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Cognitive disparity in online rumor perception: a group analysis during COVID-19

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Abstract

Background The harmonious cognitive alignment among various netizen groups is pivotal for the spread and amplification of online rumors. This alignment, characterized by shared cognitive inclinations, fosters uniformity in attitudes and perspectives, thereby precipitating synchronized engagement in the dissemination of such rumors. Notably, discernible disparities emerge in group cognition as different types of rumors pertaining to the same event propagate. This research endeavors to dissect the roles of netizen groups through the lens of cognitive variance, thereby attaining a more profound comprehension of the distinctive traits and behavioral dynamics of various netizen factions in the context of online rumor dissemination.

Methods By integrating Bloom's taxonomy and crafting a survey questionnaire, this study captured the cognitive responses of netizens to various online rumor themes across two critical dimensions: (1) Information Cognition: exploring cognitive processing levels from basic recall to application and analysis and (2) Attitude Change: evaluating higher-order cognitive processes such as evaluating and creating in response to complex rumor scenarios. The decision tree classification algorithm was meticulously applied to dissect the catalysts behind the cognitive shifts among netizens. Additionally, the K-Means clustering algorithm was effectively utilized to categorize netizen groups along thematic lines, offering a nuanced view of their cognitive engagement.

Results The initial impression of a rumor significantly influences netizens' final cognitive perceptions. Twelve characteristics were observed in netizen groups during the dissemination of rumors on different themes, and these groups were classified into four categories: knowledge-oriented, competition-oriented, social-oriented, and entertainment-oriented, based on their cognitive differences.

Conclusions Throughout the lifecycle of online rumors, from inception to dissemination, diverse netizen groups assume distinct roles, each exerting a unique influence on the spread and reception of information. By implementing tailored governance strategies that are sensitive to the characteristics of these groups, it is possible to attain substantially more effective outcomes in managing the propagation of online rumors. This nuanced approach to governance recognizes the heterogeneity of the online community and leverages it to enhance the efficacy of interventions.

Keywords COVID-19, Online rumors, Role analysis, Collective cognition, Bloom's taxonomy

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Introduction

In the era of new media, the formation, amplification, and dissemination of online public opinion are shaped not only by the circulation of information but also by the interaction of collective attitudes and opinions. Netizens, with varying cognitive characteristics, engage with trending events based on individual preferences, and some even contribute to the propagation of online rumor -- a type of unverified information that spreads widely on social networks. These rumors, particularly during public health emergencies, pose significant threats by distorting public perceptions, exacerbating cognitive biases, and hindering efficient crisis management [1]. Such distortions disrupt social order and intensify challenges for authorities in managing crises [2]. Despite considerable research on online rumors, the cognitive mechanisms underlying netizens' engagement with these rumors remain insufficiently explored. Previous classifications of participants in rumor propagation, such as spreaders, forwarders, and recipients [3, 4], fall short of capturing the complexity and diversity of cognitive processes involved. Additionally, the wide range of topics addressed by online rumors complicates our understanding of how netizens cognitively process and react to different types of such rumors [5].

To address this gap, this study introduces Bloom's Taxonomy as a framework for analyzing netizens' cognitive processes when engaging with online rumors. Bloom's Taxonomy, initially developed to categorize educational objectives, provides a structured model of cognitive development, progressing through stages such as remembering, understanding, applying, analyzing, evaluating, and creating [6]. Bloom's Taxonomy outlines the cognitive processes individuals undergo in a hierarchical manner, explaining the behaviors associated with different cognitive levels. This framework aligns closely with the cognitive process that netizens follow when engaging with online rumors. The similarity lies in the structured progression through different stages of understanding. Just as Bloom's Taxonomy moves from basic recall to more complex tasks like evaluation and creation, netizens follow a similar cognitive path when processing rumors. They begin by recognizing and recalling the rumor, then progress through stages of understanding, applying, analyzing, and finally evaluating the rumor's credibility [7]. The highest stage, where new content or responses are generated, parallels Bloom's "creation" level, where individuals synthesize information to contribute original ideas or solutions.

The introduction of Bloom's Taxonomy into the study of rumor cognition offers theoretical insights into the complexity of these processes. While the taxonomy has been widely adopted in educational contexts to categorize cognitive tasks and evaluate learning outcomes [8–10], its application to netizens' cognitive engagement with misinformation remains understudied. By employing this framework, the study aims to deepen our understanding of the cognitive mechanisms that shape how netizens process and respond to rumors during public health emergencies.

From a practical perspective, the study also has significant implications for improving public communication strategies during crises. Understanding the cognitive structures of different netizen groups can inform more effective information dissemination strategies. Tailoring communication to address the specific cognitive biases of various groups could ensure that accurate information is better received and acted upon, leading to more efficient crisis management and reduced social costs. Additionally, analyzing individual cognitive structures provides insights into how information can be structured to alleviate "information anxiety"—the overwhelming stress caused by the overabundance of conflicting information during public health emergencies. By identifying which types of information help mitigate anxiety, public health officials can design communication strategies that not only inform but also reassure the public, fostering better engagement and decision-making.

Given these considerations, this study seeks to answer two key questions:

(1) how can we reduce inefficiencies in emergency response caused by cognitive biases among netizens through appropriate information dissemination and organization?
(2) how can we alleviate information anxiety among different groups of netizens during public health emergencies to ensure timely and accurate understanding of real situations?

Related research

Research on online rumor dissemination

Research on the dissemination of online rumors has provided several frameworks to understand the roles and behaviors of netizens in spreading such information. Lebensztayn et al. categorized participants in rumor circulation into rumor spreaders, forwarders, and recipients, drawing from communication theory to explain these roles [3, 4]. In the contemporary era of social media, the proliferation of rumors has become increasingly effortless. Public attitudes, which are shaped by individuals' internal psychological experiences and behavioral tendencies, significantly influence the scope and societal impact of rumor events. Cognitive processes play a decisive role in the formation of these attitudes, where different cognitive pathways lead to varying behavioral responses [11, 12].

For example, Bonwitt et al. conducted interviews during the Ebola virus outbreak to explore how discrepancies between health information and individual cognitive experiences arise. Their findings emphasized the importance of raising public awareness and improving basic cognitive understanding to mitigate the spread of rumors during public health crises [13]. Similarly, Shao Han's interviews revealed that people's attitudes toward rumors are shaped by their understanding of facts, cognitive levels, and cultural backgrounds, leading to collective behavioral patterns [14]. Other studies, such as those by Yin et al. [15] and Wang X [16]. , explored netizens' proactive and reactive behaviors in response to rumors, while Banakar emphasized trust-building between the government and the public to reduce the adverse effects of rumors [17].

These studies, while insightful, tend to oversimplify the diversity of cognitive behaviors among netizens who engage with online rumors in different ways depending on their cognitive processing of information. This underscores the need for a more nuanced framework to analyze the cognitive differences that influence how individuals interact with rumors. This research seeks to fill that gap by applying cognitive frameworks to better understand how these processes impact rumor dissemination, especially during public health emergencies.

Revisions to Bloom's taxonomy

Bloom's Taxonomy, first developed in 1956, provides a hierarchical classification of cognitive processes, organizing tasks into six levels: remembering, understanding, applying, analyzing, evaluating, and creating [6]. This framework has been instrumental in educational research, offering a structured approach to understanding how individuals process, evaluate, and generate information. Over the years, it has been widely applied to enhance critical thinking and learning outcomes in various fields, such as education and linguistics [7, 8].

In 2001, Anderson and Krathwohl revised Bloom's Taxonomy to reflect more contemporary understandings of cognitive processes [18]. The revised taxonomy introduced key modifications, such as updating the categories to more accurately describe cognitive activities. For example, "remembering" replaced the original "knowledge" level, emphasizing the retrieval of stored information, while "creating" replaced "synthesis" to focus on generating new content. This structure helps explain how individuals move through progressively complex stages of cognitive engagement, from recalling information to generating new ideas [18]. The overall structure of this revised taxonomy is illustrated in Fig. 1.

The revised taxonomy has been adopted across disciplines to improve understanding of cognitive behaviors. For instance, Tabuena et al. used Bloom's Taxonomy to analyze teaching scenarios [19], and Harmon and Chatterton applied it to narrative frameworks in education [20]. In fields such as medical education and decision-making, it has been shown to enhance critical thinking [21, 22].

Despite its widespread use in educational contexts, Bloom's Taxonomy has yet to be fully explored as a framework for understanding the cognitive processes netizens undergo when engaging with online rumors. By analyzing how individuals process rumors through the stages outlined in Bloom's framework, this research provides a novel lens through which to examine the cognitive mechanisms that shape rumor engagement, particularly during public health emergencies.

