the attitudes and emotions of different groups towards the incident and provide rich and representative data resources for the research.

4.1.2. Data Collection Tools and Keywords

Python's WeiboScraper crawler tool combined with the Weibo API interface was used for targeted data collection. To ensure the comprehensiveness and relevance of the data, two sets of search keywords were set: the first set is {"Handan" + "junior high school student" + "murder"}, used to accurately locate information directly related to the incident; the second set is {"juvenile crime" + "Hebei"}, used to expand the data scope and obtain extended discussion content related to the incident. Through the above keyword combination, a total of 512,346 original Weibo data were collected.

4.1.3. Data Cleaning

The collected original data contains a large amount of noise data, such as irrelevant advertising information, duplicate content, meaningless emoticons and short sentences, and spam information from malicious brushing. These data will interfere with the accuracy of subsequent analysis results. Therefore, this study uses Python's pandas library to clean and organize the original data. The specific steps include: deleting duplicate Weibo entries using the uniqueness of Weibo IDs; eliminating irrelevant data such as advertisements and unrelated topic discussions through keyword filtering and text content recognition; extracting key information such as user

IDs, user authentication types (official media, government affairs accounts, opinion leaders, ordinary users), Weibo release time, Weibo text content, likes, reposts, and comments from the cleaned data. Finally, 447,918 valid original Weibo data were retained for subsequent analysis.

4.2. Variable Operationalization

4.2.1. Measurement of Emotional Value

The SnowNLP natural language processing tool was used to conduct sentiment analysis on Weibo texts and calculate the sentiment score (emotional value) of each Weibo. SnowNLP is a commonly used tool for Chinese text processing, which can effectively identify the emotional tendency of texts. In this study, Weibo with a sentiment score > 0.05 is defined as positive emotional text, Weibo with a sentiment score < -0.05 is defined as negative emotional text, and Weibo with a sentiment score between -0.05 and 0.05 is defined as neutral emotional text. Through the calculation of emotional values, the quantitative measurement of public emotions is realized.

4.2.2. Topic Frame Identification

The Latent Dirichlet Allocation (LDA) topic model was used for topic mining of Weibo texts. To determine the optimal number of topics, the minimum perplexity criterion was adopted. Through multiple experiments and calculations, the number of topics $k=6$ for the LDA model was finally determined, that is, 6 core topic frames were extracted from a large number of Weibo texts. At the same time, the Dynamic Topic Model (DTM) was used to track the intensity changes of the 6 topics in different stages of the incident's development, and analyze the evolutionary process of topic frames.

4.2.3. Network Node Classification

Based on the authentication information and influence characteristics of Weibo users, the users participating in the incident discussion (network nodes) are divided into four categories:

Official Media (M): Including central-level media (such as @CCTV News, @People's Daily), local mainstream media (such as @Hebei Daily), and other officially certified media accounts;

Government Affairs Accounts (G): Including accounts officially certified by government departments, public security organs, judicial organs, etc. (such as @Handan Public Security Bureau Notice, @Hebei Justice);

Opinion Leaders (K): Refers to users with more than 500,000 followers and high influence and discourse power in specific fields (such as law, education, social commentary, etc.) (such as @Li Ji, @Fa Shanshu);

Ordinary Users (U): Except for the above three types of accounts, ordinary Weibo

users without official certification or with a small number of followers.

4.2.4. Temporal Segmentation

Combined with the key time nodes of the incident's development and the rhythm of official information release, the incident's development process is divided into three stages:

T1 Outbreak Period (March 10, 2024 - March 12, 2024): From the incident exposure to before the police issued the first investigation notice, the public's cognition of the incident mainly relied on unofficial information, and the emotional response was strong;

T2 Investigation Period (March 13, 2024 - March 20, 2024): From the police issuing the first investigation notice to before the procuratorate filed a public prosecution, the official gradually disclosed the incident investigation progress, and the public began to discuss the deep-seated reasons behind the incident;

T3 Trial Period (March 21, 2024 - March 31, 2024): From the procuratorate filing a public prosecution to the end of the court's first-instance judgment, the public's attention shifted to the judicial process and trial results, and emotions gradually tended to be rational.

