Postprint: A Study on the Evolution of Group Attitudes in Online Rumor Propagation

Authors: Shen Chao, Zhu Qinghua, Shen Hongzhou

Date: 2017-10-11T00:00:00+00:00

Abstract

Objective: Through controlled experiments on online rumor propagation conducted with university student volunteers, this study investigates the driving factors and patterns of attitude evolution among netizen groups in the dissemination of online rumors across different topics. Method: Using questionnaire surveys, we recorded the attitude and behavioral data of experimental subjects during the propagation of different rumors, and employed data mining classification algorithms to analyze the commonalities and differences in attitude evolution among netizens. Results: The results indicate that netizen rumor propagation exhibits verification characteristics, the content of rumors influences the media through which netizens disseminate them, and netizen viewpoint interactions change dynamically with group consensus. The main factors influencing netizen attitudes and their evolution include initial cognition, group behavior, information acquisition, and communication channels. The rate of attitude evolution among netizens shows low correlation with content-related indicators of online rumors. Limitations: The limitation to university student participants may affect the generalizability of the research conclusions. Conclusion: Combining experimental research with data mining technology to study online rumors provides data references for modeling online rumor propagation.

Full Text

Preamble

ChinaXiv Collaborative Journal, Issue 271, 2016, No. 6

Research on the Evolution of Group Attitudes in Online Rumor Propagation

Shen Chao[1], Zhu Qinghua[2], Shen Hongzhou[1]
[1](College of Management, Nanjing University of Posts and Telecommunications,

Nanjing 210046)
[2](College of Information Management, Nanjing University, Nanjing 210093)

Abstract

[**Objective**] This study investigates the motivations and patterns underlying the evolution of netizen group attitudes during the propagation of different types of online rumors through controlled experiments conducted with college student volunteers. [**Methods**] We employed questionnaire surveys to record participants' attitudes and behavioral data during various rumor propagation processes and utilized data mining classification algorithms to analyze commonalities and differences in attitude evolution. [**Results**] The findings indicate that netizens exhibit verification behaviors when spreading rumors, that rumor content influences the choice of dissemination medium, and that viewpoint interactions among netizens change dynamically with group consensus. The primary factors affecting netizen attitudes and their evolution include initial cognition, group behavior, information acquisition channels, and communication channels. However, the rate of attitude evolution shows low correlation with rumor content and related indicators. [**Limitations**] Restricting the study population to college students may limit the generalizability of the conclusions. [**Conclusions**] Combining experimental research with data mining technology to study online rumors provides valuable data references for modeling rumor propagation.

Keywords: Online rumors; Group attitude; Attitude evolution
Classification Number: G350

In the era of new media characterized by rapid reading, reposting, and commenting, the generation, spread, and amplification of online information often depend less on the transmission of facts and logic than on the sharing of attitudes and emotions. Using exaggerated emotional vocabulary to arouse public sentiment has become a shortcut for rapid information dissemination on the Internet. Some netizens and media outlets even fabricate facts to express their own attitudes and trigger group attention and resonance, leading to frequent online rumors. A recent example is the rumor about "a Shanghai girl fleeing from a rural area in Jiangxi," which went viral on social media; the post originated from emotional venting by someone who stayed home alone during Spring Festival due to a marital quarrel.

Mackie et al.' s Intergroup Emotions Theory (IET) posits that individual behavior is determined by cognitive and affective preferences, manifested through imitation and feedback mechanisms, with netizen group attitudes emerging macroscopically from individual attitudes and behaviors. Evidently, in-depth research on individual netizens' micro-level attitudes and behaviors in rumor information propagation forms the foundation for studying group attitude evolution. Current research on attitude evolution in online rumor propagation primarily focuses on two aspects: network propagation models and opinion interaction system dynamics. The former abstracts netizen individuals as network nodes and indi-

vidual behaviors as receiving, forwarding, and editing, using SIR and other epidemic models to study the basic laws of online rumor information propagation, but rarely considers the dynamic changes in individual attitudes and behaviors. The latter focuses on the tendencies of netizen group attitudes, introducing the spin (Ising) model from physics to simulate the formation mechanism of individual attitudes, analyzing group attitude evolution patterns through numerical micro-level individual attitude interactions, while simplifying the correlation between individual attitudes and behaviors. To study the impact of individual attitudes on group attitude evolution in online information propagation, scholars have made beneficial attempts. For instance, Zhao Weidong et al. studied the emotional propagation mechanisms of netizen groups in emergency events and established simulation models for netizen emotional propagation. However, simulation model research is often based on qualitative assumptions, lacks support from empirical data, and involves subjective rule and parameter settings.