Research design

Research ideas

Netizens are the primary target of online rumor governance during public health emergencies. By obtaining netizens' attitudes towards different thematic rumors, the study aims to analyze the cognitive differences within this group and achieve differentiated governance. Netizens are the primary target of online rumor governance during public health emergencies. By obtaining netizens' attitudes towards different thematic rumors, the study aims to analyze the cognitive differences within this group and achieve differentiated governance. It begins with the design of a survey based on Bloom's taxonomy, which classifies cognitive skills and learning objectives. Once the survey is designed, user attitudes are collected online, with the responses corresponding to various cognitive levels. The data is then analyzed using both Decision tree classification algorithms and K-Means clustering, allowing for a nuanced understanding of the cognitive differences among users. The decision tree method helps classify user attitudes, while the K-Means algorithm groups respondents into clusters based on their cognitive attributes. These results are used to conduct a cognitive difference analysis, identifying distinct cognitive patterns within the group. Subsequently, role segmentation is carried out based on these cognitive differences, providing a basis for tailoring governance approaches. The final stage of the process involves formulating governance recommendations by summarizing and generalizing the insights derived from the role-based segmentation. The research framework is illustrated in Fig. 2.

Decision trees are a fundamental method in machine learning used for both classification and regression tasks [23]. They work by recursively partitioning the data into subsets based on the most significant features, with the goal of creating a model that can predict outcomes or classify data points effectively.

Construction of a decision tree involves the following steps:

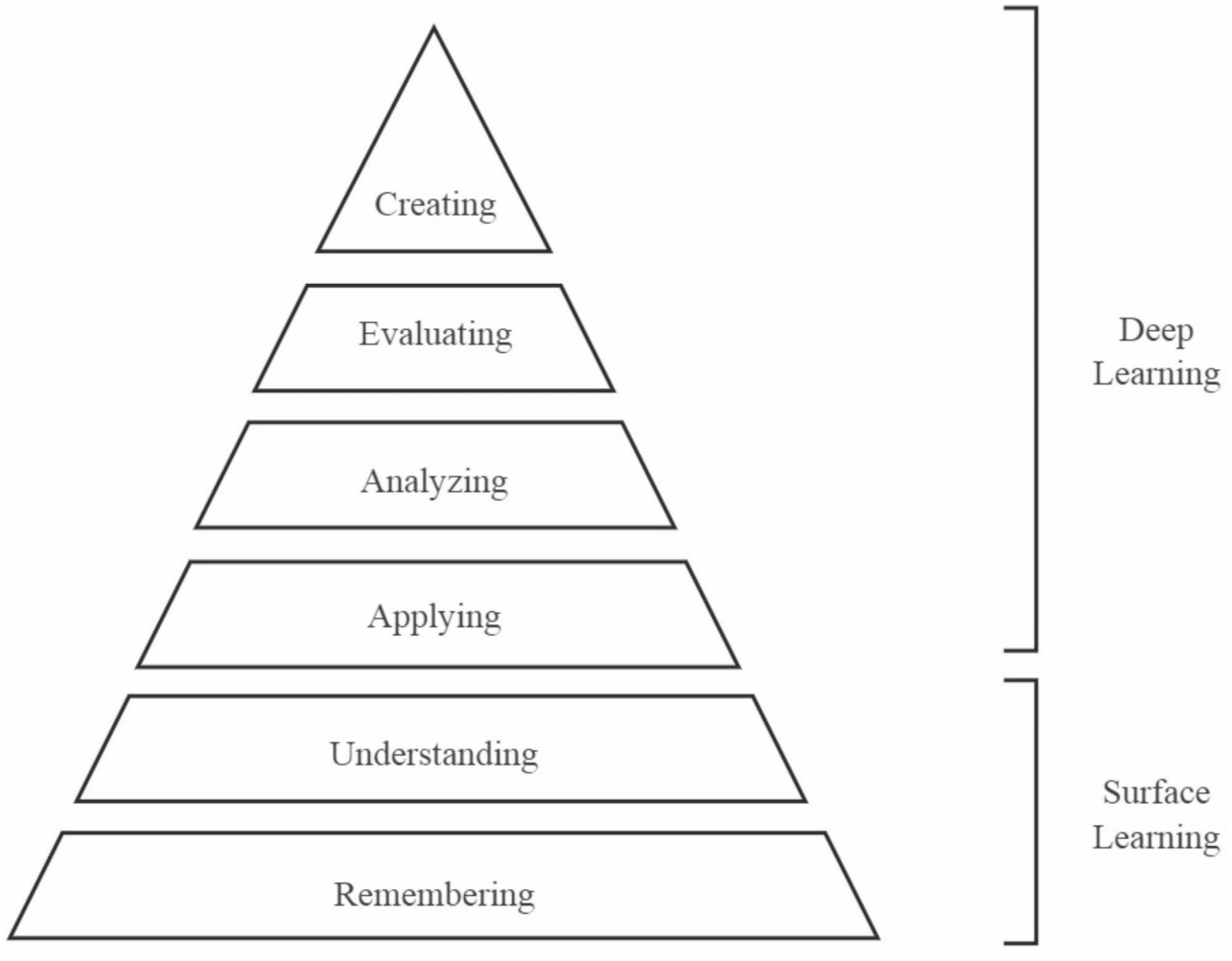

Fig. 1 Revised classification framework of Bloom's Taxonomy

Feature Selection: Identify the feature that best splits the data. This is typically done using criteria such as Information Gain (for classification) or Mean Squared Error (for regression), which measure the effectiveness of a feature in reducing uncertainty or variance.

Node Splitting: Partition the dataset into subsets based on the selected feature. Each subset corresponds to a branch of the tree.

Recursive Building: Apply the splitting process recursively to each subset, creating new nodes and branches until a stopping criterion is met, such as reaching a maximum tree depth or achieving a minimum number of samples per node.

Pruning: To prevent overfitting and improve model generalization, the tree may be pruned by removing branches that have little significance in predicting outcomes.

Decision trees provide a clear and interpretable model for understanding the relationships between features and outcomes, making them valuable for various predictive and analytical tasks.

In addition, The K-means clustering algorithm is a well-established technique in unsupervised learning [24, 25]. Its primary objective is to partition a dataset into k pre-specified clusters, such that the similarity among samples within the same cluster is maximized, while dissimilarity between samples from different clusters is maximized. The core principle of K-means clustering involves optimizing cluster compactness through an iterative procedure, which aims to minimize the distance between data points and their respective cluster centroids. The fundamental steps of the K-means clustering algorithm are as follows:

Initialization: Randomly select k data points to serve as the initial cluster centroids.

Assignment: Allocate each data point to the cluster associated with the nearest centroid.

