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ORIGINAL RESEARCH

The Relationship Between Social Media Information Sharing Characteristics and Problem Behaviors Among Chinese College Students Under Recommendation Algorithms

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Purpose: With the development of information technology and various social media, recommendation algorithms have increasingly more influence on users' social media usage. To date, there has been limited research focused on analyzing the impact of recommendation algorithms on social media use and their corresponding role in the development of problematic behaviors. The present study analyzes the impact of recommendation algorithms on college students' information sharing and internalizing, externalizing problem behaviors to address the aforementioned shortcomings.

Methods: An online questionnaire survey was conducted among 34,752 college students in China. A latent profile analysis was conducted to explore the various behavioral patterns of Chinese college students' information sharing across the three social media platforms identified for this study. The Bolck–Croon–Hagenaars (BCH) method Regression Mixture Modeling was then used to analyze the differences in internalizing and externalizing problem behaviors among the different subgroups of Chinese college students.

Results: The level of information sharing by college students across different social media platforms could be divided into "WeChat Moments low-frequency information sharing", "middle-frequency comprehensive information sharing", "TikTok high-frequency information sharing", and "Sina Weibo high-frequency information sharing". Significant differences were observed regarding internalizing and externalizing problem behaviors among college students in different information-sharing subgroups.

Conclusion: This study identified four subgroups with different information-sharing characteristics using latent profile analysis. Among them, college students who are in subgroup of social media information sharing influenced by recommendation algorithms exhibit higher frequency of information sharing and higher level of internalizing and externalizing problematic behaviors. These results expand our understanding of college students' social media usage and problem behaviors from a technological perspective. In future, the negative impacts of recommendation algorithms on college students can be reduced by improving their awareness of these algorithms and optimizing the algorithms themselves.

Keywords: user-generated content, recommendation algorithms, latent profile analysis, internalizing problem behaviors, externalizing problem behaviors

Introduction

In recent years, with the development of network information technology, various social media platforms have been integrated into people's daily lives. Up to December 2022, the number of social media users accounted for 95.13% of the total number of Internet users, and the total monthly active users of social media platforms such as WeChat, TikTok, and Sina Weibo exceeded 3 billion.[1] The diversified development of social media has led to the popularization and universality of cross-platform information behavior among users, whereby a user may generate or encounter similar or identical User-generated Content (UGC) on different social media platforms. Essentially, it is a form of information

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sharing behavior under the combined use of multiple social media. The information sharing behavior is a form of information feedback, which involves the mutual exchange of information among users. In this process, users not only receive information but also actively create and share information, reprocess or share and forward the received information.[2] However, with the continuous innovation of recommendation algorithm technology, social media platforms have transformed from being passive platform providers to active implementers of algorithmic recommendation services,[3] participating in the dissemination process of user information sharing. This has led to the replacement of "human-to-human" information feedback with a "human-algorithm-human" information feedback.[3] Users' information sharing behavior is not only influenced by other users' information sharing but also significantly influenced by the information presented by recommendation algorithms. It becomes a behavior that is not determined by oneself but influenced by recommendation algorithms. As the frequency of this behavior increases, the influence of recommendation algorithms also increases, ultimately making users' information sharing behavior as a product of human-machine collaboration. Moreover, recommendation algorithms that satisfy users' information needs also prompt users to spend a significant amount of time on social media, leading to excessive use of social media. However, previous studies have mostly examined the factors influencing the excessive use of social media from the perspective of users (such as misuse), with little consideration given to the role of social media algorithm recommendation and the impact of recommendation algorithms on users' information sharing behavior. It is also unknown how the information sharing behavior on social media combination use, influenced by recommendation algorithms, affects users' problem behaviors. Therefore, this study taking college students as the research object to analyze the impact of information sharing on problem behaviors across different social media platforms, investigate the influence of recommendation algorithms on Chinese college students' information sharing behaviors on social media, and explore its role in both social media information sharing and problem behaviors.