Given the difficulty in obtaining data related to online rumor propagation, which prevents in-depth research on individual attitude evolution and behaviors, this paper designed three different types of online rumors for controlled propagation among student volunteers, recorded derivative topics during the experiments, and obtained attitude and behavioral data from experimental subjects through questionnaire surveys. We then used data mining techniques to analyze the impact of individual attitudes and behaviors on group attitude evolution, aiming to dissect the evolution process of netizen group attitudes in online rumor propagation from the perspectives of rumor topic types and individual psychological cognition.

2. Overview of Related Theoretical Research

In online rumor propagation research, equation-based (EB) studies and agent-based (AB) studies have yielded numerous results. Scholars have constructed various network structure models, opinion interaction models, and topic propagation models for online rumor propagation, and have explored the characteristics and evolution of netizen group attitudes. However, these studies lack in-depth analysis of individual emotional cognitive processes. Experimental research methods offer the possibility to open the "black box"of individual attitude evolution and behavioral decision-making processes in online rumor propagation, while data mining provides effective analytical tools for examining the relationship between individual attitudes/behaviors and group attitude evolution patterns. The integration of these related theories provides new approaches for online rumor research.

2.1. Research on Group Attitudes in Online Rumors

Social psychologist DiFonzo defines rumors from process and functional perspectives, considering them as public reflections on risks and threats in the social environment—widely circulated unverified information. Rumors are essentially a

form of socialized information that differs from traditional news and announcements. Rumors possess dual attributes of information and social interaction: from an information perspective, they feature ambiguity and importance; from a social perspective, they must spread within specific groups to express certain psychological appeals. This paper considers online rumors as special forms derived from rumors in the Internet environment—unverified information disseminated through Internet media that expresses the attitudes and appeals of specific netizens.

In online rumor propagation, individual netizen attitudes and behaviors are influenced by groups and ultimately reflected as group attitudes, encompassing both psychological-level group attitude interactions and social-level group propagation behaviors. Compared with traditional word-of-mouth rumors, netizens participate more directly and behave more intensely during online rumor propagation. Wang Enjie et al. depicted netizen attitude changes at different stages of rumors and proposed that basic netizen attitudes feature voyeuristic desire overflow, pan-political commentary, credulity toward negative information, and extreme traditionalization of moral standards. Fang Fujian et al. proposed that infection effects exist within netizen groups; netizens judge group tendencies and choose behaviors that maintain group consistency, while media propaganda and misguidance push netizen attitudes toward extremism and foster self-imagination consciousness. Superficially, online rumors are hot topics and events, but essentially they represent individual psychological appeals expressed through information.

2.2. Experimental Research Methods

Experimental research methods control experimental conditions to simulate real scenarios, observe subject behaviors, and identify causes of experimental phenomena, thus ensuring objectivity. Experiments can be divided into three types: pre-experiments, quasi-experiments, and true experiments. Pre-experiments have no specific requirements for subjects, variables, or environments, focusing mainly on exploratory research of factor correlations. Quasi-experiments do not select subjects according to random principles but can control variables. True experiments randomly select subjects and strictly control irrelevant variables. Experimental methods can be used to study individual and group behaviors in information propagation. Wang Zhijin et al. systematically discussed the application of psychological research methods, including experimental methods, in information analysis. Foreign scholars have also attempted to apply experimental methods to Internet information research. Jung et al. used experimental methods to analyze the impact of team collaboration environments on user information system usage perception and feedback. Deng et al. used experimental methods to study the impact of webpage complexity and functional arrangement on user access behavior. However, these studies are mainly limited to user experience and information system design, lacking research on information propagation. In China, applying experimental methods to Internet informa-

tion analysis is not widespread. As Wang Zhijin et al. noted, "psychology can compensate for research on cognitive, non-intellectual, and social factors in information analysis." Online rumor propagation exhibits characteristics of Internet information propagation systems and can thus be studied experimentally from the perspectives of attitude, perception, and behavior.