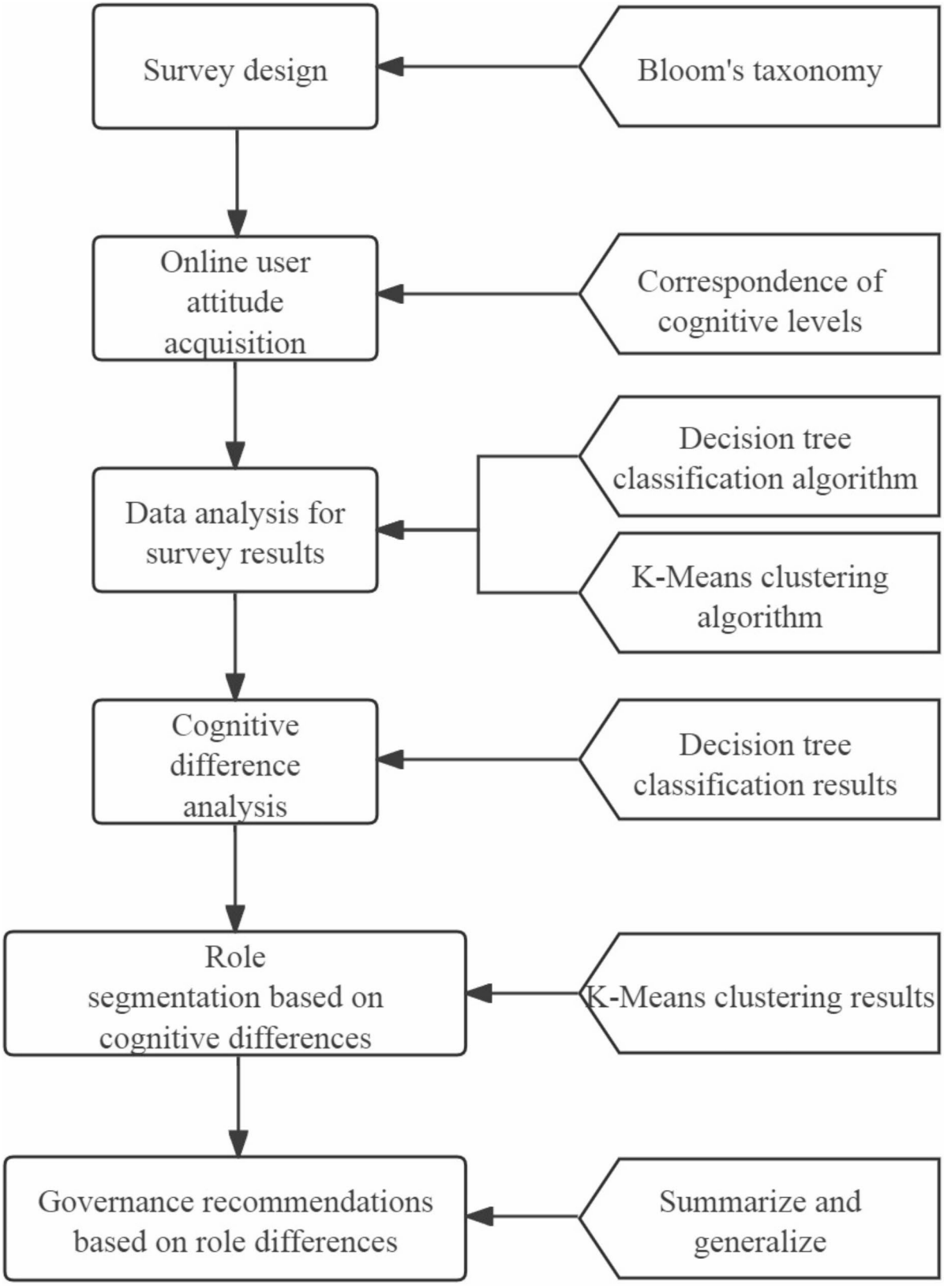

Fig. 2 Research framework

Update: Recompute the centroid of each cluster by calculating the mean of all data points assigned to that cluster.

Iteration: Continuously repeat the assignment and update steps until a convergence criterion is satisfied, such as when changes in the centroids fall below a predefined threshold or after a fixed number of iterations.

The objective function of the K-means algorithm is to minimize the sum of squared errors (SSE) within clusters, mathematically represented as:

$$SSE = \sum_{i=1}^{k} \sum_{x \in C_i} ||x - \mu_i||^2$$

where k represents the number of clusters, Ci represents the set of samples in the i-th cluster, x represents a sample point in the cluster, μi represents the centroid of the i-th cluster, and $||x - \mu_i||$ represents the Euclidean distance between the sample point x and the centroid μi.

Regarding the thematic categories of online rumors during unexpected public health incidents, and drawing on the thematic study by Shen et al. [25] conducted during the COVID-19 pandemic, we classify these rumors into five main categories: event prevention and control, panic creation, production and daily life, virus transmission, and social figures.

The selected online rumor cases for each thematic category are as follows: for event prevention and control, the case of Xi'an Fangcang (rumors regarding the construction of a Fangcang hospital at the Xi'an International Convention and Exhibition Center during the Xi'an outbreak); for virus transmission, the claim of virus transmission through airport air conditioning (suggesting that the air conditioning system in Terminal 3 of Xi'an Xianyang International Airport contributed to "unusual virus transmission" during the outbreak); for virus prevention, the widely circulated but unsubstantiated claim that gargling with warm saline water, tea, or vinegar can eliminate the virus; for production and daily life, the rumor that masks cause cancer (based on the false claim that ethylene oxide residue found in medical masks, classified as a Group 1 carcinogen, causes cancer); and for social figures, the rumor that Dr. Zhang Wenhong, a prominent medical expert in Shanghai's epidemic prevention efforts, had been rewarded with a lakeside villa and 12 million yuan in research funding by the Shanghai Municipal Government.

Questionnaire design and implementation

In line with the Bloom's Taxonomy, this study explores netizens' cognitive responses to different thematic online rumors. The questionnaire used in the research is divided into four sections: individual demographic variables, internet usage habits, information cognition analysis, and attitude change assessment. To ensure data quality, five screening options are included to identify and exclude invalid responses. The hierarchical structure of the questionnaire design, aligned with the cognitive goal classification theory, is depicted in Fig. 3.

In designing a questionnaire to assess netizens' cognitive processes regarding rumors, Bloom's Taxonomy provides a valuable framework for aligning different levels of cognitive activities with specific aspects of rumor cognition [26]. The taxonomy helps to structure questions that cover both surface (shallow) and deep (higher-order) learning processes.

Surface Learning: Through questions aligned with remembering and understanding, the questionnaire collects data on basic knowledge and habits, which forms the basis for deeper analysis.

Deep Learning: Questions designed around analyzing, evaluating, and creating engage respondents in higher-order thinking. These questions explore how individuals process, assess, and react to complex rumor scenarios, reflecting more sophisticated cognitive engagement.

By addressing the higher-order cognitive processes of creating and evaluating, these questions "Creative rumor cognition based on reasoning and decision making" require respondents to engage in deep learning. They are not merely recalling or understanding information but are expected to analyze and critically assess complex scenarios and generate new insights or solutions. This reflects the deeper cognitive engagement necessary for understanding and responding to sophisticated rumors.

The questions "Task-based rumor perception with a focus on judgment and analysis" correspond to the level "Analyzing" and "Applying". While analysis represents a higher-order cognitive task, applying the analysis to practical situations involves a synthesis of both understanding and application, bridging the gap between shallow comprehension and deep, actionable insights.

The questions "Internet usage habits" and "Individual statistical variables" are designed to capture respondents' ability to remember and describe their online behaviors, sources of information, and personal characteristics that might influence their engagement with rumors. They involve recalling factual information and understanding basic patterns of behavior. This level provides foundational data that supports more complex analyses but does not require the higher-order cognitive processes involved in evaluating or creating responses.

The questionnaire is distributed online through "Wenjuanxing" (a survey platform), targeting netizens from various regions nationwide (For details, please refer to Additional file 1). The survey was conducted from January 22, 2022, to March 20, 2022. A total of 387 questionnaires were collected, of which 299 were valid. Prior to