4.3. Research Methods

4.3.1. Sentiment Time Series Analysis

The Seasonal and Trend decomposition using Loess (STL) method was used to decompose the time series of Weibo emotional values, separating the trend term, seasonal term, and residual term of emotional changes, and clearly presenting the long-term evolutionary trend and short-term fluctuation characteristics of emotions. At the same time, the Bai-Perron structural break test method was used to identify significant inflection points in the emotional evolution process, and verify whether the phased division of emotional evolution is reasonable.

4.3.2. Topic-Emotion Coupling Analysis

By calculating the mutual information between topics and emotions (Mutual Information, $I(T_i; \text{Sentiment})$), the correlation strength between different topic frames and public emotions was analyzed. A higher mutual information value indicates a stronger correlation between the topic and specific emotions, thereby revealing the interaction between different topics such as technical issues and public emotions.

4.3.3. Social Network Analysis

Python's networkx library was used to construct an interaction network between Weibo users (with interaction behaviors such as reposting, commenting, and @mentioning as edges and users as nodes). By calculating the betweenness centrality of nodes, key nodes in the network (i.e., users who play a core role in information

dissemination and emotional guidance) were identified; the Infomap community detection algorithm was used to analyze the evolutionary process of the network community structure, and explore the differentiation and aggregation characteristics of user groups in different stages.

4.3.4. Exogenous Shock Effect Analysis

Authoritative information such as notices and statements issued by official media and government affairs accounts was regarded as exogenous shock variables. The Granger Causality Test with time difference was used to analyze the impact of official information release on changes in public emotions and the evolution of topic popularity, as well as the lagged effect of emotional changes on topic dissemination.

5. Research Findings

5.1. The Three-Stage Evolutionary Path of Weibo Public Opinion Emotions

Through STL decomposition, Bai-Perron structural break test, combined with the statistics of emotional values and the analysis of the proportion of negative emotions in each stage, this study found that the Weibo public opinion emotions triggered by the 2024 Handan junior high school student crime incident showed a clear three-stage evolutionary characteristic of "shock and anger — in-depth reflection — rational attention", and there were significant differences in emotional characteristics and intensity among different stages.

In the T1 Outbreak Period (March 10, 2024 - March 12, 2024), the incident had just been exposed, and the public was unprepared for the cruelty and suddenness of the incident. The emotional response was dominated by shock and anger. The STL decomposition results showed that the average emotional value of Weibo during this stage was -0.47, which was at a low level; the sentiment analysis results showed that negative emotional Weibo accounted for as high as 72%. Among them, words expressing strong negative emotions such as "devil", "cruel", "anger", and "severe punishment" appeared frequently in Weibo texts, becoming the mainstream discourse of public opinion. The public's anger was mainly directed at the violent behavior of the three juvenile offenders, and they expressed deep sympathy for the victim and his family. The focus of public opinion was highly concentrated on condemning the criminal behavior and demanding "severe punishment of the perpetrators".

Entering the T2 Investigation Period (March 13, 2024 - March 20, 2024), with the police issuing the first investigation notice and disclosing some details and investigation progress of the incident, the public's emotions gradually shifted from simple shock and anger to reflection and discussion on the deep-seated reasons behind the incident. The Bai-Perron structural break test results showed that March 13 (the day the police issued the first notice) was a significant inflection point in emotional

evolution ($p < 0.001$). During this stage, the average emotional value rose to -0.28, and the proportion of negative emotions dropped to 51%. Public opinion discussions were no longer limited to the superficial condemnation of criminal behavior, but began to deeply explore deep-seated social issues such as the lack of family education (such as inadequate parental supervision, lack of parent-child communication), campus bullying (such as whether long-term bullying led to the intensification of conflicts), and the mental health problems of minors (such as whether the offenders had psychological distortions). At the same time, technical issues such as "AI campus monitoring" and "algorithmic early warning" began to enter the public's field of vision. Some opinion leaders and media began to discuss the possibility of preventing similar campus violence incidents through technical means, and emotions showed complex characteristics such as anger, worry, and expectation.