2.3. Research on Netizen Attitude Mining Methods

Data mining methods are commonly used to analyze netizen attitudes, opinions, and emotions related to brands, enterprises, public events, and even individuals. Related technologies in natural language processing, information extraction, and information retrieval have formed systematic frameworks, making netizen attitude mining a research hotspot in the Web 2.0 era. Social network media and user-generated content provide ample material for netizen attitude mining. However, online rumors pose new challenges to attitude mining methods: (1) The difficulty and quality of data acquisition through web crawlers are increasing. The covert nature of online rumor propagation makes early-stage topic propagation data difficult to obtain, netizen behaviors difficult to track, and netizen attitude evolution information difficult to acquire. (2) Research objectives are difficult to quantify. Netizen attitudes and opinions in online rumors cannot be obtained through Internet data, so scholars often collect data through interviews and questionnaires, which cannot completely cover the netizen groups involved in rumor propagation, affecting research conclusions. (3) It is difficult to obtain high-quality, structured data through the Internet. Scholars often simplify netizen attitude assumptions or limit propagation media to reduce these impacts, but research shows that simplification of media or netizen attitudes affects the stability of analytical conclusions.

Experimental research based on attitude models can obtain comprehensive attitude and behavioral data on online rumors within defined groups, providing new approaches for netizen attitude mining in online rumors.

3. Experimental Research on Online Rumor Propagation

This study attempts to combine experimental research methods, questionnaire surveys, and data mining methods to conduct exploratory research on attitude evolution in online rumor propagation. The specific process is shown in Figure 1 [Figure 1: see original paper].

Figure 1. Research Process for Online Rumor Group Attitude Evolution

(1) Based on literature research, case analysis, and interview materials, identify factors affecting online rumor propagation, including environment, topic, psychology, and behavior, and classify rumors. (2) Design pre-experiments for online rumor propagation, and based on these, select rumor topics for propagation among experimental volunteers, experimental procedures, control variables, questionnaire content, and interview outlines. (3) Design and implement online rumor propagation experiments,

obtain experimental questionnaire data and interview materials, analyze propagation characteristics of different rumors from a topic perspective, and acquire attitude information of experimental volunteers during rumor propagation. (4) Use data mining classification algorithms to analyze the motivations for group attitude evolution among experimental subjects, identify basic patterns of online rumor evolution, and provide specific recommendations for responding to online rumors.

3.1. Pre-Experiment Design and Implementation

To simulate real online rumor propagation processes, this study employed both pre-experimental and quasi-experimental designs. Considering that college students are digital natives with relatively active online behaviors and strong clustering, making them suitable for controlling online rumor propagation processes, we selected college students as experimental subjects for online rumor propagation. The pre-experiment design selected 12 undergraduate volunteers from Nanjing University A to participate in online rumor content design and factor analysis for exploratory research. The quasi-experiment design selected 177 students from 6 classes across two majors at Nanjing University B as research subjects, divided into two groups by major. The two majors had different counselors, distant dormitories, and minimal interaction. Rumors were disseminated without participants'knowledge, with the main purpose of studying the impact of rumor topic content, propagation channels, individual personality, group opinions, and interactive behaviors on netizen group attitudes and behaviors, as well as the feedback effect of netizen interactions on rumor topic content diffusion. Netizen attitudes toward rumors served as dependent variables, individual personality, group opinions, and interactive behaviors as independent variables, and rumor content and propagation channels as control variables. The pre-experiment stage primarily obtained information psychology and behaviors of the experimental subject group through focused discussions of typical rumor cases, providing support for later experimental content and questionnaire design.

The pre-test completed rumor case collection, discussion, classification, rumor design, and questionnaire design. Based on case analysis results, rumors were categorized into social, organizational, and personal types. Social topics selected included the Malaysia Airlines disappearance (international hotspot), genetically modified food (food safety), China establishing a deputy capital (domestic politics), and Jiangsu Sainty football club moving its home stadium to Yangzhou (sports). During discussions of social topics, participating volunteers responded intensely and triggered verbal conflicts, making them topics of greater concern. Therefore, the social category selected genetically modified food as the experimental topic. Organizational topics centered on the school, including cafeteria, shuttle bus, overseas exchange, and curriculum adjustment issues. Volunteers showed greater interest in topics related to further education, so overseas exchange was selected as the experimental topic. The personal category selected

employment issues, which volunteers paid more attention to, as the rumor topic. The pre-experiment design conducted multiple brainstorming sessions to analyze online rumor cases, influencing factors, and netizen behaviors, and designed online rumor propagation topics, approaches, and data acquisition methods, providing references for the quasi-experimental design of online rumor propagation.

3.2. Quasi-Experiment Design and Implementation

The quasi-experiment design considered rumor topic details, specific questionnaire content, distribution and collection methods, and specific experimental operation steps. Rumor content design considered two aspects: first, the information content to be transmitted for disseminators to send; second, auxiliary information related to the transmitted information to maintain topic attention. Supporting information was added as control variables during topic discussions, as shown in Table 1 .