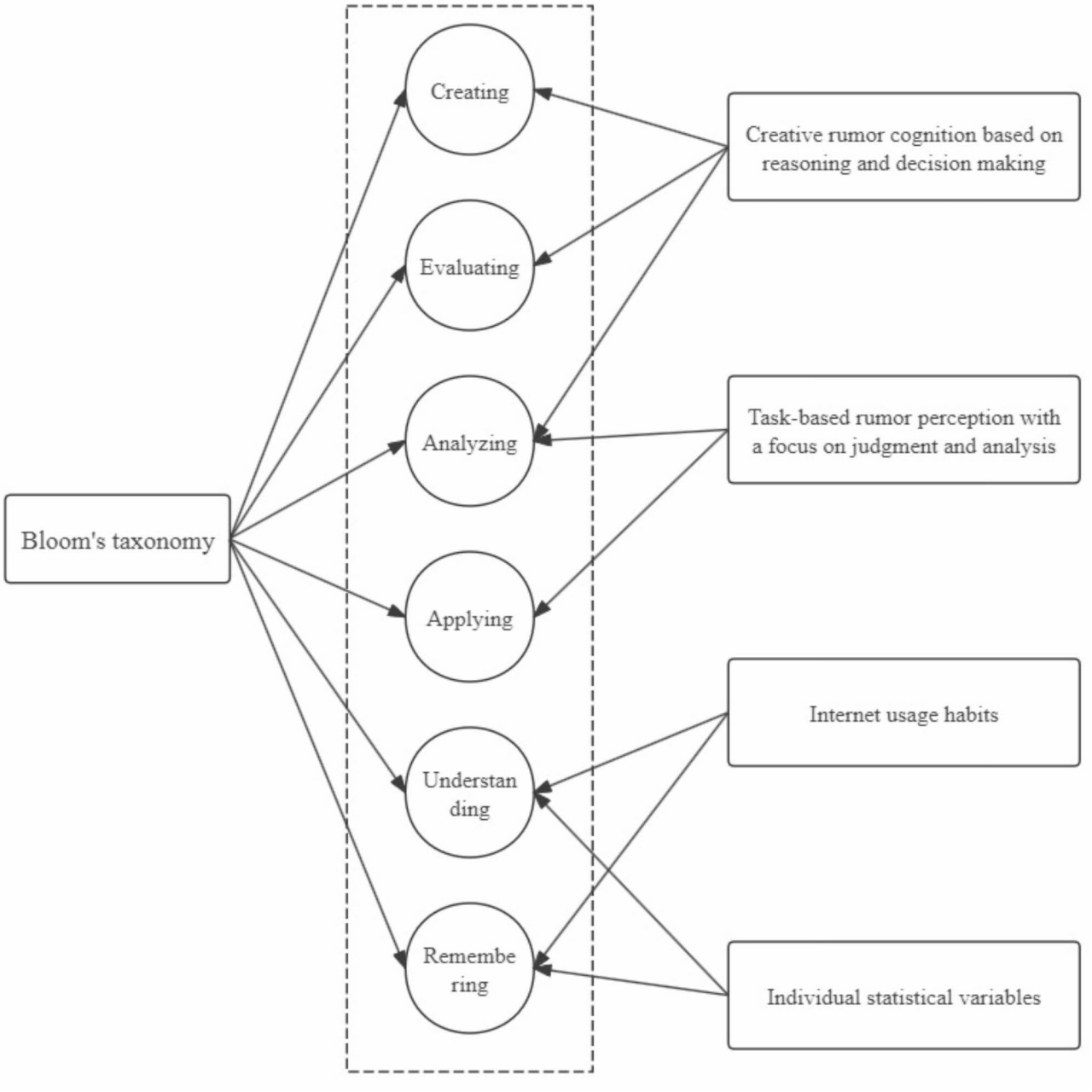

Fig. 3 Correspondence diagram

distributing the questionnaire, two pretests were conducted to ensure the rationality of the questionnaire items.

Results

Factors influencing rumor final credibility

When individuals first encounter a rumor, their initial reactions can vary, encompassing belief, disbelief, or uncertainty. As they gather more information and their understanding evolves over time, their stance on the rumor may shift. The concept of final credibility refers to the ultimate, stable evaluation of a rumor's truthfulness that individuals arrive at, which becomes resistant to further change despite ongoing exposure to new information. This reflects how, as a situation develops, the perception of the rumor transitions from an unstable initial belief to a stable understanding, marking a significant evolution in cognitive processing throughout the rumor's dissemination.

This section aims to investigate whether netizens' cognitive responses differ when confronted with online rumors of varying themes and to analyze the key factors

Table 1 Field categories and names in attitude evolution modeling

Field category	Field name
Basic information	Gender, age, occupation, education level, income, personality, access to information, type of Internet application commonly used, frequency of use, exposure to the epidemic, credibility of the channel, willingness to discuss
Attitudes in the communication process and behavior	Fangcang exposure, Fangcang information source, Fangcang initial credibility, Fangcang influence factor, Fangcang anxiety, Fangcang response, Fangcang dissemination motivation, Fangcang dissemination channel
Information processing	Fangcang information processing, Fangcang continuous attention, Fangcang transformation reasons, Fangcang disinformation response
Final attitudes and behaviors	Fangcang final credibility

Table 2 Ranking of important variables of final credibility of rumors on five categories

Five types of final credibility fields	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
D1-fangcang-final credibility	C3-fangcang-initial credibility	Frequency of use	C8-fangcang-dissemination channel	Gender	Exposure to the epidemic
D2-air conditioning-final credibility	C3-air conditioning-initial credibility	Information Processing	Dissemination Motivation	Occupation	Anxiety level
D3-tea-final credibility	C3-tea-initial credibility	Dissemination Motivation	Education level	Income	Anxiety level
D4-masks-final credibility	C3-masks-initial credibility	Exposure	Personality	Dissemination Motivation	Education level
D5-reward-final credibility	C3-reward-initial credibility	Dissemination Motivation	Information source	Influence factor	Income

contributing to these cognitive differences. To achieve this, the questionnaire data was imported into a SQL Server 2019 database for further processing. After refining the data, a comprehensive table comprising 78 fields was constructed, which serves as the foundation for data mining and modeling. For illustration, Table 1 presents the construction of fields related to the thematic category of event prevention and control-focused online rumors.

To analyze the evolution of netizens' attitudes towards different thematic rumors, we will focus on the final change in netizens' attitudes regarding a specific theme. We will use three attitudes (believing, disbelieving, and feeling uncertain) as the measurement indicators. Based on the extracted fields and the attitude evolution model, we will analyze netizens' attitudes using SPSS Modeler 18.0 software. The 78 fields in the wide table will be modeled to capture the attitude evolution. To ensure the accuracy of the decision tree classification, we will exclude fields with weak categorization and overfitting. By using the final credibility of the five thematic rumor categories as the output indicator, we will select highly correlated factors that contribute to the decision-making process, as shown in Table 2.

To effectively capture and aggregate the varying attitudes of different netizen groups, we will conduct a categorical analysis of the relevant fields and cluster netizen behaviors and roles based on fields with poor fit. Our analysis will focus on the most widely circulated thematic rumors in the categories of event prevention and control, as well as panic creation, to identify key audience characteristics. Low-correlation factors that do not significantly impact the final credibility of these thematic rumors will be excluded from the analysis, and a decision tree classification will be performed to better understand the patterns.

Event prevention and control

Credibility is an effective indicator for measuring netizens' attitudes. In this study, we designed the questionnaire to measure netizens' final credibility as an indicator of group attitudes, aiming to explore the distribution patterns of netizens' final credibility towards different thematic rumors. To determine the factors influencing netizens' final credibility towards different thematic rumors, we found that the impact of individual basic attributes was relatively consistent when considering the overall theme popularity and questionnaire measurement dimensions. Therefore, we chose to exclude individual basic attributes. The main dimensions investigated were internet usage habits, information cognition, and attitude change. We continuously adjusted the severity of pruning in the decision tree by using cross-validation and pruning severity to prevent overfitting with noisy data. By modeling with a BA neural network, we obtained the variable importance for event prevention and control rumors. The top five variables in terms of importance were initial credibility, reasons for change, information sources, frequency of use, and coping measures as shown in Fig. 4.

The final credibility of event prevention and control rumors is mainly determined by the factors of initial credibility, reasons for change, and frequency of use. About 44.49% of netizens are likely to change their initial attitudes towards rumor information. Among netizens who experience attitude changes, the majority are influenced by authoritative sources (77.5%) and internet usage frequency (50%). The transition from disbelief to belief in event prevention and control rumors is primarily

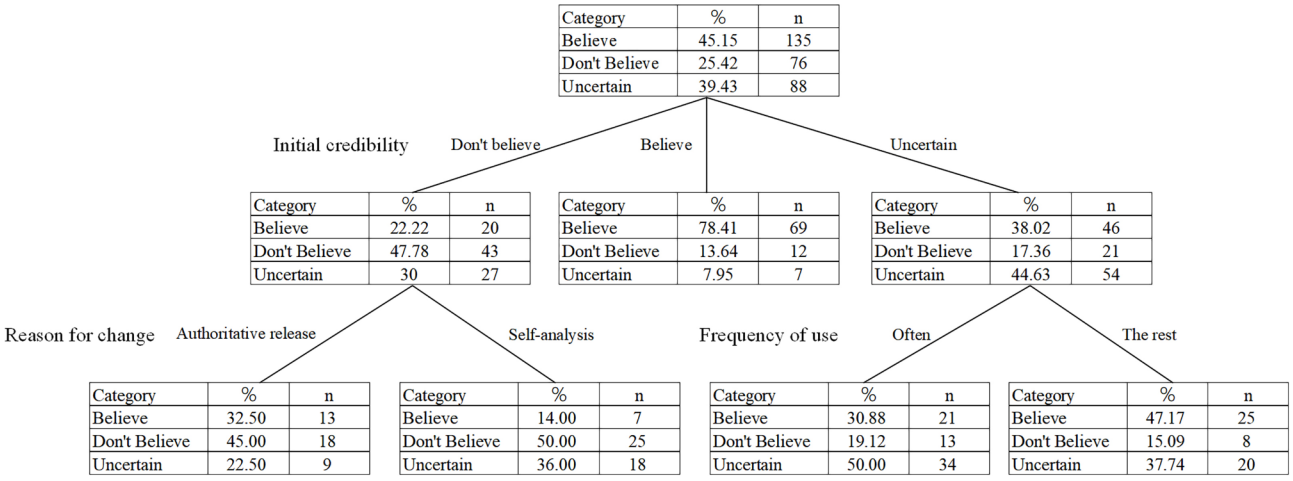

Fig. 4 Rumor decision tree for event prevention and control category

influenced by the content of textual information and netizens' internet usage habits. Netizens who use the internet frequently, particularly within the range of 2 to 6 h, are more likely to change their initial credibility and believe in this category of rumors.