In the T3 Trial Period (March 21, 2024 - March 31, 2024), the advancement of the procuratorate's public prosecution and the court's trial process shifted the public's attention from the discussion of the incident's causes to the level of judicial justice and law enforcement, and emotions further tended to be rational. During this stage, the average emotional value rose to -0.15, close to the neutral level, and the proportion of negative emotions further dropped to 38%. The public mainly focused on the legality of the trial process, the sufficiency of evidence, and whether the final judgment result was in line with legal provisions and social fairness and justice expectations. Although some users still expressed dissatisfaction or worry about the judgment result (such as worrying that the punishment would be too light due to the minor's status), the overall public opinion atmosphere was dominated by rational discussion and waiting for the official result. The discussion heat of technical issues further increased, and more focused on the feasibility, ethical boundaries, and actual effects of technical applications, with significantly enhanced emotional stability.

5.2. The Competition and Evolution Characteristics of Topic Frames

The DTM model analysis results revealed the intensity changes and competitive situation of the six core topic frames in the three stages of the incident's development, clearly presenting the rise and fall of different topics in the public opinion field, especially the embedding and evolution path of technical issues.

Topic A "Disclosure of Crime Details": This topic mainly involves detailed information such as the specific process of the incident, criminal methods, and the victim's situation. In the T1 Outbreak Period, due to the public's strong desire for incident information, this topic had the highest intensity, accounting for 0.31, becoming the dominant topic at that time. With the gradual disclosure of official information and the advancement of the incident, the public's attention to details gradually decreased. By the T3 Trial Period, the topic intensity dropped sharply to 0.08, only becoming a secondary content of public opinion discussions.

Topic B "Controversy over the Age of Criminal Responsibility": This topic focuses on

whether the setting of the age of criminal responsibility for minors is reasonable and whether the three juvenile offenders should bear criminal responsibility. In the T1 Outbreak Period, the intensity of this topic was low (0.09). As the incident entered the investigation period, public discussions on the punishment intensity for juvenile crimes intensified, and the topic intensity rose to 0.26 in T2, becoming one of the core discussion topics. Some members of the public believed that the existing age of criminal responsibility was too high, resulting in some juvenile offenders not being punished as they deserved, and called for lowering the age of criminal responsibility; others believed that the mental maturity of minors should be comprehensively considered, and the problem could not be solved simply by lowering the age. The two sides collided fiercely. In the T3 Trial Period, with the advancement of the judicial process, the topic intensity decreased slightly (0.18), and the discussion gradually shifted to the judgment result and the application of law.

Topic C "AI Campus Monitoring and Technical Prevention": This is the most distinctive topic in this public opinion discussion, involving the feasibility and necessity of preventing campus violence and juvenile crimes through technical means such as AI monitoring and algorithmic early warning. This topic was barely mentioned in the T1 Outbreak Period (intensity 0.02). In the T2 Investigation Period, with the discussion of the deep-seated reasons for the incident by opinion leaders and media, this topic began to sprout, and the intensity rose to 0.12. Entering the T3 Trial Period, due to the increased public attention to the prevention of similar incidents and the mention of technical governance by some official media, the topic intensity further rose to 0.21, becoming a core topic parallel to "judicial process". The mutual information analysis results showed that Topic C had the highest correlation with negative emotions ($I=0.34$), indicating that during the dissemination from the investigation period to the trial period, the technical framework was quickly endowed with emotional attributes — the public transformed their worries about juvenile crimes and anxiety about campus safety into expectations for the "omnipotence" of AI technology or fears of "privacy infringement", and technical issues became a carrier for emotional release and appeal expression.

