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Research on Public Perception of Academic Achievements under Public Health Emergencies

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Abstract

The public perception of academic achievements under public health emergencies directly affects the recognition and release of the social value of the achievements. Analyzing this relationship will help improve the theories and methods of assessing the social impact of academic achievements. The study selected posts and user interaction data mentioning academic achievements on Weibo, a Chinese social media platform, during the COVID-19 pandemic as samples. Combining with public perception theory, we analyzed the public's comments and reposted texts, aiming to reveal the public's attention to academic achievements and their emotional attitudes. We found the public generally has a positive attitude of respect and trust toward academic achievements, researchers, and bloggers. The dissemination of academic achievements has a positive influence on the public's cognition and behavior. However, there are still some critical and questioning voices. In order to further improve the social impact assessment and promote the dissemination and influence of academic achievements among the public, it is recommended to fully explore the social media data that can be used for the social impact assessment, and build public trust in academic achievements through various stakeholders, such as researchers, mainstream media, and government departments.

Introduction

Since the 20th century, the interpenetration of science, technology, and society has gradually made scientific research a cause that requires the joint efforts of all sectors. Against the backdrop of the knowledge economy, scientific research, as the cornerstone for promoting national transformation and social progress, is being placed with greater social expectations. Compared with the academic impact, social impact driven by public values and social needs is gradually becoming an important consideration in the science and technology policies of many countries. In recent years, China has issued a number of policy documents emphasizing the assessment of the social impact of academic achievements. It has emphasized the

implementation of classified assessment and evaluation, focusing on the quality, contribution and impact of landmark achievements (Ministry of Science and Technology of the People's Republic of China, 2020); and pointed out that it was necessary to comprehensively and accurately assess the scientific, technological, economic, social and cultural value of scientific and technological achievements (The State Council of the People's Republic of China, 2021). Many international organizations have begun to conduct social impact assessments on a regular basis, such as the Research Excellence Framework (REF) in the UK, Research Quality Framework (RQF) in Australia, and Standard Evaluation Protocol (SEP) in the Netherlands.

As the knowledge economy continues to deepen and the model of knowledge production evolves, the public is no longer a passive recipient of knowledge (Fecher & Hebing, 2021). Scientific research assessment has increasingly focused on the social impact on the public. The dynamic four-spiral mechanism of Knowledge Production Model III, innovatively developed within the dual-spiral structure of the three-spiral nonlinear network model, has given rise to the "University-Industry-Government-Civil Society" innovation ecosystem model (Schütz, Heidingsfelder, & Schraudner, 2019), which affirms the important position of the public in scientific activities. In the era of self-media, the degree of engagement and activity in online science discussions has increased significantly. Several studies have demonstrated that social media platforms have significantly influenced research assessment by enhancing the visibility of scientific outputs, facilitating rapid dissemination, and promoting robust public engagement with research findings (Haustein, Costas, & Larivière, 2015; Sugimoto et al., 2017). Public participation in science not only improves their scientific literacy, but also influences the public cognition, values, and other aspects, thereby realizing the social value and broad dissemination of academic achievements. However, public attitudes toward science are often complex. On one hand, due to limited understanding of science, the public is willing to trust science and scientists as representatives of the scientific system, believing that science can solve problems. On the other hand, the uncertainties in science, negative events (such as academic misconduct), and the potential risks posed by scientific advances (such as genetically modified organisms and nuclear energy), often lead to public skepticism about scientists and scientific research. Furthermore, as science continues to develop toward sophistication, depth, and specialization, it becomes progressively more difficult for the public to fully understand science and technology. Consequently, the focus of relevant research has shifted from exploring whether

the public understands science to investigating whether the public trusts the science and scientists (Irzik & Kurtulmus, 2021; Goldenberg, 2023; Tranter, 2023).

Surveys show that global skepticism toward science has been on the rise (Nuyen, 2019), and the outbreak of COVID-19 in 2020 has exacerbated this challenge. The pandemic put science under the public microscope. Research issues are directly related to everyone's daily life, prompting the public to rely more on scientific research and expertise. During this period, mass media became a key source of scientific information for the public. The scientific community has also increasingly focused on communicating and interacting with the public through social media platforms, and social media data have been widely used in studies related to public trust. Van Dijck and Alinejad (2020) found that social media were indeed two-sided swords of health communication, and were deployed to both undermine and enhance public trust in scientific expertise during a health crisis. Algan et al. (2021) conducted a large-scale survey across twelve western countries from March to December 2020 and found a marked decline in public trust in scientists, particularly in France. Additionally, Mihelj, Kondor, and Štětka (2022) conducted a study involving interviews and diary surveys in four Eastern European countries, which revealed a general trust in experts. However, some respondents in Serbia and Hungary expressed strong distrust in the experts appointed to the national crisis teams by their governments. Public trust in science has been severely eroded by various sources of information, including paper retractions, the spread of pseudoscience on social media (Muhammed T, S., & Mathew, S. K., 2022), the spread of fake news triggered by flawed preprints, and research findings that fail to align with public expectations. Many people have started to question the professional competence, ethical conduct, and research motives of scientists, and these sentiments are spreading and being reinforced on social media. Positive or negative public perceptions of science have a direct impact on the public's acceptance and adoption of vaccines, therapeutic drugs, and public health policies based on scientific research, thereby affecting the ability of scientific research to achieve its societal value in improving health and well-being.