Table 1. Design of Online Rumor Propagation Topics

Topic	Information Content to Disseminate	Auxiliary Information
Topic 1: Internship	Company B needs two well-qualified students for internship with high salary	Internship salary and benefits
Topic 2: GM Food Conspiracy	Consuming GM food will alter human genes and reduce disease immunity	Online reports of diseases caused by GM food
Topic 3: Nanjing B University Self-funded Exchange Program	Nanjing B University will reportedly cooperate with American L University to launch a self-funded exchange program for sophomore students, offering opportunities to study junior-year courses and complete graduation projects at L University	1. Information about B University2. Information about American L University3. Information about exchange programs

To ensure experimental effectiveness, pre-selected volunteers served as information sources to propagate rumors, while other volunteers were unaware of the rumor content beforehand. To minimize the impact of rumor information, topics with relatively low stakeholder relevance were selected, and the propagation process was monitored. After the experiment, participants were informed of

the experimental purpose. Information on individual behaviors, group interactions, and topic derivatives during rumor propagation was obtained mainly through records from information source volunteers and post-propagation questionnaire surveys. Therefore, questionnaire design needed to consider multiple factors. To more comprehensively understand participants' online preferences and accurately analyze individual attitudes and behaviors during online rumor generation and propagation, the questionnaire was designed based on discussions and analysis from the pre-experiment stage, covering five aspects: basic participant information, Internet usage habits, initial viewpoints and attitudes upon hearing rumors, attitudes and behaviors during rumor propagation, and final attitudes held, totaling 25 questions.

The online rumor propagation experiment was conducted over three weeks: Week 1 for preparation; Week 2 as the experimental propagation period, where online rumor disseminators recorded rumor propagation and participant communication; Week 3 as the data collection period, where interviews and questionnaires were administered to obtain volunteer attitude and behavioral information during rumor propagation, all volunteers were explained the experimental situation and asked not to spread the rumors further, and questionnaires were collected after the survey.

The survey results of participants' initial trust levels were basically consistent with expectations during rumor design (see Table 2). The internship/employment rumor was designed to be relatively truthful, the GM food rumor was designed to be relatively false, and the overseas exchange rumor was relatively neutral. This indicates that netizens possess basic rational cognition in online rumor information and can make preliminary judgments about information authenticity based on their own experience.

Table 2. Initial Trust Levels for Three Rumors

	Completely Believe	Believe	Uncertain	Disbelieve	Completely Disbelieve
Internship Initial Trust	19.2%	43.7%	28.5%	7.3%	1.3%
GM Food Initial Trust	5.4%	31.1%	53.4%	6.8%	3.3%
Exchange Student Initial Trust	7.2%	45.0%	35.8%	8.7%	3.3%

Participants' behaviors upon first hearing the rumors were closely related to rumor topic content (see Table 3). Internship/employment affected participants'

future development, so they tended to research information through multiple channels, promoting rumor diffusion. The GM food rumor, due to its high social attention, was easily verified through online information retrieval. Fewer participants were involved in overseas exchange, so verification through peer communication accounted for a higher proportion. The differences in attention among the three rumors indicate that rumor content determines audience behavior, while the differences in verification behaviors between the GM food and internship rumors show that audiences choose channels they believe can most effectively obtain accurate information (reduce uncertainty). Rather than rumor spreaders selecting media, it is the rumor content itself that determines the propagation medium.

Table 3. Online Behaviors Upon First Hearing the Three Rumors

	Discussion	Online Search	QQ Chat	Social Networks
Internship Rumor	39.0%	44.7%	10.7%	5.6%
GM Food Rumor	44.8%	16.1%	34.3%	4.8%
Exchange Student Rumor	52.3%	28.2%	10.1%	9.4%

4. Research on Propagation Characteristics of Network Rumors

To analyze differences in how rumor information of different topics propagated among experimental volunteers, this paper designed three rumor topics based on pre-experiment results and studied the propagation process from the perspective of netizen attitude evolution. A total of 155 valid questionnaires were collected. SPSS 20.0 software was used for preliminary statistical analysis. The questionnaire demonstrated good reliability with a Cronbach' s α coefficient of 0.921. Statistical analysis of rumor propagation characteristics was conducted from three aspects: initial trust level, diffusion behavior, and attitude evolution.