Panic creation

By modeling with a BA neural network, we obtained the variable importance for panic creation rumors. The top five variables in terms of importance were initial credibility, information processing, influential factors in decision-making, channel credibility, and information sources. A classification model was established to measure the final credibility of panic creation rumors. After multiple iterations, three models with suitable accuracy and node distribution were obtained. The model with the highest response rate was selected for audience attribute analysis, as shown in Fig. 5.

From the main decision tree model, it can be observed that the final credibility of panic creation rumors is mainly influenced by initial credibility, reasons for change, and information sources. The transition rate of attitude towards rumors reaches 39.80%. The majority of netizens (60.27%) consistently disbelieve in this type of rumor, and the highest proportion belongs to those who ultimately disbelieve. The transition of final credibility is influenced by authoritative sources (73.78%) and information sources (63.04%). Most netizens who have not been exposed to this type of thematic rumor rely on their initial knowledge and judgment of the information content to consider it as a rumor and hold a disbelief attitude. After information processing, factors related to the source of the rumor lead to significant changes in netizens' attitudes. The number of netizens who disbelieve in the rumor decreases from 146 to 125, mainly due to prior knowledge and the content of information processing.

In conclusion, initial credibility and reasons for change are key factors that influence the final credibility of the audience towards thematic rumors. Moreover, the order of influential factors may vary depending on the different rumor themes, indicating that there are cognitive differences among netizens in response to different thematic rumors.

Analysis of audience roles from a cognitive perspective

During the spread of online rumors, netizens adopt varying attitudes and behaviors, influenced by their cognitive differences. To better understand the behavioral patterns of netizens in response to different thematic rumors, a cluster analysis can be applied to measurement data using indicators that reflect their behavioral motivations. This method allows for the effective classification of netizen roles in the dissemination of online rumors, particularly during public health emergencies, and supports the development of targeted governance strategies.

Role clustering

Cluster analysis was conducted on netizens' attitudes and behaviors regarding the five thematic rumors to identify cognitive differences among netizen groups and observe potential relationships between them. The K-Means algorithm, implemented using SPSS Modeler 18.0 software, was chosen for the clustering analysis of user behaviors. The input fields included individual demographic information, internet usage habits, information cognition research, and attitude change research. The target variable for clustering was the final credibility level. Initially, the clustering model was set to generate 5–10 clusters. After iterative adjustments, the model was refined to produce 4 or 6 clusters, allowing for analysis of netizen characteristics and roles within each thematic category.

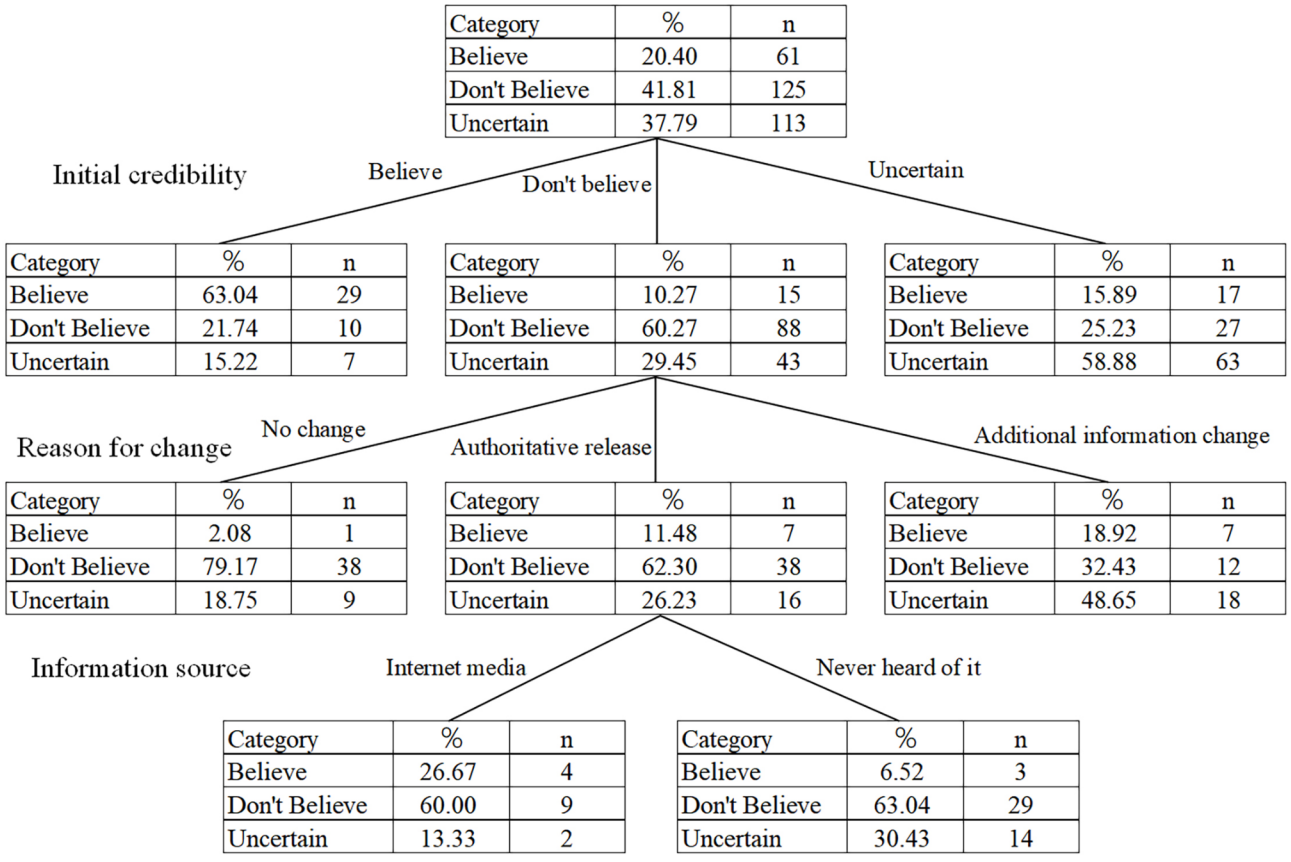

Fig. 5 Rumor decision tree for panic creation category

Event prevention and control

The selected behavior and attitude fields from the questionnaire related to the "event prevention and control" thematic rumor include initial credibility, final credibility, information processing, dissemination motivation, dissemination channels, and other relevant fields. With the aid of the K-Means clustering algorithm, we aimed to explore the attitudes of netizens in the context of public health emergency rumors. To facilitate analysis and interpretation, the number of clusters was determined to be between 3 and 6. After careful consideration, it was decided that 3 clusters would provide the most meaningful results. When using 4, 5, or 6 clusters, there were instances where the sample sizes in some clusters were low, which made it difficult to accurately characterize their cluster characteristics. By setting the number of clusters to 3, we obtained the clustering results as shown in Table 3.

In the context of event prevention and control class rumors, with the number of clusters set to 3, the clustering results revealed the significant influence of 13 fields on the clustering outcome. Fields with similar clustering proportions were removed. Among the three clusters, the first cluster represents the "Rumor Observation" type of netizens. They have encountered similar rumors before and continue to monitor the development of rumors. They typically choose social media platforms such as WeChat, Weibo, and Xiaohongshu to disseminate information. After processing the information, they choose to believe the rumor and refrain from easily spreading it through social media. They tend to continue seeking verification and display mild anxiety. They have a high level of acceptance for information released by official media.

The second cluster represents the "Ambiguous Debunking" type of netizens. They have low exposure to rumors related to public health emergencies and choose not to pay attention to such information. The dissemination channel plays an important role in influencing their credibility. They choose to ignore and not propagate the rumor, but they cannot determine the veracity of the rumor. They act as the stoppers in the dissemination process but lack comprehensive understanding of the rumor's evolution.