In summary, numerous studies have examined the relationship between the public and science, and the concept of social impact assessment of academic achievements is evolving toward focusing on stakeholders (Benneworth, 2017; Muhonen, Benneworth, & Olmos-Peñuela, 2020; Bonaccorsi, Chiarello, & Fantoni, 2021). Public attitudes toward science, especially on issues closely related to public interest, such as public health emergencies, play a crucial role in determining the real-world impact of scientific research and the stability of societal functioning. Therefore, it is

necessary to examine the public's views and attitudes toward academic achievements from the perspective of public perception. Users' activities on social media platforms, such as browsing, liking, commenting, and reposting, serve as primary means for users to express their opinions and engage in information exchange. These actions also reflect users' views, emotions, and cognition within the social media environment. Commenting and reposting, in particular, represent higher levels of user participation, as they involve more substantial cognitive and emotional engagement (Sailunaz & Alhajj, 2019). Therefore, this study, set against the backdrop of the COVID-19 pandemic, focuses on Weibo posts that mention academic achievements, along with their comments and reposts. Weibo, a mainstream social media platform in China, has 586 million monthly active users and high user engagement, making it an important channel for online communication and information gathering (Zhang, Jin, Liu, & Xue, 2024). By analyzing Weibo data, previous studies have offered crucial insights into the attitude and behavioral changes of Chinese social media users in the early stages of the COVID-19 pandemic(Li et al., 2020; Zheng, Adams, & Wang, 2024), and have also pointed out that the daily life status reflected by Weibo can help in predicting personality (Wang et al., 2020).By analyzing these comments and reposts, the study aims to explore the following questions:

Q1: How does the public perceive and understand academic achievements?

Q2: What attitudes does the public exhibit towards academic achievements?

Q3: What factors lead to the public's negative emotions and perceptions of academic achievements?

The findings will provide insights into enhancing public trust in science, promoting the social utility of academic achievements, and improving the assessment system for the social impact of scientific research.

Public perception theory

As key stakeholders in academic achievements, the public's attitudes and views directly influence the generation and dissemination of the social impact of academic achievements. Analyzing public perception is an effective way to understand these attitudes and views. The foundational theory of public perception suggests that public perception consists of cognition, emotion, and behavior, which together represent a social awareness of changes and effects in the objective world that impact one's own life (Qu & Lu, 2016). People judge unknown concepts or phenomena through cognitive processes, integrating them with their emotions or personal experiences. This leads to the formation of behavioral intentions, ultimately resulting

in consistent actions and perceptions. In this process, public perception plays a significant role in guiding group behavior. Related studies have defined public perception as the degree of awareness, attitudes, and views of the public toward specific events, issues, technologies, and policies (Stephanides, et al., 2019), or the knowledge and emotional attitude on specific topics (Huang et al., 2019； Fan & Zhuang, 2024). This study focuses on analyzing public perception of academic achievements through comments and reposts on Weibo. Drawing from the foundational theory of perception and previous research, we limit the scope of public perception to public attention and emotional responses to academic achievements. This study aims to provide deeper insights into the dissemination effects of scientific research in social media and how it influences public behavioral intentions. Ultimately, this research will help researchers and policymakers better understand and enhance the social acceptance of academic achievements.

Research design

Data collection

This study uses Weibo as the data source, focusing on popular accounts with high interaction and influence in the field of health and medicine. According to the survey, the top 10 most influential and the top 10 most popular influencers on Weibo in 2020 and 2021, as well as the most influential and most popular influencers in 2022, have been identified. Additionally, this study added the accounts of Nanshan Breathing (Nanshan Zhong's research team), Dr Zhang Wenhong, and five mainstream media accounts such as People's Daily, for a total of 48 source accounts. We used Python to scrape original posts containing the keywords "COVID-19", "novel coronavirus", "SARS-CoV-2" and "2019-nCoV" from these accounts. The time range for these posts is limited from January 2020 to June 2023. The posts mentioning academic achievements were classified into different subjects through manual categorization. The most prevalent subjects were "drug development", "epidemiological research", "virus structure, origin tracing, and infection mechanism studies". These subjects garnered the highest number of likes, comments, and reposts, indicating broad public interest and representativeness. Therefore, we selected posts within these three subjects as our sample.

We retained posts with more than 10 comments, and manually reviewed and filtered those that mentioned academic achievements according to the following criteria: (1) Posts mentioning papers, academic reports, vaccines, drugs, diagnostic technologies, and other types of scientific contributions are included in the dataset. (2) If the post

is related to COVID-19 but the mentioned academic achievement is not specifically relevant to the pandemic, that post is excluded. (3) Posts referencing academic achievements in various forms, such as links, images, references, DOIs, patent numbers, or those citing key elements like the journal, research team, or platform, or using key phrases like "research shows", "according to the literature", or "approved" are also included. After review and selection, the final dataset comprised 525 posts from the subjects of "drug development", "epidemiological research", "virus structure, origin tracing, and infection mechanism studies". Based on the unique ID of each post, we further crawled the first and second-level comments and repost texts, while gathering the number of likes on these comments and reposts to analyze public perception of academic outcomes.

Data coding

In posts mentioning academic outcomes, public comments, reposts, and other forms of interaction indicate the public engagement and the emotional responses to the research findings. The act of commenting itself demonstrates the public's interest, and the object of the comment further reveals their key concerns. Comment content often contains the public's specific opinions and feelings, serving as an external manifestation of public perception. Public perception of academic achievements shapes the direction and content of their comments. For instance, expressing personal opinions on the research outcomes and engaging in discussions and debates reflect the public's concern, while emotional reactions such as gratitude, praise, doubts, or criticism directed towards bloggers or researchers represent emotional feedback. Therefore, analyzing the content of the comments can further reveal the public's deeper perception of academic achievements.