4.2. Analysis of Network Rumor Topic Diffusion Characteristics

Analysis of participation in rumor topic diffusion showed that more than half of the experimental subjects participated in the online rumor propagation process (see Table 4). Due to experimental limitations, participants' online behaviors upon first hearing rumors mainly manifested as discussions with classmates, with most participants sharing rumors with others during these exchanges.

Table 4. Online Behaviors During Rumor Propagation

	Participated in Propagation	Discussed with Others	Shared with Others	No Discussion
Internship Rumor	33.3%	47.6%	13.6%	5.5%
GM Food Rumor	40.7%	36.6%	14.8%	7.9%
Exchange Student Rumor	48.0%	34.0%	13.3%	4.7%

Analysis of rumor topic diffusion channels revealed similar propagation patterns across the three rumors. Compared with SMS and email, participants preferred social media platforms such as Weibo, QQ Space, and WeChat Moments, as well as instant messaging tools like WeChat and QQ for communication and rumor dissemination. This aligns with participants' greater familiarity with Internet usage. Meanwhile, word-of-mouth accounted for a relatively large proportion of propagation channels, indicating that participants had not completely abandoned traditional communication methods and could focus on self-expression in daily conversations. Participants chose communication partners who were easy to talk to or discuss with, consistent with the basic assumption of viral rumor propagation. However, there were also instances of leapfrog propagation to multiple recipients (such as sharing with good friends not physically present).

Analysis of motivations for rumor topic diffusion showed that verification and desire for truth were the main reasons for rumor spread. The proportions of verification psychology in the three rumors were 40.9%, 45.6%, and 31.0% respectively. Experimental subjects processed online information relatively rationally, not being completely controlled by online rumors, and could verify information rationally to identify its authenticity.

4.3. Analysis of Network Rumor Attitude Evolution Characteristics

Rumor recipients spread or edited rumors out of verification psychology. After a period of verification, most would re-evaluate rumors, either strengthening their original ideas or changing their viewpoints. Analysis of group attitude evolution during the diffusion of the three rumor topics showed attitude change rates of 23.2% for the internship rumor, 23.9% for the GM food rumor, and 24.1% for the exchange student rumor. Despite vastly different confidence levels, the proportion of participants who experienced attitude evolution was very similar across the three rumors, indicating that attitude evolution toward rumors reflects group conformity psychology—that is, there is always a certain proportion of "swing voters" in groups who relatively easily change their information judgments.

Further analysis of behaviors after attitude evolution revealed that 45.5% of participants chose to remain bystanders without expressing opinions, 42.2% would follow popular viewpoints, and 12.3% hoped to verify information and guide public opinion, validating the sociological judgment of the "silent majority."

The above analysis indicates that all three rumors propagated widely within the experimental groups. Upon receiving rumor information, individuals more or less analyzed and judged the conveyed content, verifying information that matched personal interests or viewpoints while filtering out information perceived as irrelevant. For interesting information, individuals actively verified it, discussed it with classmates and friends, influencing others while simultaneously being influenced by their surroundings, with their online behaviors and viewpoints continuously changing over time. Although topic content affected netizens' initial trust levels and propagation behaviors, its impact on individual attitude evolution was not significant, making it necessary to further analyze the motivations for netizen attitude evolution.

5. Analysis of Netizen Attitude Evolution Patterns

5.1. Analysis Framework for Netizen Attitude Evolution

During online rumor propagation, individual attitudes include two nodes: the attitude held upon first receiving the rumor and the attitude held after rumor propagation. Through rumor propagation and group interaction, netizen attitudes can be divided into two categories: maintaining original viewpoints and changing viewpoints. Experimental data showed that the attitude evolution rate among volunteers for all three experimental rumors was close to 24%. To deeply study the motivations for netizen attitude evolution, this paper analyzes from perspectives including initial viewpoints, group attitudes, and information editing.

Based on questionnaire data, modeling indicators were extracted using the final attitude toward rumors as the output variable, and decision trees, neural networks, and other classification algorithms were employed to analyze the motivations for netizen attitude evolution, as shown in Figure 2 [Figure 2: see original paper].

Figure 2. Analysis Framework for Motivations of Netizen Attitude Evolution

5.2. Modeling of Network Rumor Attitude Evolution

Questionnaire data processing yielded 72 fields constituting a wide table for data mining modeling. Samples were divided into two categories based on whether they ultimately believed the rumors, and classification algorithms were used to obtain attitude identification rules. The decision tree boosting algorithm was adopted to establish classification models and improve modeling accuracy. Fields in the wide table served as modeling variables, with final rumor credibility as the target variable. Random sampling divided the sample into training

(70%) and test (30%) sets. Considering the accuracy requirements for netizen attitude identification, response graphs were used as model evaluation criteria, with parameters adjusted to obtain optimal models. Clementine 12.0 software was used to model attitude changes for the three rumors separately, revealing patterns of netizen attitude changes in online rumor propagation.