The third cluster represents the "Free Propagation" type of netizens. They have prior experience and commonly use new media channels on the internet. They have a high level of interest in rumor information and are motivated to spread existing information with a single click to seek verification or satisfy their curiosity. They exhibit a lower level of anxiety towards rumor information and are

Table 3 K-Means clustering table

Indicators	Cluster 1(102)	Cluster 2(164)	Cluster 3(33)
Level of exposure	Exposed(84)	Not exposed(154)	Exposed(29)
Continuous attention	Wait and see(33)	No attention(81)	Wait and see(14)
Information source	Social media(32)	Never heard of it(155)	New media(9)
Initial credibility	Believe(57)	Uncertain(82)	Believe(18)
Influencing factors	Information content presentation(46)	Information dissemination channels(80)	Experiential cognition(12)
Anxiety level	Mild anxiety(25)	Not anxious(73)	Not anxious(8)
Response	Like(43)	Ignore(89)	Like(16)
Dissemination Motivation	No dissemination(47)	No dissemination(150)	Personal interest(8)
Dissemination Channel	Social media(52)	No dissemination(154)	New media(16)
Information processing	Selective forwarding(35)	Selective forwarding(134)	One-click forwarding(18)
Final credibility	Believe(71)	Uncertain(67)	Believe(16)
Reason for change	Authoritative release(40)	Authoritative release(65)	No change(11)
Debunking response	Seek proof(62)	Seek proof(85)	Seek proof(18)

Table 4 K-Means clustering table

Indicators	Cluster 1(105)	Cluster 2(55)	Cluster 3(139)
Level of exposure	Not exposed(69)	Exposed(52)	Not exposed(135)
Continuous attention	Wait and see(37)	Continuous attention(23)	Continuous attention(84)
Information source	Never heard of it(69)	Internet media(17)	Never heard of it(135)
Initial credibility	Uncertain(50)	Believe(33)	Disbelieve(84)
Influencing factors	Information dissemination channels(49)	Information dissemination channels(26)	Information dissemination channels(67)
Anxiety level	Mild anxiety(26)	Moderate anxiety(14)	Not anxious(64)
Response	Doubt(66)	Ignore(90)	Doubt(21)
Dissemination Motivation	No dissemination(65)	Proliferation alert(21)	No dissemination(133)
Dissemination Channel	No dissemination(47)	Social media(23)	No dissemination(123)
Information processing	No dissemination(54)	One-click forwarding(25)	No dissemination(129)
Final credibility	Uncertain(52)	Believe(29)	Disbelieve(68)
Reason for change	Authoritative release(41)	Authoritative release(29)	Authoritative release(47)
Debunking response	Seek proof(79)	Seek proof(24)	Seek proof(67)
Personality	Emotional(27)	Rational(23)	Emotional(45)

influenced by the channels, forms, and content of rumor dissemination, ultimately engaging in the propagation of rumors.

Panic creation

In the case of panic creation rumors, relevant indicators were selected as clustering variables for individuals in public health emergencies related to panic creation rumors. The K-Means clustering analysis was conducted using SPSS Modeler 18.0 software, and the clustering parameters were adjusted. Setting the number of clusters to 3 yielded a suitable result, as shown in Table 4.

In the clustering results, there were no significant differences in individual demographic indicators among the clusters of panic creation rumors, and the differentiation effect between categories was not clear. Ineffective variables were eliminated, and 14 significant variables were selected as influencing factors.

Within the 3 clusters, the first cluster consists of skeptical debunkers. These individuals have not been exposed to relevant epidemic-related rumors. They hold a continuous attitude of skepticism towards the truth of rumors and consider the information dissemination channels as important factors for assessing the veracity of information. However, due to a lack of understanding of the specific rumors, they remain uncertain about their veracity before and after information processing. They have an emotional disposition and do not choose to spread the rumors.

The second cluster consists of debunking followers. This group has a certain accumulation of scientific knowledge related to public health emergencies. They pay attention to the information dissemination channels and spread incorrect internet information through information processing to raise awareness. They have a rational self-judgment disposition.

The third cluster consists of rational observers. These individuals tend to disbelieve in rumor information. Their attitude conversion rate is low even with supplementary information. They maintain a stable judgment about rumors, and the information dissemination channels become the decisive factors influencing their judgment. They have an emotional disposition and choose to constantly monitor the relevant event information but do not engage in spreading rumors or debunking.

Production and daily life

For the production and daily life-related rumors, relevant indicators were selected as clustering variables for individual online behaviors during public health emergencies. The clustering parameters were adjusted, setting the

number of clusters to 3, resulting in significant clustering effects as shown in Table 5.

In the clustering results, the variables showed significant differences among the clusters. The largest group, classified as Positive Observers (Class 1), displayed initial and final disbelief in such rumors. They did not pay much attention to the development of these rumors, and the impact of rumor dissemination on this group was minimal. They had strong abilities to discern rumors and had a self-characterization of being outgoing. With prior experiences and stable emotions, they exhibited low conversion rates of attitudes after information processing. This group had not been exposed to epidemic-related rumors.

The second group, Rational Observers (Class 2), represented the characteristics of spreading panic-related rumors. The factors that had a significant influence on this group were the information dissemination channels and the reasons for attitude changes. They had high trust in authoritative organizations' information releases and self-identified as rational individuals. After information processing, the choice of rumor dissemination channels continued to influence this group, making them crucial nodes in the spread of rumors.

The third group, Negative Rumor Spreaders (Class 3), exhibited characteristics of spreading negative rumors.

Table 5 K-Means clustering table

Indicators	Cluster 1(128)	Cluster 2(101)	Cluster 3(70)
Level of exposure	Not exposed(76)	Not exposed(97)	Exposed(53)
No attention	No attention	No attention(65)	Wait and see(30)
Information source	Never heard of it(77)	Never heard of it(97)	Social media(20)
Initial credibility	Disbelieve(115)	Disbelieve(50)	Disbelieve(23)
Influencing factors	Experiential cognition(97)	Experiential cognition(50)	Experiential cognition(23)
Anxiety level	Not anxious(58)	Not anxious(53)	Not anxious(19)
Response	Doubt(80)	Ignore(71)	Doubt(32)
Dissemination Motivation	No dissemination(105)	No dissemination(98)	Proliferation alert(26)
Dissemination Channel	No dissemination(91)	No dissemination(93)	New media(23)
Information processing	No dissemination(95)	No dissemination(94)	Selective forwarding(23)
Final credibility	Disbelieve(116)	Disbelieve(52)	Disbelieve(24)
Reason for change	No change(62)	Authoritative release(34)	Self-analysis(33)
Debunking response	Don't care(62)	Don't care(47)	Don't care(40)
Personality	Cheerful(32)	Rational(32)	Rational(27)

When investigating the characteristics of different types of rumors, it was found that individuals with high exposure to epidemic-related information were more sensitive to rumor information and experienced significant emotional fluctuations.In fact, these people, who are emotionally volatile and sensitive to rumors, tend to share rumors without thinking, in order to achieve a self-soothing effect and relieve information anxiety [27].

Virus spread

For the virus transmission-related rumors, relevant indicators were selected as clustering variables for individual online behaviors during public health emergencies. The clustering parameters were iteratively adjusted, and setting the number of clusters to 4 was deemed appropriate. The modeling results are shown in Table 6.

The audience of virus transmission rumors can be roughly divided into four groups, with a relatively high proportion in Cluster 2. The first group belongs to the Prior Debunkers, who have been exposed to epidemic-related rumors on the internet. They rely on their prior experiences to judge the veracity of the rumors. Although they experience mild anxiety due to the contagious nature of the virus, they do not become spreaders of the rumors. They possess some prior knowledge and exhibit skepticism, choosing to continue observing the rumors after evaluating them.

The second group belongs to the Free Debunkers, who have never been exposed to rumors regarding public health emergencies. They rely on their individual experiences to judge the truthfulness of the information and do not experience anxiety or other emotions. They do not participate in the dissemination of epidemic-related rumors and choose to ignore false information about the outbreak.

The third group belongs to the Negative Rumor Spreaders. Within the process of rumor dissemination, individuals in this group have come into contact with related information. Through platforms such as Tiktok and Kuaishou, they engage in behaviors such as sharing, seeking verification, and expressing doubts. Their judgment regarding the epidemic also relies on the authority of the information channels. The information related to virus transmission triggers anxiety among individuals, and they choose to share the information they see without processing it. When encountering information that raises doubts, they continue seeking verification.

The fourth group belongs to the Negative Observers. Individuals in this group perceive rumors as highly anxiety-inducing information but do not believe in such rumors. They engage in skeptical behaviors based on their prior experiences but do not spread related information. They neither spread these rumors nor engage in debunking activities.