Preliminary research indicates that public comments not only involve the academic achievements themselves, but also encompass various aspects, such as the credibility of researchers, bloggers' approaches to disseminating information, and the impact of related policies. Public attitudes toward researchers and bloggers may enhance or weaken public trust in research achievements, and criticism or questioning of related policies may also affect the practical application and public acceptance of academic achievements. Consequently, the public comments directed at various objects reflect the social impact of academic achievements from a multifaceted perspective. To this end, this study adopted the content analysis method and constructed a two-level coding system to categorize the comment content around various comment objects, including academic achievements, bloggers, researchers, and policies. This will help

grasp the different focuses in public discussions and fully understand the public's multi-dimensional perception characteristics of academic achievements.

In order to clarify the cognitive and emotional characteristics reflected in the content of users' comments on social media, this study reviewed related literature. Liu et al. (2017) identified three types of tweets quoting papers: excerpts from the paper, external information about the paper, and attitudes toward the paper. These attitudes can be further subdivided into positive, neutral, somewhat supportive and negative. Positive attitudes include not only emotionally positive tweets but also neutral or exploratory ones, such as speculation, humorous responses, linking the paper to other topics, raising questions, and potential applications of the findings.

Regarding speech acts, Searle (1976) first divided them into direct speech acts and indirect speech acts, and further divided the agent's behavior into elaboration or assertion, commitment, instruction, declaration, and expression based on basic conditions, sincerity conditions, prerequisites, and propositional conditions. Furthermore, Zhang et al.(2013) divided speech acts into statements, questions, suggestions, comments, and mixed categories. Nemer (2016) fully considered the characteristics of online communication and divided speech behaviors into asking, requesting, instructing, inviting, informing, claiming, expecting, accepting/rejecting, apologizing, thanking, etc. This study designed a comment coding scheme, as shown in Table 1, based on the comment motivation classification system from the relevant literature and preliminary analysis of the study's dataset. The primary category covers various objects of commentary, such as research outcomes, bloggers, researchers, policies, and others, all of which are assigned numeric codes. The secondary category focuses on the content of the comments, coded with lowercase letters.

Table 1. Comment coding scheme.

Objects of commentary	*Comments*	*Account for*
1-Academic achievements	a-Praise and recognition	Express praise, affirmation and recognition
	b-Criticism and questioning	Point out possible errors, question the scientificity and authenticity, etc.
	c-Discussion and conjecture	Discuss and propose conjectures
	d-Surprise and worry	Expressing negative emotions such as surprise and worry

Objects of commentary	*Comments*	*Account for*
	e-Recommendations and expectations	Propose suggestions for optimizing the achievements or future research directions, and express expectations for achievements
	f-Association	Share other achievements related to the results mentioned in the original blog, or the opinions of professionals
	g-Humour	Express opinions in a humorous and witty manner
	h-Statement of experience	Describe relevant experience or real situations based on achievements or blog content
	i-Mention of external information	Discusses external information such as publication journals, research teams, links, peer reviews, industrialisation status of achievements, etc.
	j-Communicating practical issues	Discuss real-life issues based on the achievements, such as precautions, how to apply it
2-Bloggers	a-Approval and thanks	Thank the blogger for sharing, agree with and support the blogger's point of view
	b-Criticism and questioning	Criticise or satirise the blogger's viewpoints and positions, question the correctness and objectivity of the post, point out errors in the content, etc.
	c-Suggestions	Suggestions to bloggers on how to improve the content of posts
	d-Asking questions	Consult bloggers about the problems existing in the practical application of academic achievements
3-Researchers	a-Praise and thanks	Express respect, trust and gratitude to researchers
	b-Criticism and questioning	Express doubt or sarcasm to researchers
4-Policy	a-Suggestions	Propose suggestions and expectations for policies
	b-Support and affirmation	Support or comply with policy arrangements

Objects of commentary	*Comments*	*Account for*
	c-Doubts and concerns	Express different opinions on policies and concerns about the impact of policies on personal lives
5-No clear object for comments	a- Incomprehension	Express difficulty in understanding the content of academic findings
	b-Praise	Directly express praise without naming the person or entity, and it is difficult to judge based on the original post
	c-Belief in science	Demonstrate belief in and support for science
	d-Firm beliefs	Express trust in China and good expectations for the future

Two coders randomly selected and pre-coded 10% of the comments from each subject. During the pre-coding process, we identified certain low-quality comments that either had little analytical value or were irrelevant to the research objectives of this study. These comments were excluded based on the following criteria: (1) posts with no substantive content, including reposts, @ other accounts, punctuation only, emojis, interjections, and so on; (2) comments containing profanity, inciting arguments, creating division, or engaging in personal attacks; (3) comments that only contained hashtags or replicated the content of the original post without contributing new insights; (4) incomplete or unclear statements; (5) comments unrelated to the content of the post, such as advertisements; (6) comments involving the politicization of science, such as conspiracy theories. The coders discussed their coding results to further clarify and refine the coding criteria. After excluding the above-mentioned types of comments, the consistency of the coding results exceeded 90%.

A single coder conducted formal coding, yielding a final dataset of 15,354 coded comments. This included 4,552 comments related to "epidemiological research", 3,213 regarding "viral structure, origin tracing, and infection mechanism studies", and 7,589 related to "drug development". A month later, a random 10% sample from each thematic category was selected for secondary coding, and the consistency coefficient exceeded 95%, demonstrating the reliability of this coding.