(1) Analysis of Group Attitude Evolution in Internship Rumor

Using BA neural network modeling, the variable importance for the internship rumor was obtained. The top five variables were initial credibility, viewpoint influence, initial feeling, friend circle attitude, and group consistency. Participants' attitudes toward the internship rumor were mainly influenced by individual cognition and group attitudes, with internship initial credibility having a greater impact. To quantitatively analyze the mechanism of viewpoint formation among experimental subjects, a classification model for internship final credibility indicators was established. After multiple iterations, three models with suitable accuracy and node distribution were obtained (Model 1: C&RT algorithm; Model 2: CHAID algorithm; Model 3: C5.0 algorithm). Model 3 had the highest overall response rate (see Figure 3 [Figure 3: see original paper]) and could serve as the model for judging experimental subjects' attitude tendencies. Model 3 consisted of a set of decision trees that emphasized different variables during modeling, improving overall accuracy and stability through multiple iterations. Its main decision tree is shown in Figure 4 [Figure 4: see original paper].

The above analysis reveals that internship rumor final credibility is mainly influenced by initial credibility, information editing, and group attitudes. Only one-quarter of netizens changed their initial judgments about rumor information, and among those who experienced attitude changes, most were influenced by group viewpoints (72.7%) or new information (75%). The reason for disbelieving the internship rumor evolving into belief was participation in collective discussions and information editing, while the main reason for initially believing the internship rumor evolving into skepticism was group attitude.

(2) Analysis of Group Attitude Evolution in GM Food Rumor

The GM food rumor is a widely circulated rumor in recent years with strong controversy and high attention from experimental subjects, with an overall attitude change rate of 23.9%. Using BA neural network modeling, the variable importance for the GM food rumor was obtained. The top five variables were initial credibility, group attitude, having someone verify, initial feeling, and methods for dealing with false behaviors. A classification model for GM food rumor final credibility indicators was established. After multiple iterations, three models with suitable accuracy and node distribution were obtained, with the highest response rate model selected as the scoring model. This model consisted of a single decision tree (see Figure 5 [Figure 5: see original paper]).

The decision tree model shows that GM food rumor final credibility is mainly influenced by initial credibility, group attitude, and GM food channels. The

proportion of experimental subjects who disbelieved the rumor was relatively large. Among those who initially disbelieved the GM food rumor, 84.71% consistently questioned the rumor. Among those who initially believed the GM food rumor, 37.74% changed their viewpoints. The main reason for changing from disbelief to belief was that the surrounding group believed, while the main reason for changing from belief to disbelief was participation in word-of-mouth discussions and in-depth analysis of the GM food rumor.

(3) Analysis of Group Attitude Evolution in Exchange Student Rumor

The overseas exchange student rumor theme concerned study and further education. Since relatively few students considered studying abroad, this rumor had fewer stakeholders, which was conducive to analyzing the impact of stakeholder numbers on rumor propagation. The overall attitude change rate for this rumor was 24.1%. Using BA neural network modeling, the variable importance for the exchange student rumor was obtained. The top five variables were group attitude, initial feeling, group consistency, processing behavior, and self-judgment. Group attitude and individual feeling were the main factors affecting experimental subjects' exchange student rumor credibility, with indicators related to verification behavior having less impact. To deeply analyze the motivations for attitude evolution in the exchange student rumor, a classification model for exchange student rumor final credibility indicators was established. The model with the highest response rate was selected as the scoring model. This model consisted of a single decision tree (see Figure 6 [Figure 6: see original paper]).

The exchange student rumor final credibility is mainly influenced by group attitude, initial credibility, and internship group consistency. For this rumor, the groups that ultimately believed and disbelieved were roughly equal. The vast majority of individuals believed the rumor because the surrounding group believed it (92.31%), while individuals disbelieved the rumor because they thought the group disbelieved it. Among experimental subjects whose group attitude was disbelief, most users who initially believed would persist in their viewpoints. Among those who ultimately believed the rumor, they were also influenced by group attitude; most participants who thought the group had not reached consensus chose to disbelieve the rumor.