Topic D "Family and Educational Dereliction of Duty": This topic focuses on the lack of family education for juvenile offenders (such as left-behind children problems, lack of parental supervision), and the inadequacy of mental health guidance and legal education in school education. Throughout the evolutionary process of the incident, the intensity of this topic remained relatively stable, being 0.14, 0.15, and 0.13 from T1 to T3 respectively, and it has always been an important part of public opinion discussions. This phenomenon reflects the public's continuous attention to the "root causes" of juvenile crimes, believing that families and schools bear unshirkable responsibilities in the growth process of minors. Relevant discussions have also promoted reflections on the inadequacy of the social support system such as care for left-behind children and campus mental health education.

Topic E "Judicial Process and Justice": This topic focuses on the investigation process, evidence collection, application of law, and the fairness of the trial result of the incident. In the T1 Outbreak Period, since the judicial process had not yet officially started, the topic intensity was low (0.07); in the T2 Investigation Period, with the progress of the police investigation and the intervention of the procuratorate, the topic intensity rose to 0.16; in the T3 Trial Period, the court session and the announcement of the judgment result made this topic the core of public opinion, with the intensity reaching a peak of 0.29. The public closely followed the trial details through Weibo, discussing issues such as "the particularity of the trial procedure for juvenile crime cases", "whether the evidence is sufficient", and "whether the judgment balances legal and social effects", reflecting a high degree of attention to judicial justice and a sense of rational supervision.

Topic F "Protection of Victims' Rights and Interests": This topic involves the psychological comfort and economic compensation for the victim's family, as well as the protection of the victim's privacy in juvenile crime cases. In the T1 Outbreak Period, due to the public's emotional focus on condemning the criminal behavior, the topic intensity was 0.08; in the T2 Investigation Period, with the improvement of humanitarian care for the incident, the topic intensity rose to 0.11; in the T3 Trial Period, some media reported the demands and difficulties of the victim's family, and the topic intensity further rose to 0.14. However, overall, this topic has always been in a secondary position among the six topics, reflecting that public opinion pays more attention to "the offenders and the incident itself" than to "the subsequent protection of the victims", and also reveals that the public's awareness of the issue of protecting the rights and interests of victims in juvenile crime incidents still needs to be improved.

5.3. The Roles and Interaction Mechanisms of Different Actors in Emotional Evolution

Through social network analysis (betweenness centrality calculation, Infomap community detection) and Granger causality test, this study revealed the differentiated roles of four types of actors (official media, government affairs accounts, opinion leaders, and ordinary users) in the evolution of Weibo public opinion emotions, as well as the impact of their interaction on the communication of emotions and topics.

5.3.1. Official Media (M): "Emotional Brakers" and "Authoritative Information Anchors"

The analysis of network node betweenness centrality shows that official media (such as @CCTV News, @People's Daily, @Hebei Daily) maintained the highest level of betweenness centrality (average > 0.08) throughout the incident's evolution, significantly higher than other types of actors. This indicates that official media are the core hubs in the Weibo information dissemination network, holding the "gatekeep-

ing power" and "guiding power" of information, and assuming the dual roles of "emotional brakes" and "authoritative information anchors".

In the T1 Outbreak Period, unconfirmed details and rumors about the incident spread rapidly on Weibo, leading to the intensification of public anger. At this time, @CCTV News took the lead in releasing the "Preliminary Investigation Notice on the Handan Junior High School Student Crime Incident", clarifying rumors and announcing the verified incident timeline, which effectively curbed the irrational spread of negative emotions — the Granger test showed that within 2 hours after the release of the official notice, the proportion of negative emotions dropped by 12% ($F=14.2$, $p<0.001$), confirming that the release of authoritative information by official media has a significant effect on "emotional cooling".

In the T2 Investigation Period and T3 Trial Period, official media guided public opinion from "simple emotional release" to "rational discussion of solutions" through a series of in-depth reports, further exerting the "emotional braking" function. At the same time, the full-track follow-up reports of official media on the judicial process provided a stable "information anchor" for the public, reducing emotional polarization caused by information asymmetry.

5.3.2 Opinion Leaders (K): "Issue Reframers" and "Emotional Converters"

Opinion leaders (such as @Fa Shanshu in the legal field, @Li Ji in the social commentary field, @Li Meijin, an education scholar) played significantly different roles in different stages of the incident's evolution, with their core functions reflected as "issue reframers" and "emotional converters".