Public Perception of Academic achievements in Social Media

Focus and Attitude Analysis Based on Commentary Texts

Comments offer a direct means for users to express their opinions. These comment texts contain valuable original insights, from which we can extract the public's understanding, evaluation, and discussions of academic achievements. This helps to uncover specific public viewpoints. On the Weibo platform, many users express their support for a particular viewpoint by liking comments. As a result, comments with a high number of likes tend to reflect topics that attract widespread attention or recognition from the public, and have a high degree of dissemination and influence. This study focuses on the coding of comment texts related to posts that mention academic achievements, exploring the overall distribution of public comments and the content characteristics of comments with a high number of likes. The objective is to reveal the public's areas of focus and emotional attitudes toward academic achievements.

For Weibo posts mentioning academic achievements, the distribution of the objects of commentary is as follows: academic achievements (66.9%), bloggers (8.8%), researchers (4.8%), and policies (3.7%). In addition, comments without a specific object account for 15.9% of the total. This indicates that the public's primary interest lies in the academic achievements themselves, particularly their practical applications. In contrast, comments directed at bloggers, researchers, policies, or other aspects are less common. In this study, comments with 10 or more likes are defined as highly praised comments, and 1,441 comments were obtained from the screening, accounting for 9.4% of the total coded comments in the dataset. Figure 1 compares the content distribution of these highly praised comments to all comments.

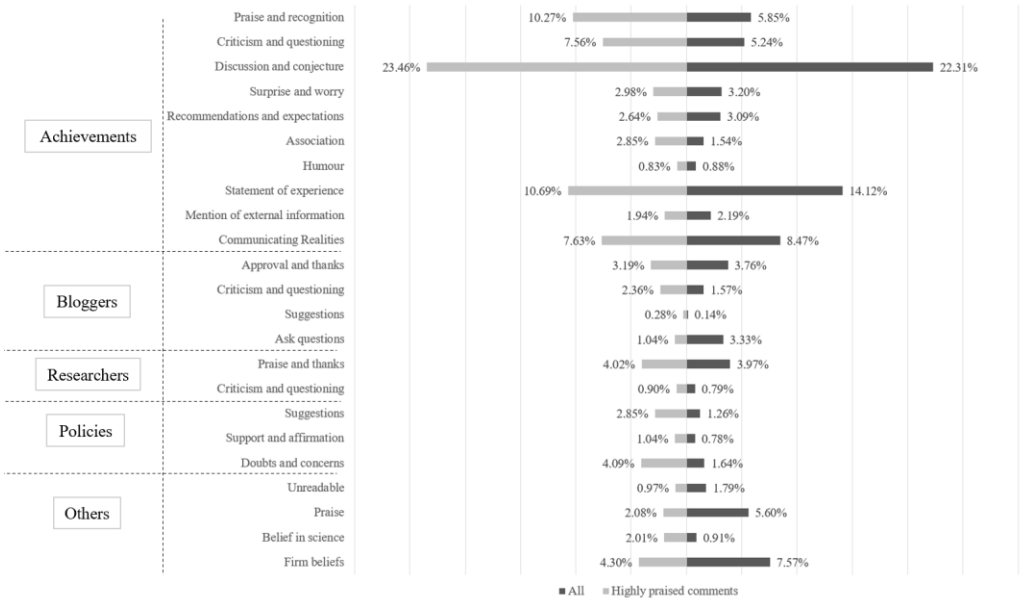

Figure 1. Comparison of content distribution of highly praised comments and all comments.

Focus and Attitude Analysis of Comments on academic achievements

Discussion and conjecture (22.3%) and statement of experience (14.1%) are the most common comment types on academic achievements. These are followed by communicating realities (8.5%), praise and recognition (5.8%), criticism and questioning (5.2%), surprise and worry (3.2%), recommendations and expectations (3.1%), mention of external information (2.2%), association (1.5%), and humor (0.9%). Weibo users typically engage in discussions about the details of academic achievements by combining the content of the original post, their own knowledge, and professional information sourced from other outlets. Despite the limited professionalism of public discussions, these interactions nonetheless demonstrate the significant public interest in academic achievements, a crucial aspect of their social impact. Simultaneously, the public also shows a greater concern for the practical application of these achievements in their daily lives, which is reflected in two content types: statements of experience and communicating realities. For instance, people might discuss the precautions that different groups should take when getting vaccinated or share their experiences after receiving the vaccine. In comparison to the overall percentage of comments, statements of experience and communicating realities receive significantly fewer likes. This is likely due to the clear association of such comments with individual attributes and specific needs, which limits their

widespread relevance. On the other hand, comments that express praise and recognition, as well as criticism and questioning, tend to receive more likes. This suggests that the public is more engaged with comments that clearly express a stance on the academic achievements. It also suggests that content with a clear and substantive attitude tendency can more accurately reflect the impact of achievements on public perception and has a higher analytical value.