Table 6 K-Means clustering table

Indicators	Cluster 1(88)	Cluster 2(128)	Cluster 3(42)	Cluster 4(41)
Level of exposure	Exposed(44)	Not exposed(127)	Exposed(40)	Not exposed(38)
Continuous attention	Wait and see(26)	No attention(93)	Wait and see(16)	Pure curiosity(13)
Information source	Never heard of it(44)	Never heard of it(127)	New media(13)	Never heard of it(38)
Initial credibility	Disbelieve(95)	Disbelieve(75)	Believe(17)	Disbelieve(28)
Influencing factors	Experiential cognition(61)	Experiential cognition(66)	Information dissemination channels(14)	Experiential cognition(22)
Anxiety level	Mild anxiety(21)	Not anxious(73)	Very anxious(16)	Severe anxiety(11)
Response	Doubt(61)	Ignore(90)	Doubt(15)	Doubt(32)
Dissemination Motivation	No dissemination(54)	No dissemination(124)	Proliferation alert(13)	No dissemination(27)
Dissemination Channel	No dissemination(42)	No dissemination(124)	New media(16)	No dissemination(20)
Information processing	No dissemination(46)	No dissemination(140)	One-click forwarding(15)	No dissemination(28)

Table 7 K-Means clustering table

Indicators	Cluster 1(107)	Cluster 2(50)	Cluster 3(70)	Cluster 4(72)
Level of exposure	Not exposed(102)	Exposed(44)	Not exposed(65)	Exposed(46)
Continuous attention	No attention(76)	Continued monitoring(16)	No attention(28)	Pure curiosity(32)
Information source	Never heard of it(102)	Social media(16)	Never heard of it(65)	Never heard of it(26)
Initial credibility	Disbelieve(85)	Believe(36)	Uncertain(45)	Uncertain(42)
Influencing factors	Experiential cognition(52)	Experiential cognition(16)	Information dissemination channels(47)	Information content presentation(24)
Anxiety level	Not anxious(63)	Mild anxiety(10)	Mild anxiety(35)	Mild anxiety(41)
Response	Ignore(62)	Like(21)	Ignore(42)	Ignore(28)
Dissemination Motivation	No dissemination(103)	Proliferation alert (16)	No dissemination(62)	No dissemination(54)
Dissemination Channel	No dissemination(94)	New media(14)	No dissemination(54)	No dissemination(31)
Information processing	No dissemination(97)	One-click forwarding(20)	No dissemination(61)	No dissemination(35)

Social figures

For social figure-related rumors, relevant indicators were selected as clustering variables for individual online behaviors during public health emergencies. The K-Means clustering algorithm was applied using SPSS Modeler 18.0 software, with iterative adjustments of the clustering parameters. Setting the number of clusters to 4 was considered reasonable, and the modeling results are shown in Table 7.

The clustering results reveal significant variations in the indicators of social figure-related rumors, while the clustering groups demonstrate consistent patterns across the 10 identified influencing factors. The largest group, Cluster 1, consists of Free Debunkers—individuals who have not been exposed to rumor-related information. These netizens do not engage in the spread of false information and rely on personal experience to assess the credibility of rumors. As typical "immune" individuals in the rumor dissemination chain, they exhibit lower levels of anxiety regarding related information.

Cluster 2 consists of Negative Rumor Spreaders. This group has been exposed to rumors related to the epidemic, primarily acquiring information through social media platforms such as WeChat, Weibo, and QQ. They experience moderate levels of anxiety and tend to disseminate rumors via new media channels, often using one-click forwarding. Interestingly, they also contribute to the spread of positive rumors, expressing agreement by liking and sharing content they believe to be true, with the intent of raising awareness.

Cluster 3, identified as Free Observers, is composed of individuals who remain uncertain about the accuracy of the information. This group has limited exposure to epidemic-related information and relies heavily on the sources of information to determine its credibility. Although they experience a certain degree of anxiety, they refrain from spreading rumors, instead maintaining a rational stance as observers in the rumor ecosystem.

Cluster 4, the Prior Observers, differ from Cluster 3 in that they have been exposed to epidemic-related rumors but lack the capacity to effectively judge their veracity. Due to this deficiency in judgment, they are influenced by the subjective nature of the information, which in turn impacts the speed and trajectory of rumor dissemination. While they are aware of the importance of verifying information, their inability to do so renders them potential contributors to rumor propagation.

Based on their final attitudes toward rumors, netizens can be categorized into Observers, Debunkers, and Rumor Spreaders. When factoring in cognitive differences, these categories can be further subdivided into Negative, Positive, Free, Rational, Concerned, and Skeptical groups, resulting in a total of 12 distinct subgroups (see Table 8).

Table 8 Role characteristics and their description

Characteristic	Corresponding behavior	Cluster distribution
Rumor observers	Selective forwarding of rumors with eventual belief	Event prevention and control
Ambiguous debunkers	Uncertain about the truth of rumors and refraining from spreading them	Event prevention and control
Free debunkers	Not actively following rumors and refraining from spreading them	Event prevention and control/Virus spread/Social figures
Skeptical debunkers	Not believing rumors and refraining from spreading them	Panic creation
Debunking followers	Continuously monitoring rumors and selectively debunking them	Panic creation
Rational observers	Continuously monitoring rumors and selectively debunking them	Panic creation/ Production and daily life
Positive observers	Not believing rumors and not paying attention to them	Production and daily life
Negative rumor spreaders	Tendency to be anxious and spreading rumors	Production and daily life/Virus spread/Social figures
Preemptive Debunkers	Having cognitive experience and not spreading rumors	Virus spread
Negative observers	Tendency to be anxious and selectively forwarding rumors	Virus spread
Free Observers	Not paying attention to rumors and selectively forwarding them	Social figures
Preemptive Observers	Having cognitive experience and selectively forwarding rumors	Social figures

According to Bloom's taxonomy, the 12 identified groups can be summarized into four roles. The four types of roles are presented in Table 9.

Table 9 Role classifications and attributes

Classifications	Attributes
Knowledge-oriented netizens	These users are characterized by their rational and reflective approach to information. They exhibit traits such as cautious observation, positive observation, prior knowledge-based observation, and proactive debunking. This group prioritizes the acquisition, dissemination, and sharing of accurate information. They possess strong information literacy and discernment skills. During the spread of online rumors, they typically gather information from multiple sources, cross-check, and verify facts. They are also key contributors to debunking false information.
Competition-oriented netizens	These individuals focus on obtaining and spreading information about trending events. Their role characteristics include a focus on debunking, negative rumor-mongering, and negative observation. They often have strong emotional ties and positions regarding hot topics, making them more susceptible to rumors. In the context of online rumor propagation, they might spread false information to generate buzz and attract more attention or engage in debunking efforts to build a positive image and gain more recognition and traffic.
Social-oriented netizens	This group prefers to obtain and share information through social networks, with a focus on interaction and communication with others. Their role characteristics include belief-based observation, vague debunking, and questioning debunking. They have higher social literacy and are likely to spread rumors through actions like sharing and commenting to stimulate attention and discussion. However, their intent is generally less driven by personal gain compared to competition-oriented users.
Entertainment-oriented netizens	These users engage with the internet primarily for entertainment and leisure. They are characterized by their casual approach to information, with traits such as free-form debunking and free-form observation. They do not prioritize the accuracy or credibility of information. Due to their lack of critical discernment, they are highly likely to propagate rumors.

Tailored strategies for rumor governance

After classifying the roles of different groups involved in spreading online rumors, it is particularly important to provide targeted governance recommendations for each group.

Knowledge-oriented netizens are described as individuals with higher education and professional knowledge. They have the potential to aid in rumor clarification by publishing articles or providing evidence. These individuals likely operate at the higher levels of Bloom's taxonomy, particularly evaluation and creation. They are more capable of critically analyzing information, distinguishing fact from rumor, and even creating new content that counters misinformation. You could argue that they engage in evaluative thinking when they verify rumors and in creative thinking when they actively contribute to correcting misinformation or generating new, accurate content. For this group, the recommendation is for governments and social media platforms to enhance their guidance and training, encouraging the participation of knowledgeable netizens in rumor governance by increasing their awareness and ability to actively engage in the dissemination of accurate information.

Competition-oriented netizens are characterized by their interest in trending information, often seeking attention through reposting and commenting. Competition-oriented netizens might operate at the application level of Bloom's taxonomy. They engage with information primarily for external rewards (e.g., attention, social capital) rather than understanding its deeper meaning. They can apply information they encounter (e.g., sharing rumors), but they might lack the reflective or analytical skills needed for deeper cognitive processing,

making them more prone to spreading false information. To address this, it is advised that social media platforms increase supervision of this group, encouraging them to verify information before sharing it, make rational comments, and exercise caution when reposting.

Social-oriented netizens might be situated at the understanding or comprehension level of Bloom's taxonomy. Social-oriented netizens possess strong social skills and excel at interacting with others on social platforms. However, their knowledge of rumors may be limited, and they may struggle to fully discern the truthfulness of information. For these individuals, platforms should focus on publishing more fact-checking information related to rumors, guiding them in debunking false claims.