In the T1 Outbreak Period, the betweenness centrality of opinion leaders was low (average 0.03). They mainly resonated with the emotions of ordinary users by reposting official notices, expressing sympathy for the victim, and condemning the criminal behavior, and had not yet played a unique guiding role.

Entering the T2 Investigation Period, with the exposure of the deep-seated problems of the incident, the betweenness centrality of opinion leaders increased significantly by 47% (average reaching 0.06), and they began to shift the focus of public opinion from "individual case anger" to "systemic reflection" through "frame reconstruction". For example, @Fa Shanshu published a long article "On the Legislative Improvement of the Age of Criminal Responsibility for Minors from the Perspective of the Handan Incident", transforming the public's anger towards the offenders into a rational discussion on "the rationality of the age of criminal responsibility"; @Li Ji, by analyzing the "long-term existence of campus bullying" in the incident, put forward the demand for "establishing a campus violence early warning mechanism" and first associated "AI monitoring technology" with "campus safety", promoting technical issues to enter the public discourse system. This "issue reframing" behavior differentiated public emotions from "single anger" into complex emotions such as "worry, expectation, and rational discussion", injecting "reflective momentum"

into emotional evolution.

In the T3 Trial Period, the betweenness centrality of opinion leaders remained at 0.05, mainly focusing on discussions on "legal interpretation of the judgment result" and "feasibility of technical prevention". For example, combining the judgment result, @Li Meijin, an education scholar, put forward the view that "technical prevention needs to be combined with mental health education", avoiding the public's "omnipotent" expectation of AI technology and further guiding emotions towards a rational direction.

5.3.3. Government Affairs Accounts (G): "Information Supplementers" and "Policy Communicators"

The betweenness centrality of government affairs accounts (such as @Handan Public Security Bureau Notice, @Hebei Justice, @Ministry of Education Government Affairs New Media) (average 0.04) is lower than that of official media and opinion leaders, but they play an irreplaceable role in specific stages, with their core roles as "information supplementers" and "policy communicators".

In the T1 Outbreak Period, @Handan Public Security Bureau Notice updated the investigation progress every 6 hours, supplementing details not covered by official media (such as "preliminary investigation results of criminal motives", "victim identity protection measures"), reducing speculation and rumors caused by information vacuum, and indirectly alleviating public anxiety.

In the T2 Investigation Period, @Hebei Justice released the "Guidelines for Handling Juvenile Crime Cases", interpreting the special procedures for handling cases; @Ministry of Education Government Affairs New Media, aiming at the campus safety issues exposed in the incident, issued the "Notice on Further Strengthening Campus Safety Management", responding to the public's concern about "campus safety policies". These contents shifted public emotions from "worry about the incident" to "expectation for policy improvement", promoting the positive transformation of emotions.

In the T3 Trial Period, @Handan Public Security Bureau Notice announced the "follow-up handling of the case" (such as the correction measures for the offenders, the accountability results for the school), and @Hebei Justice interpreted the "execution details of the judgment result", further supplementing the information of official media, enhancing the public's trust in judicial justice and policy implementation, and stabilizing the public opinion emotions in the later period.

5.3.4. Ordinary Users (U): "Emotional Diffusers" and "Community Aggregators"

Ordinary users have the lowest betweenness centrality (average 0.01), but due to their large number (accounting for 92% of the total users), they play the roles of "emotional diffusers" and "community aggregators" in emotional evolution.

In the T1 Outbreak Period, ordinary users quickly spread the information released

by official media and opinion leaders to various circles of Weibo through a large number of reposts, comments, and likes, making the incident a hot search focus within 48 hours — data shows that in 85% of the information dissemination links during this stage, ordinary users assumed the role of "intermediate nodes", accelerating the spread of negative emotions and the improvement of the incident's visibility. At the same time, ordinary users formed small communities based on region, occupation, values, etc. (such as "Hebei local user community", "parent community"), strengthening emotional resonance within the community, and enabling shock and anger to aggregate quickly in specific groups.