Analyzing the focus and attitudes of comments directed at bloggers, researchers and policies

Among the comments on bloggers, approval and thanks (3.8%) and asking questions (3.3%) are the most common types of comments. The posts collected in this study came from Weibo-verified health bloggers and official mainstream media. These sources are widely recognized for their authority and professionalism, earning public appreciation. They also attracted inquiries on professional matters. This phenomenon demonstrates the public's trust in professionals and highlights their critical role in science communication on social media. Also, their involvement enhances the social impact of academic achievements. Among the comments directed at researchers, praise and thanks (4.0%) significantly outweigh criticism and questioning (0.8%). This suggests that the public's overall attitude towards researchers tends to be one of respect and trust. For comments directed at policy, doubts and concerns (1.6%) were the most frequent, followed by suggestions (1.3%). Support and affirmation (0.8%) were the least common. To a certain extent, this distribution shows the public's strong concern about policies based on academic achievements. However, these policies have not gained widespread recognition or acceptance. Policies play a crucial role in transforming and applying scientific research, directly affecting public life. For these policies to succeed, they must be adopted and followed by the public. Without public adoption, it will be difficult to achieve the intended outcomes, such as providing references for public policy formulation and safeguarding public health.

Focus and attitude analyses of comments without specified objects

Among the comments that did not specify the target audience, the most frequent were those expressing firm beliefs (7.6%), followed by praise (5.6%). These two categories even outnumbered the total number of comments directed at researchers and policies. Typically, these comments conveyed positive attitudes or firm beliefs in concise yet powerful language, often carrying strong emotional overtones. For example, expressions such as "fantastic", "go for it", "China will win", and "may the epidemic be overcome soon" appeared frequently. The large number of such

comments under posts mentioning academic achievements highlights the public's strong confidence in the power of scientific research to overcome the epidemic. However, compared with the overall percentage, comments expressing praise and firm beliefs are often brief and repetitive, which limits their ability to generate high engagement. Therefore, the percentage of highly praised comments is relatively lower. Moreover, these comments often lack substantive opinions about academic achievements and cannot clearly reflect the social impact of academic achievements. A small percentage (0.9%) of comments express belief in science, reflecting public faith in both the scientific community and its research achievements. On the other hand, 1.8% of comments indicate that the individuals "could not understand" the content, suggesting that a certain number of members of the public have difficulties understanding the content of the research achievements. This could undermine their trust in the academic achievements and thus be detrimental to the social impact of the research achievements. During the coding process, it was observed that when bloggers fail to appropriately simplify the original academic content, often directly quoting or translating it, the specialized language can become a barrier to public understanding. Some comments pointed out that "I usually just read the last two paragraphs of such articles because I can't understand the earlier parts" or "To be clear, we can't understand it because we're not studying medicine". This feedback suggests that communicators should emphasize the research findings most relevant to the public's daily lives and present them in simple, accessible language to improve understanding and acceptance. Taken together, the public's comments show a significant positive trend, reflecting the positive social impact of the research achievements on the public.

Analysis of attitudinal tendencies based on reposted texts

Users' reposting behavior on Weibo reflects the process of information diffusion and their selective attention to specific content, which highlights the public's recognition of the information. The analysis of the reposted text could reveal the dissemination and potential influence of the academic achievements in social networks. After conducting word frequency analysis on the coded comment texts, this study identified terms that can help specify the comment objects, including bloggers, researchers, and academic achievements. By using the co-word analysis in the reposted texts, it is possible to further judge the public attitude toward various objects. The results can be used for social impact analysis.

Attitudinal tendencies toward bloggers

The word frequency statistics of the comment texts targeting bloggers reveal high-frequency words that indicate the object of comments, including "blogger", "teacher", "editor", and "doctor". From the processed reposted texts, we extracted 422 entries containing these terms, representing 1.5% of the total data. Figure 2 displays the word cloud of the top 100 words that co-occur with the above words, with word size reflecting the number of co-occurrences. According to the word cloud, the overall attitude of the public toward bloggers in the reposted texts shows a tendency of trust and gratitude. High-frequency co-occurring words such as "Science popularization", "believe", "thank you", "need", "professional" and "hope" reflect the public's high recognition and appreciation for bloggers' science popularization activities through Weibo. These professional interpretations enhance the public's trust in academic achievements and deepen their understanding of them. Additionally, the public initiates interactions with bloggers using phrases such as 'Hello,' 'May I ask' and 'Could I inquire', which correspond to the 'Asking questions' comment type, further highlighting the trust in bloggers' expertise.

Attitudinal tendencies toward researchers

The word frequency statistics of the comment texts targeting scientific researchers reveal that the high-frequency words that can specify the object of the comments include "scientific researchers", "scientists", "professionals" and "researchers". We extracted 420 data points containing the above words from the processed reposts, representing 1.5% of the total number of reposts. Fig. 3 shows the word cloud of the top 100 terms that co-occur with these words, indicating researchers. According to the word cloud, the words that co-occur more often with researchers include "hard work", "China", "keep going", "gratitude", "respect" and "thank you" etc. These words reflect the public's recognition, gratitude and respect for researchers. At the same time, words such as "impressive", "hope", "great", "success", "believe", "effort" and other positive words are also displayed, further highlighting the public's positive attitude towards researchers. It can be observed that the reposted texts, similar to the comment texts, show an overall positive attitude of the public towards researchers.

Figure 2. High-frequency co-occurrence word cloud of reposted texts toward bloggers.

Figure 3. High-frequency co-occurrence word cloud of reposted texts toward researchers.

Attitudinal tendencies toward academic achievements

We selected five high-frequency words that can represent academic achievements and counted the adjectives that co-occur more frequently with these words, as shown in Table 2. Based on the statistical results, these high-frequency co-occurring adjectives are predominantly positive in sentiment, although a small number of negative emotion words are also present. These adjectives offer more reference value for the assessment of research achievements in the field of health and medicine. Positive words such as "significant", "effective" and "take effect" indicate that the public is positive about the efficacy of drugs. In addition, some universal positive adjectives were also mentioned frequently, including "awesome", "powerful", "successful", "best", "important", etc. These words not only reflect the public's praise and trust in research achievements but also imply that these achievements have a positive impact on public perception. The public is willing to actively disseminate these valuable academic achievements, which helps promote their acceptance and application, such as increasing the public's willingness to vaccinate.