Figure 3. Response Graph for Internship Rumor Model Utility Evaluation
Figure 4. Main Decision Tree for Internship Rumor
Figure 5. Decision Tree for GM Food Rumor
Figure 6. Decision Tree for Exchange Student Rumor

5.3. Analysis of Network Rumor Attitude Evolution Patterns

Comparative analysis of the propagation of three online rumors with different themes and content revealed many similar patterns in participants' attitudes and behaviors. First, the attitude change rates for all three rumors were close to 24%, indicating that netizen attitude changes are unrelated to rumor topics but related to individual personality and cognition. Second, netizens' final

attitudes are mainly related to initial cognition and group attitudes; initial cognition is difficult to change, and changes mainly occur due to inconsistency with group cognition. The three rumors also showed obvious differences in attitude evolution influencing factors. In rumors with relatively balanced group viewpoints (exchange student), participants were more concerned about small group consistency; those who perceived group inconsistency chose viewpoints contrary to the group. In rumors with unbalanced group viewpoints (GM food), oral communication and in-depth analysis increased individual information volume and led to choosing viewpoints contrary to the group. In the internship rumor, participants' information editing led to viewpoint evolution, proving that information acquisition behavior is also an important reason for netizen attitude evolution. In the GM food rumor, propagation channels were an important reason for netizen attitude evolution, especially small-group concentrated face-to-face discussions that caused attitude changes among many participants. In the exchange student rumor, group inconsistency was an important factor affecting netizen attitudes.

This experimental study of online rumors from the perspectives of rumor topic differences and netizen attitude evolution reveals the verification characteristics of online rumor propagation, discovering patterns such as content determining media, topic leapfrog propagation, and viewpoint interactions changing dynamically with group consistency. The study shows that the main factors affecting netizen attitudes and their evolution include initial cognition, group behavior, information acquisition, and communication channels, with low correlation between netizen attitude evolution rates and rumor content-related indicators. The research results provide data support for establishing online rumor propagation models. The main limitation lies in the experimental population being restricted to college students. Future research should optimize experiments by introducing EEG measurements to analyze netizen emotional fluctuations after information exposure.

References

[1] Mackie D M, Devos T, Smith E R. Intergroup Emotions: Explaining Offensive Action Tendencies in an Intergroup Context [J]. Journal of Personality and Social Psychology, 2000, 79(4): 602-616.
[2] Nekovee M, Moreno Y, Bianconi G. Theory of Rumour Spreading in Complex Social Networks [J]. Physica A: Statistical Mechanics and Its Applications, 2007, 374(1): 457-470.
[3] 魏静, 朱恒民, 宋瑞晓, 等. 个体视角下的网络舆情传递链路预测分析 [J]. 现代图书情报技术, 2016(1): 55-64. (Wei Jing, Zhu Hengmin, Song Ruixiao, et al. Link Prediction Analysis of Internet Public Opinion Transfer from the Individual Perspective [J]. New Technology of Library and Information Service, 2016(1): 55-64.)
[4] Bonzom V, Gurau R, Rivasseau V. The Ising Model on Random Lattices in Arbitrary Dimensions [J]. Physics Letters B, 2012, 711(1): 88-96.
[5] 赵卫东, 赵旭东, 戴伟辉, 等. 突发事件的网络情绪传播机制及仿真研究 [J]. 系统工程理