In the T2 Investigation Period and T3 Trial Period, the "emotional diffusion" function of ordinary users gradually weakened, and the "community aggregation" function was further highlighted. The Infomap community detection results showed that the communities in the T1 stage were mainly region-based; in the T2 stage, they differentiated into "legal discussion communities", "educational reflection communities", and "technical discussion communities"; in the T3 stage, they further split into "legal professional communities" (composed of legal practitioners and ordinary users concerned about the judicial process) and "technical governance communities" (composed of ordinary users concerned about AI monitoring and technology enthusiasts). The community modularity index Q value increased from 0.41 in T1 to 0.58 in T3, indicating that ordinary users promote the public opinion topics to develop in a professional and refined direction through community aggregation, further promoting the rationalization of emotions.

5.3.5. Actor Interaction Mechanism: The Three-Level Communication Chain of "Authoritative Guidance — Opinion Intermediary — Mass Diffusion"

The Granger causality test and network link analysis show that a three-level communication chain of "official media/government affairs accounts → opinion leaders → ordinary users" has been formed between the four types of actors, which dominates the process of emotional evolution and topic communication.

The first level: Official media and government affairs accounts release authoritative information (such as investigation notices, policy notices) to form the "information source"; the second level: Opinion leaders "reframe" the authoritative information (such as interpreting legal provisions, associating technical issues), transforming "official discourse" into "publicly understandable discourse" and becoming "opinion intermediaries"; the third level: Ordinary users spread information and emotions to a wider circle by reposting and commenting on the content of opinion leaders, completing "mass diffusion". For example, in the T2 Investigation Period, @Ministry of Education Government Affairs New Media released the "Campus Safety Management Notice" (first level), @Li Ji interpreted the "campus safety early warning" clause in the notice and put forward the view that "introducing AI monitoring technology can improve early warning efficiency" (second level), and ordinary users discussed this view with more than 100,000 reposts, promoting the popularity of the "AI campus

monitoring" topic to increase by 35% (third level). The Granger test shows that there is a significant causal relationship between the "reframing" of official information by opinion leaders and the emotional changes of ordinary users ($F=8.7$, $p<0.01$), confirming the effectiveness of this three-level communication chain.

6. Conclusions and Discussions

6.1. Research Conclusions

6.1.1. The Three-Stage Evolution Law of Weibo Public Opinion Emotions

The Weibo public opinion emotions triggered by the 2024 Handan junior high school student crime incident showed a phased characteristic of "shock and anger — in-depth reflection — rational attention", and there were significant differences in emotional intensity, dominant emotional types, and public opinion focus among different stages. The inflection points of emotional evolution are highly consistent with the release of official information (such as police notices, procuratorate prosecutions), confirming the "braking" and "guiding" role of authoritative information on emotions.

6.1.2. The Competition of Topic Frames and the Emotional Embedding of Technical Issues

The six topic frames showed a competitive situation of "rise and fall" in different stages of the incident. Among them, the evolutionary path of the technical issue of "AI campus monitoring" is the most typical — from "almost no attention" in T1, to entering public discourse after being "reframed" by opinion leaders in T2, and then being deeply bound to public emotions in T3, becoming a core topic. The mutual information analysis shows that technical issues have the highest correlation with negative emotions, reflecting that technical issues are prone to be "emotionalized" in sudden social events and become a carrier for public emotional release and appeal expression.

6.1.3. The Differentiated Roles of Actors and the Three-Level Communication Mechanism

Official media are "emotional brakes" and "authoritative information anchors", opinion leaders are "issue reframers" and "emotional converters", government affairs accounts are "information supplementers" and "policy communicators", and ordinary users are "emotional diffusers" and "community aggregators". The four types of actors form a three-level communication chain of "authoritative guidance — opinion intermediary — mass diffusion", which jointly dominates the process of emotional evolution and topic communication.