Table 2. High frequency co-occurrence adjective list for academic achievements.

Representative terms of academic achievements	*High-frequency co-occurring adjectives (number of co-occurrences)*
Research	Important (34), Effective (29), Significant (19), Popular (13), Best (12), Obvious (9), Awesome (9), Unique (8), Reliable (7), Strict (7)
Miracle drugs	Effective (83), Awesome (6), Successful (5), Powerful (3), Important (3), Powerful (3), Great (3), Failed (2), Unnecessary (2)
Traditional Chinese medicine	Effective (53), Powerful (36), Awesome (33), Profound (33), Mighty (21), Great (11), Dependable (8), Useful (7), Fantastic (7), Proud (7)
Vaccinations	Effective (108), Urgent (63), Successful (41), Ineffective (30), Significant (27), Efficient (18), Serious (18), Best (18), Important (14), Powerful (13)
Data	Good (15), Effective (13), Best (12), Very good (8), Reliable (6), Strict (6), Important (6), Cautious (5), Obvious (5)

Analysis of the causes of negative perceptions based on object of comment

Based on previous analyses of the coded comments, this study found that the public's perceptions of posts that mention scientific achievements exhibit a range of emotional tendencies, including positive, negative, and neutral. According to trust theory, trust is a "leap of faith" or willingness to be vulnerable (Leith, 2013). The public needs scientific knowledge to solve problems and dilemmas in practice and tends to trust science and researchers with expertise, seeking their assistance. However, this trust can be altered by a variety of factors, which in turn can affect the public's acceptance and support of specific scientific achievements. It is clear that only when researchers and their achievements are trusted and accepted by the public can achievements be integrated into public practice and have a positive social impact. In contrast, negative perceptions, such as public criticism and questioning, can impede the realization of social impact. In order to promote the social benefits of research achievements, this study analyzes qualitatively the comment texts around bloggers, researchers, and academic achievements, especially those expressing negative attitudes, and analyzes what causes the public's negative perception of academic achievements.

Negative perception analysis toward bloggers

Based on the bloggers' identity authentication on Weibo, this study classified the bloggers into four identity types: mainstream media, clinician, R&D personnel, and industry association members. By extracting the comments directed at the bloggers, the distribution of comment content was plotted as shown in Figure 4. Criticism and questioning, which express negative public attitudes, accounted for the highest proportion of comments in mainstream media. However, comments directed at

clinicians, R&D personnel, and industry association members mainly consisted of approval, gratitude, and questions.

Tracing back to the original text, the study found that the main reason for the public's negative perception of academic achievements was the questioning of the professionalism and authenticity of the posts. This is manifested in the following ways: the content published by bloggers exhibits problems of lack of rigor, such as inconsistent images and typos, as well as unprofessional issues like misinterpretation of research conclusions and the incorrect use of professional terms. In addition, the completeness and objectivity of the published content also affect the public's perception of academic achievements. For example, some bloggers either failed to provide accurate data on vaccine protection rates, lacked detailed explanations on sample selection, or generalized conclusions based on limited samples. As a result, this may lead to doubts or misunderstandings among the public about the findings of scientific research and thus may hinder the positive impact of academic achievements on the public's perceptions and behaviors. Meanwhile, in the process of research dissemination, bloggers often neglect to explain the research design and focus only on presenting the research findings, and there are also a number of inaccurate citations or ambiguous statements. To ensure that academic achievements have a positive impact on public perceptions and are effectively applied, communicators need to be rigorous and precise in their references to the achievements, elaborating on key points that the public may have doubts about.

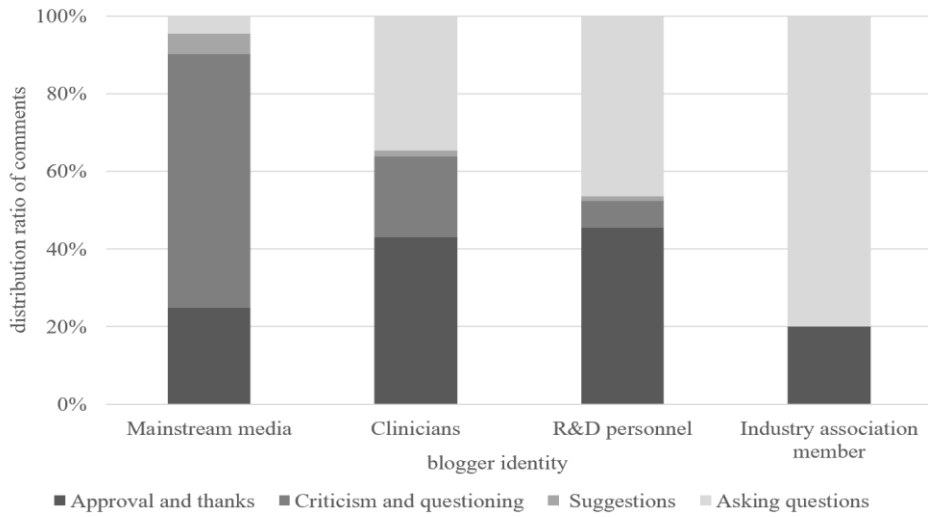

Figure 4. Distribution of comments by blogger identity.