Entertainment-oriented netizens are noted for having lower media literacy and a lack of proactive fact-checking awareness. Entertainment-oriented netizens may operate primarily at the remembering level. Their engagement with information is more passive, focusing on immediate entertainment without a deeper cognitive engagement. Governance strategies for this group should include increased efforts from social media platforms to raise their understanding of the dangers associated with spreading false information. Measures such as account suspensions, banning, or comment deletion should be implemented to penalize irresponsible rumor dissemination within this group.

Discussion

Main findings

In this study, we applied Bloom's taxonomy to explore the cognitive differences and individual roles in the dissemination of online rumors across various topics. Through surveys and analysis of participants in rumor-spreading networks, we identified role typologies of netizens based on their differentiated cognitive processes.

We observed that netizens' attitudes toward rumors—whether believing, disbelieving, or uncertain—tend to change over time. Initial perceptions of credibility play a crucial role in shaping these changes. Netizens who initially believed a rumor often continued to believe it, while those who initially disbelieved were likely to maintain their skepticism. This phenomenon aligns with selective exposure theory [28], which posits that individuals prefer information that confirms their existing beliefs while avoiding or disregarding contradictory information. Those who initially believed the rumor remained open to confirming information, actively seeking evidence to support their views. This selective exposure often involves consuming rumor-related content, such as social media posts and news reports, further reinforcing their belief in the rumor. This confirmation bias causes them to dismiss or ignore contradictory information [29]. A similar pattern was observed among netizens who initially disbelieved the rumor.

Then, we present explanations for the four netizen role typologies identified in this study:

Knowledge-oriented netizens are individuals with higher education and expertise, playing a crucial role in ensuring the accuracy and authenticity of online information. They leverage their academic background, professional knowledge, and research skills to better understand and explain complex issues while providing reliable information. Knowledge-oriented netizens typically possess extensive subject matter expertise, often being scholars, professionals, or researchers. Their ability to evaluate information from diverse sources allows them to engage in objective analysis, fact-checking, and the identification of misinformation. Prior research has shown that personality traits influence behavior in the context of rumor dissemination [30, 31]. Consequently, knowledge-oriented netizens exhibit a strong sense of responsibility and are generally less likely to spread rumors.

Competition-oriented netizens are driven by strong emotions and a desire for recognition, often amplifying rumor events to gain attention and build their online reputation. Emotions have been shown to affect rumor judgment [32, 33], and these netizens may deliberately spread sensationalized or false information to provoke discussion and increase their visibility. However, competition-oriented netizens may also contribute positively by participating in debunking efforts, recognizing that exposing the truth can enhance their status and influence [34]. Through fact-checking, they can showcase their rational judgment and expertise, gaining respect and approval from other users.

Social-oriented netizens excel in social interaction and communication within online networks. They are active participants in social media, sharing viewpoints, emotions, and information with others. However, due to limited knowledge in specific domains, they may struggle to assess the credibility of information accurately. A key characteristic of this group is their close-knit social networks, where trust in personal relationships strongly influences their belief in rumors. Studies have shown that the credibility of rumors is often linked to the source of the information [35] and the closeness of social relationships [36]. Consequently, social-oriented netizens tend to trust and share information within their social circles. Despite their limitations, they can be effective allies in rumor debunking, as sharing corrective content within trusted networks often yields stronger results [37].

Entertainment-oriented netizens primarily seek entertainment and amusement online, prioritizing engaging and attention-grabbing content over accuracy. Their focus on entertainment makes them more likely to

spread rumors without verifying their validity [38]. These netizens are driven by the pursuit of fun, relaxation, and social interaction, which can lead them to share unverified rumors for the sake of attention. However, entertainment-oriented netizens also play a positive role: through humor and creative content, they can attract attention to the truth behind rumors, leveraging their influence to disseminate corrective information [39].

Implication of study

From a theoretical perspective, the application of Bloom's taxonomy to study netizens' cognition of different themed rumors significantly expands its traditional boundaries. While this theory has been extensively researched within educational contexts, our study broadens its application by analyzing the cognitive hierarchy of netizens in the online environment, particularly during public health crises like COVID-19. Existing research on netizens has largely focused on behavioral aspects, such as their actions and interactions on social media platforms. However, our study shifts the focus toward the cognitive processes underlying these behaviors, enabling a more nuanced understanding of how netizens process, evaluate, and respond to online rumors. By employing Bloom's taxonomy, we can effectively delineate the complexity of netizens' cognitive structures in navigating rumor information during critical situations, thus introducing a new dimension to the study of online behavior.

From a methodological standpoint, Bloom's taxonomy has rarely been applied in the context of online rumor studies, making this an innovative theoretical extension. The layered nature of this taxonomy allows us to dissect the cognitive processes of netizens, offering a structured framework to differentiate between various levels of understanding, evaluation, and action. This enables the formulation of specific hypotheses regarding how different cognitive levels influence netizens' likelihood to believe, spread, or debunk rumors. In our study, these hypotheses were operationalized through surveys, followed by classification and clustering methods to categorize netizens into distinct roles. By applying this cognitive framework and integrating it with empirical data, we provide a comprehensive understanding of group behaviors in the digital space.

From a practical standpoint, the unexpected severity of COVID-19 has significantly impacted individuals' mental health, leading to increased stress, anxiety, depressive symptoms, insomnia, anger, and fear [40]. Many netizens have turned to social media to regain a sense of perceived control through information-seeking behaviors aimed at managing their anxiety [41]. Social media platforms have not only made information readily accessible but have also provided significant contributions in terms of social support [42]. Previous research indicates that individuals with higher levels of psychological anxiety are more prone to believing online rumors [43, 44]. Anxiety can heighten sensitivity toward uncertainty, prompting netizens to seek information to alleviate their distress. In uncertain situations, netizens are more inclined to share rumors as they offer explanations that help cope with anxiety. This behavior can be seen as an emotion-driven response that allows individuals to transfer their anxiety to others, functioning as a form of emotion regulation and release [45].

By analyzing the cognitive differences among netizens—such as varying levels of knowledge, emotional engagement, and cognitive processing—we can uncover behavioral patterns and motivations that explain why some netizens are more susceptible to believing and spreading rumors while others are more inclined to debunk misinformation and provide accurate content. This analysis illuminates the psychological drivers underpinning rumor propagation, including selective exposure, confirmation bias, and anxiety-related behaviors.

Furthermore, understanding these distinct behavioral patterns offers critical insights for social media platforms and policymakers. This knowledge provides a foundation for developing targeted information strategies tailored to different user groups, ultimately facilitating public engagement and participation in managing crises while reducing social costs. Additionally, analyzing individual cognitive structures can identify strategies that help alleviate information-related anxiety among the public during emergent events. These differentiated approaches, grounded in cognitive insights, present a more effective means of addressing the complex issue of online rumor dissemination.

Limitations and future research

Undeniably, this study has some limitations. Firstly, the research was conducted during the COVID-19 pandemic, which gives it a specific context that may limit the generalizability of the findings. Secondly, the sample used in the study may not be fully representative and may only cover a portion of the netizen population. Therefore, future research could utilize larger samples to obtain more generalizable conclusions. Lastly, although this study subdivided netizens, the categories may still be somewhat broad, and the motivations for netizens spreading rumors are highly diverse. There may be additional subcategories of netizens worthy of investigation, and future research can explore further in this aspect.

Conclusions

With the widespread use of the internet and social media, netizens now have more extensive and convenient channels for accessing information. However, this convenience is accompanied by challenges, such as the

increased exposure to false information and rumors. In the creation, spread, and prevention of online rumors, different groups of netizens play distinct roles and exert varying levels of influence. As such, understanding netizen groups is crucial for the effective governance of online rumors.

This study examines the role characteristics of different netizen groups in spreading rumors across various themes, focusing on cognitive differences. By incorporating Bloom's taxonomy and designing a questionnaire based on typical rumor themes, we explored the factors influencing cognitive differences among netizens. Initial credibility and the reasons for changes in beliefs were identified as key elements. Based on these findings, netizens were classified into four distinct roles: knowledge-oriented netizens, competition-oriented netizens, social-oriented netizens, and entertainment-oriented netizens. This role classification offers valuable insights for developing targeted strategies to manage online rumors in the future.

Supplementary Information

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Supplementary Material 1

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study has been approved by the Ethics Committee of the School of Management at Nanjing University of Posts and Telecommunications (Approval No: NJUPT2023-GL006). All participants involved in the study have provided informed consent. Participation in the research project will not result in any physical or psychological harm. All methodologies employed adhere to relevant guidelines and regulations.

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