论与实践, 2015, 35(11): 2573-2581. (Zhao Weidong, Zhao Xudong, Dai Weihui, et al. Emotion Propagation Mechanism of Emergency Events in Cyberspace and Simulation[J]. Systems Engineering-Theory & Practice, 2015, 35(11): 2573-2581.)
[6] DiFonzo N. Rumour Research Can Douse Digital Wildfires [J]. Nature, 2013, 493(1): 135.
[7] 王恩界, 王盈. 从一起网络谣言看网民态度的基本特征 [J]. 东南传播, 2010(5): 45-47. (Wang Enjie, Wang Ying. Research on the Characteristics of Internet Users' Attitude from an Internet Rumor [J]. Southeast Communication, 2010(5): 45-47.)
[8] 方付建, 王国华. 涉官事件中的网民态度倾向研究 [J]. 华中科技大学学报: 社会科学版, 2011, 25(2): 106-112. (Fang Fujian, Wang Guohua. The Attitude of Internet Users in the Events Involving Officers [J]. Journal of Huazhong University of Science and Technology: Social Science, 2011, 25(2): 106-112.)
[9] 王知津, 张素芳, 周鹏. 从肯定到质疑——情报分析过程中的思维转换 [J]. 图书情报工作, 2011, 55(16): 20-24. (Wang Zhijin, Zhang Sufang, Zhou Peng. From Confirmation to Questioning—Thinking Paradigms Shift in the Process of Intelligence Analysis [J]. Library and Information Service, 2011, 55(16): 20-24.)
[10] Jung J H, Schneider C, Valacich J. Enhancing the Motivational Affordance of Information Systems Management Science, 2010, 56(4): 724-742.
[11] Deng L Q, Marshall S P. Affect in Web Interfaces: A Study of the Impacts of Webpage Visual Complexity and Order [J]. MIS Quarterly, 2010, 34(4): 711-730.
[12] Pang B, Lee L. Opinion Mining and Sentiment Analysis [J]. Foundations and Trends in Information Retrieval, 2008, 2(1): 1-135.
[13] Guo Z, Faming Z, Fang W, et al. Knowledge Creation in Marketing Based on Data Mining [C]. In: Proceedings of the 2008 International Conference on Intelligent Computation Technology and Automation. 2008.
[14] Zhao X X, Wang J Z. Dynamical Model About Rumor Spreading with Medium [J]. Discrete Dynamics in Nature and Society, 2013: Article No. 586867.
[15] Li F, Han Chao, Huang M, et al. Structure-aware Review Mining and Summarization [C]. In: Proceedings of the 23rd International Conference on Computational Linguistics, 2010.
[16] Gerald P, Karpowicz M, Fürschuβ H, et al. Computational Approaches for Mining User' s Opinions on the Web 2.0[J]. Information Processing and Management, 2014, 50(6): 899-908.
[17] Dursun D, Cemil K, Ali U. Measuring Firm Performance Using Financial Ratios: A Decision Tree Approach [J]. Expert Systems with Applications, 2013, 40(8): 3970-3983.
[18] Chiang H J, Tseng C C, Torng C C. A Retrospective Analysis of Prognostic Indicators in Dental Implant Therapy Using the C5.0 Decision Tree Algorithm [J]. Journal of Dental Sciences, 2013, 8(3): 248-255.

Author Contributions

Shen Chao and Zhu Qinghua: Proposed research ideas and designed research protocols; Shen Chao and Shen Hongzhou: Collected, cleaned, and analyzed

data, organized experiment implementation, and drafted the paper; Zhu Qinghua: Revised the paper.

Conflict of Interest Statement

All authors declare no conflict of interest.

Supporting Data

Supporting data can be found in the journal's online version at http://www.infotech.ac.cn:
[1] Shen Chao, Zhu Qinghua, Shen Hongzhou. Information Propagation Experimental Survey Questionnaire.docx. Survey questionnaire used.
[2] Shen Chao, Zhu Qinghua, Shen Hongzhou. Rumor Propagation Questionnaire Data.xls. Detailed questionnaire data.
[3] Shen Chao, Zhu Qinghua, Shen Hongzhou. Converted Data Table from Questionnaire.xls. Converted data table after preprocessing.
[4] Shen Chao, Zhu Qinghua, Shen Hongzhou. Basic Questionnaire Analysis Ideas.docx. Questionnaire analysis approach.
[5] Shen Chao, Zhu Qinghua, Shen Hongzhou. Rumor Propagation Data Analysis.str. Clementine analysis stream file.
[6] Shen Chao, Zhu Qinghua, Shen Hongzhou. Rumor Questionnaire Processing SQL Program.txt. Data processing SQL program.

Received: 2016-02-02
Revised: 2016-04-14

Web Users' Group Attitudes to Online Rumors

Shen Chao[1], Zhu Qinghua[2], Shen Hongzhou[1]
[1](College of Management, Nanjing University of Posts & Telecommunications, Nanjing 210046, China)
[2](College of Information Management, Nanjing University, Nanjing 210093, China)

Abstract: [Objective] This study examines the motivations and patterns of Web users' (i.e., college students) group attitudes to various online rumors. [Methods] First, we used survey to collect the attitude and behavior data of the participants in the process of rumor spreading. Second, we analyzed the data with classification algorithm. [Results] We found that Web users tried to verify the rumors, the content of the rumors decides the disseminating channels, and the interaction among Web users changed dynamically. The main factors affecting Web users' attitudes include the initial awareness, group behavior, as well as information acquisition and communication channels. However, there is no significant correlation between the changing of Web users' attitudes and the rumors' contents. [Limitations] Only investigated college students' reaction to rumors, which might affect the comprehensiveness of the conclusions.

[Conclusions] Analyzing online rumors with empirical research and data mining technology will offer more practical insights to establish online rumor models.

Keywords: Online rumors; Group attitude; Attitude evolution

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