Social Media Information Sharing and Recommendation Algorithms

Social media information sharing refers to the behavior of users on social media platforms to communicate and share information, viewpoints, experience, and other content that they are interested in or consider valuable, by posting, forwarding, commenting and other means. Current studies on the influencing factors of social media information sharing primarily focus on two aspects: users characteristics and information characteristics. Specifically, previous studies have found that group pressure,[4] positive information sentiment,[5] information sharing value,[6] information quality, users' habits,[7] motivation, needs and the sources of information[8] all have an impact on users' social media information sharing.

Although some influencing factors of social media information sharing have been explored, there are two shortcomings which need to be addressed. Firstly, recommendation algorithms are rarely considered. Recommendation algorithms are information filtering systems that aim to recommend users with relevant information by analyzing their interests and behaviors on social media. Collecting various data from users' interactions on social media platforms, such as browsing history, likes, comments, and shares is the first step of this process. Next is establishing users' profile, based on the collected data, and analyzing the characteristics of the information content on social media platform. Subsequently, collaborative filtering, content-based filtering, and deep learning algorithms are employed to recommend the most likely interesting content to users. Furthermore, the recommendation algorithms are continuously updated and optimized based on users' latest behaviors and feedback. However, with the commercial development of social media platforms, recommendation algorithms are increasingly being applied to attract potential users, retain existing users, and increase user engagement (ie, prolong the time that users spend on social media).[3] This greatly increases users' usage of social media, leading to excessive use of social media and even addictive behaviors.[9] Hasan[10] found that the use of recommendation algorithms leads to excessive use of video streaming services provided by YouTube and Netflix. A cognitive neuroscience study also indicates that recommendation algorithms can sustain users' attention on personalized content for longer periods, prolonging their use of social media.[9] These studies suggest that recommendation algorithms increase users' usage of social media, and as a form of social media usage, information sharing is likely to be more frequent among users influenced by recommendation algorithms. On the other hand, under the dual catalysis of "socializing for all" and "diversification of social media", the behavior of users' information sharing cross social media has become popular and universal. While previous studies have mostly analyzed the use of social media in a holistic

manner or focused on information sharing on a particular social media platform. It is necessary to analyze users' social media usage from the perspective of different types of social media usage in order to have a clearer understanding of the underlying mechanisms of users' excessive use of social media. In summary, the first objective of this study is to identify the types of users' information sharing combinations across different social media platforms and analysis the impact of recommendation algorithms on users' information sharing behaviors.

Recommendation Algorithms and Problem Behavior

Currently, there has been no research analyzing the impact of social media information sharing on users' internalizing and externalizing problem behaviors. Existing studies have primarily examined this from a more macro perspective of social media usage. Research has found that while social media usage brings convenience to people's lives, there are also cases of inappropriate usage that can develop into excessive social media use, leading to higher levels of internalizing and externalizing problem behaviors among users. Regarding internalizing problem behaviors, researchers have found that excessive social media users display a greater frequency of experiencing negative emotions, specifically loneliness,[11] anxiety,[12,13] and depression,[14] as well as poorer sleep quality.[15] Regarding externalizing problem behaviors, excessive use of social media impacts users' cognitive function,[16,17] social activities,[18] purchasing behavior,[19,20] decision-making[21] and recording and posting illegal materials.[22]