6.2. Theoretical Contributions

The three-dimensional analytical framework of "emotion - topic - network" constructed in this study integrates emotional dynamics, topic competition, and network structure into a unified analysis system. It reveals the evolutionary law of public opinion emotions in sudden social events through quantitative methods, provides new empirical evidence for the theoretical system of "dynamic changes of network emotions" in computational communication, and makes up for the lack of investigation on the micro-mechanism of "technical issue embedding in emotional evolution" in existing research. In addition, the study also finds that in sudden social events, technical issues will be emotionalized through the path of "opinion leader frame reconstruction — ordinary user emotional binding — community discussion strengthening", which may further trigger cognitive biases such as "technical omnipotence" or "technological stigmatization". This finding provides a new perspective for understanding the "media generation mechanism of technological stigmatization" and enriches the theoretical research in the fields of technical communication and risk communication. Finally, the study confirms that the "visibility" of Weibo public opinion is not controlled by a single subject, but is jointly constructed by multiple actors such as official media, opinion leaders, and ordinary users through "information competition — frame game — emotional interaction", which further verifies the applicability of the "networked gatekeeping" and "visibility competition" theories in the public opinion of sudden social events.

6.3. Practical Implications

First, the precise guidance strategy for public opinion related to juvenile crimes should be optimized in a timely manner, and phased measures should be adopted. In the incident outbreak period (T1), the official should release authoritative information in a timely manner to clarify rumors and avoid the irrational spread of negative emotions; in the investigation period (T2), through cooperation between official media and opinion leaders, promote the topic to shift from "emotional release" to "rational reflection", and take the initiative to introduce constructive topics such as technical prevention and educational improvement; in the trial period (T3), focus on interpreting the judicial process and judgment reasons, and strengthen the public's trust in judicial justice.

In addition, the juvenile crime prevention system should be gradually improved, and the coordination between families and schools should be strengthened. Aiming at the lack of family education and campus safety loopholes exposed in the incident, the government should promote the "family-school collaborative education mechanism", such as carrying out "parent education guidance courses", strengthening campus mental health education and legal education, and establishing an "early warning system for campus violence". At the same time, a social support network should be actively built, focusing on special groups such as left-behind children and children in distress, and providing them with psychological counseling, life assis-

tance, and other support through government procurement of services and social organization participation, so as to reduce the possibility of juvenile crimes at the source. At the same time, it is necessary to promote the combination of technology and systems. In campus safety management, AI monitoring, algorithmic early warning, and other technologies should be reasonably used, but the applicable boundaries of technology should be clarified, and a "technical application ethical review mechanism" should be established to avoid the abuse of technology and infringement of students' privacy.

6.4. Research Limitations and Future Directions

This study only focuses on the original text data of the Weibo platform, and does not include multimodal data such as short videos, pictures, and comment area interactions, nor does it involve other social media platforms such as WeChat, Douyin, and Zhihu, which may lead to an insufficiently comprehensive investigation of the evolution of public opinion emotions; the analysis of technical issues such as "AI campus monitoring" only stays at the level of public discourse, and does not deeply explore the algorithm logic, application effects, and ethical risks of the technology itself, making it difficult to fully reveal the interaction mechanism between technical issues and emotions; the time scope of this study is limited to 21 days after the incident, and the long-term evolutionary trend of public opinion emotions and policy impacts after the incident subsides are not tracked, so it is impossible to evaluate the long-term effect of public opinion guidance strategies.

In the future, relevant research can consider cross-platform and multimodal data fusion, integrate data from multiple platforms such as Weibo, WeChat, and Douyin, include multimodal information such as text, images, and videos, and use technologies such as computer vision and speech recognition to more comprehensively analyze the evolutionary process of public opinion emotions. It can also combine the perspective of the sociology of technology, through in-depth interviews, case studies, and other methods, investigate the cognition and practice of AI campus monitoring by technology developers, policy makers, and school administrators, and reveal the transformation mechanism of technical issues in "public discourse — policy practice — technical application". At the same time, it is possible to conduct long-term tracking of similar juvenile crime incidents, analyze the long-term evolutionary trend of public opinion emotions, evaluate the actual effects of public opinion guidance strategies and juvenile crime prevention policies, and provide more targeted basis for subsequent policy optimization.

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