Analysis of negative perceptions toward researchers

According to the coding scheme, the content of criticism and questioning reflects the distrust of researchers, with a total of 121 comments. Due to the relatively small sample size, this study identified the following three key reasons contributing to the public's negative perception of researchers through manual reading and analysis. Firstly, the public believes that researchers fail to prioritize the public's interest in conducting scientific research. Instead, they are perceived as being more driven by personal reputation and professional appraisal, thus making it difficult to understand and respond to the public's actual needs and plight. Secondly, the public lacks confidence in the research process, feeling uncertain about the reliability and validity of researchers' work. Doubts about the rigor of research methods and perceived inadequacies in research practices directly influence the public's trust in the research outcomes. Thirdly, the public points out that researchers' remarks in public lack objectivity and fail to reflect their professionalism and rigor. This undermines public trust in researchers.

In summary, the public's negative perception of researchers primarily arises from two phases: research process and dissemination of results. This distrust may further lead to negative public perceptions of research achievements, hindering their social application and overall impact. To address these concerns, it is recommended that researchers pay more attention to the public value of their research work when conducting research, and ensure that research projects can effectively respond to public concerns. During the research process, researchers should strictly adhere to research ethics and academic norms, ensuring the transparency and scientific integrity of the research to enhance its rigor and credibility. When disseminating research achievements, researchers should maintain an objective and professional attitude, clearly and accurately presenting the findings to foster a positive public image and facilitate the effective dissemination and application of research outcomes.

Analysis of negative perceptions toward academic achievements

According to the coding scheme, the criticism and questioning content reflects public mistrust toward academic achievements, with a total of 804 comments. This study used the LDA model to classify the public's negative perceptions toward the achievements into three themes. Figure 5 presents the co-occurrence map of theme words. Themes are distinguished by different grayscale levels in the figure, as shown in the legend.

Terms like "data", "vaccine", "study", "virus", "sample", "mortality", "drug", "effect" and "conclusion" were found across multiple themes, indicating that these terms are central to public concerns. Theme 1 includes terms such as "experiment", "trial", "clinical trial", "double-blind", "side effect", "placebo", "control group", "traditional Chinese medicine", "chloroquine" and "hydroxychloroquine". These terms reflect the public's distrust of the design of clinical trials of drug effectiveness and their implementation. The public may be concerned about the scientific validity of the trial design, the reliability of the trial results, and the risk of potential side effects. Theme 2 includes terms like "patient", "sample size", "statistics", "proportions" and "blood type". These terms point to the public's questioning of sample selection in research achievements. The public believes that sample selection bias may affect the accuracy and representativeness of the research findings, which may lead to discrepancies between the findings and the actual situation. Theme 3 includes terms such as "R&D", "strain", "number", "mutation", "efficacy", "infection rate", "protection rate" and "test". These terms reflect public doubts about the protective effects of vaccines. The public may have concerns about the vaccine development process, its effectiveness against different strains, and its overall efficacy.

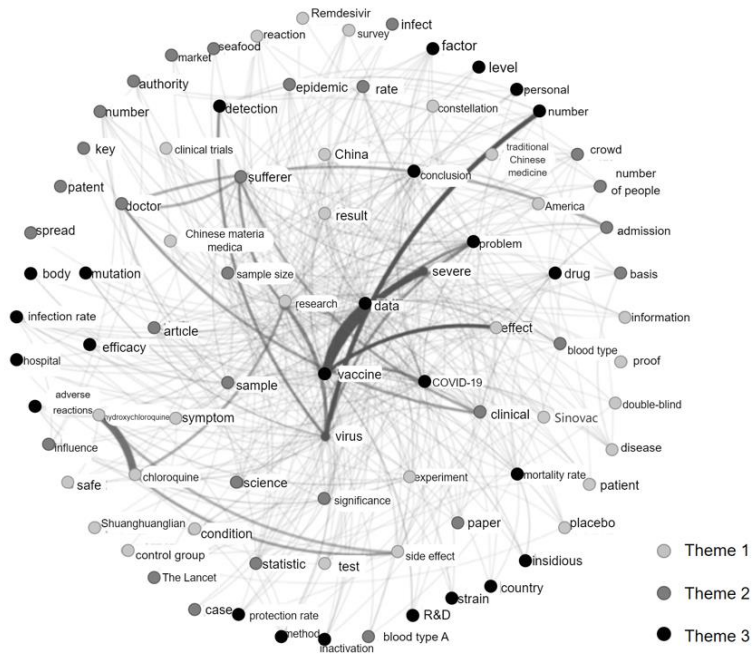

Figure 5. Thematic Co-occurrence of Negative Perceptions of Academic Achievements.

Conclusion and Implications

In this study, we used Weibo as the data source, collecting posts, comments, and reposts that mentioned academic achievements related to the COVID-19 pandemic, from health-related bloggers and mainstream media. Combining with the theory of public perception, we designed a coding scheme for comments and manually coded them. The public attitudes and perceptions reflected in likes, comments, and reposts were used to analyze the social impacts of academic achievements. The study shows that the public generally holds a positive attitude of respect and trust toward academic achievements, researchers, and bloggers. The dissemination of scientific findings has had a positive influence on public cognition and behavior, though some critical and skeptical voices still remain. In order to further improve the social impact assessment of academic achievements and enhance their dissemination and influence among the public, this study puts forward the following suggestions:

Fully explore social media data for assessing the social impact of academic achievements

With the development of the Internet era, an increasing number of the public access the latest scientific information and participate in public discussions through online media. The content of academic achievements and their applications (e.g., policies, products), as well as the corresponding user comments and reposts data, can be used as an important source of data for assessing the social impact of academic achievements. Based on the coding results of comments in this study, the content of public comments is varied and complex. On one hand, there are many comments that are unrelated to academic achievements or lack substantial content. These comments can hardly reflect the actual social impact of the research achievements. Therefore, the corresponding machine learning algorithms such as similarity matching, keyword recognition need to be developed to filter and mine online texts for social impact analysis. On the other hand, among the valid comments related to academic achievements, the focus of the commenters varies, such as academic achievements, bloggers, researchers, policies, etc. These objects of commentary are directly or indirectly linked to the impact of research achievements and can reflect the social impact from different perspectives. We should assign different weights based on the content of the comments when conducting social impact assessments. For example, regarding comments toward bloggers, we should consider the blogger's attitude toward the academic achievements in the original post to judge whether the social feedback of the achievements is positive or negative. Comments toward policies should be given higher weight, as they directly reflect the practical application of the

research outcomes. Comments that validate the research conclusions with personal experience, although showing public support for science, should be assigned less weight because they lack a professional perspective and are highly subjective. Similarly, comments that merely repeat the content of the research outcomes without offering new insights should be assigned lower weight.

Enhancing Public Trust in Academic achievements from the Perspective of Multiple Stakeholders

Enhancing public trust in academic achievements can promote the public's acceptance and application of scientific research results and secondary outputs based on them. This is of enormous significance for promoting the full use of academic achievements. To this end, public trust can be enhanced by focusing on the key stakeholders involved in the social impact transmission mechanism of research achievements: researchers, mainstream media, and government departments.

Researchers are both producers of academic achievements and the main force of scientific communication. Public mistrust of researchers primarily emerges during the phases of conducting research and disseminating research outcomes. Therefore, in fields closely related to public interests, scientific researchers should enhance their social responsibility, designing research topics and conducting studies based on public needs and interests. Scientific researchers should maintain a rigorous attitude toward their research work and avoid engaging in academic misconduct. Furthermore, researchers should actively engage in science communication by using social media platforms to share and exchange scientific information with the public, thereby bridging the gap between the public and academia. Our study has shown that the public tends to trust clinical doctors and researchers more than mainstream media, indicating that researchers' involvement in science communication activities can better enhance public understanding and acceptance of research achievements. However, as holders of specialized knowledge, researchers must align their communication with the actual needs of the public, providing clear answers to the scientific questions that the public cares about and simplifying technical language, explaining terms when necessary, rather than directly copying research texts. Our study found that a significant number of public comments expressed confusion, such as, "I don’t understand." Related research has also shown that different readability characteristics affect the Altmetric Attention Score of academic papers (Jin et al., 2021). Moreover, public skepticism toward research outcomes is partly due to insufficient explanations of research content. So, one of the challenges for scientists in science communication is ensuring that complex research processes and

conclusions are explained in a clear, simple, and objective manner. This is key to whether the public will truly recognize and accept research achievements, ultimately generating the desired social impact.

Mainstream media, with their broad audience reach and significant influence, have become the primary channels for the public to obtain scientific information, carrying the important responsibility of guiding public opinion. According to this study's analysis of how mainstream media mentions research achievements, media outlets tend to present the latest research findings succinctly, focusing on disseminating and promoting outstanding research achievements. Their reports are typically short, concise, and to the point. Although the main task of the mainstream media is not to analyze academic achievements in depth or answer public questions, the study found that they have used misspelled words, misused professional terms, and misinterpreted the research conclusions. These unprofessional actions can mislead the public to some extent and damage public trust in science. Therefore, while striving for timeliness in news reporting, mainstream media should maintain a rigorous and objective attitude. They must carefully verify information sources and present scientific information accurately and in detail, avoiding sensationalism, exaggeration of research findings, and improper inferences about research outcomes. To this end, mainstream media could establish a collaborative mechanism with researchers or professional science communicators to review content professionally before publishing related news reports, ensuring the authenticity and accuracy of the information.

Government departments develop public policies based on scientific research findings to promote the enhancement of public health and well-being, as well as the advancement of socio-economic development, thereby allowing research achievements to achieve their ultimate social impact. The scientific validity and rationality of public policies, as well as their ability to reflect the fundamental interests of the public, directly influence how the public understands and implements these policies. This study found that the public has voiced negative sentiments regarding certain policies on social media, indicating potential concerns or misunderstandings about the policy content or formulation process. To enhance public recognition and compliance, government departments should ensure transparency in using scientific research to formulate policies. This includes clearly stating the theoretical basis, scientific principles, and expected social effects of the policy, ensuring that the policymaking process respects and reflects the public's fundamental interests. Furthermore, government departments should establish comprehensive communication mechanisms to explain the background, objectives,

anticipated outcomes, and potential challenges of policies through diverse channels. This will help enhance public understanding and foster trust and support for the policies.

This study has some limitations. Firstly, due to the selection of Weibo as the data source, its built-in information filtering and blocking mechanisms resulted in the inability to access some negative comments. Secondly, the study limited the sources of posts to mainstream media and high-influence health domain bloggers, making the field of study somewhat narrow. To address these limitations, future research will expand the data sources, considering the inclusion of data from platforms such as Zhihu and WeChat official accounts. Additionally, future research will cover a broader range of research fields, focusing on research outcomes with high public attention and those closely related to public interests.

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