Previous studies have analyzed the influence of excessive social media use on users' internalizing and externalizing problem behaviors from multiple perspectives. The premise of their analysis on the impact of excessive social media use on internalizing and externalizing problem behaviors is that users' own factors (such as improper use) are considered as the reasons for their excessive social media use. However, consistent with the previous discussion, the role played by recommendation algorithms in the relationship between users' social media usage and internalizing and externalizing problem behaviors has been overlooked with the rapid development of information technology. On the one hand, recommendation algorithms may contribute to users' prolonged social media usage, even leading to excessive social media use and short video addiction. Existing research has shown that excessive use of social media increases the risk of problem behavior among users, including both internalizing behaviors (such as depression, anxiety) and externalizing behaviors (such as hyperactivity, attention deficit, disciplinary issues). On other hand, recommendation algorithms heavily present homogenized information, limiting users' access to a wide range and depth of information.[23] This leads to information confinement, indirectly resulting in an increase in problem behavior among users. He found that recommendation algorithms can create information filter bubbles, increasing the risk of depression and loneliness among older adults.[24] Another study found that recommendation algorithms decrease the likelihood of users encountering diverse information, leading to a decrease in decision quality.[25] According to Media Context Theory,[26] changes in media lead to changes in social environments, which in turn influence human behavior. Based on this theory, the homogenized information environment created by recommendation algorithms leads to changes in the media context, resulting in corresponding changes in the social environment that ultimately impact users' behavior. Thus, users' information sharing behavior becomes a product of human-machine collaboration, where their expression of emotions and behavior is not only influenced by their own emotions but also guided by recommendation algorithms. This results in a narrowing and singularization of users' information sharing, as they are constantly immersed in a homogeneous and like-minded communication environment. This may cause users isolate themselves.[27] Furthermore, when users return to the diverse real-life with various viewpoints, their own identity may be challenged, leading to problem behavior. Therefore, it is possible that recommendation algorithms may exert a positive influence on users' internalizing and externalizing of problem behaviors by influencing their social media usage. However, previous research on this issue is extremely limited. Moreover, in the current era where user-generated content (UGC) is prevalent in social media, users' sharing of social media information can better represent their deeper engagement in social media usage, the impact of this engagement on users' internalizing and externalizing of problem behaviors has also been scarce in previous research. In summary, the second objective of this study is to determine the differences in the levels of internalizing and externalizing of problem behaviors among users with different combinations of social media information

sharing, and to analyze the influence of recommendation algorithms on internalizing and externalizing of problem behaviors.

Current Study

The present study focuses on college students as the research population. College students are the main users of social media, and they are more receptive to emerging social media platforms. In addition, college students are in a transitional phase from adolescence to adulthood, facing various choices and pressures,[28] making them a high-risk group for problem behavior.[29] Firstly, we explore the impact of recommendation algorithms on college students' social media information sharing, mainly through latent profile analysis of college students' information sharing on three social media platforms, including WeChat Moments, Sina Weibo, and TikTok. Each of these platforms have a broad user base, with the monthly active users being 1.009 billion, 336 million, and 760 million, respectively.[30] WeChat Moments itself does not have an algorithmic recommendation function, and the content shared by users mainly falls under "sharing life", which describes users' initiative to share their life feelings and thoughts. Sina Weibo does rely on algorithmic recommendation; users are easily influenced by it and are thus involved in the interaction of all kinds of information. Similarly, TikTok also utilizes recommendation algorithms that shape the content, quality, duration, and label of information shared by users, and then recommends this content to more users with the same information needs. Therefore, by examining the combination of Chinese college students' use of the above three social media platforms, it can be determined whether recommendation algorithms have an influence on college students' information sharing (When college students primarily use social media platforms without recommendation algorithms and hardly share information on platforms with recommendation algorithms, their exposure to the influence of recommendation algorithms is minimal. Conversely, if college students predominantly share information on social media platforms with recommendation algorithms, they are likely to be greatly influenced by these algorithms). This analysis can therefore help to determine the level of influence recommendation algorithms have on college students' problem behaviors (including internalizing and externalizing problem behaviors).

Based on the integration of existing theories and relevant empirical research results, the present study proposes the following hypotheses:

H1: There are different combinations of social media, using for information sharing among college students, and college students who use social media platforms with recommendation algorithms tend to have a higher frequency of information sharing behaviors.

H2: College students influenced by recommendation algorithms exhibit higher levels of internalizing and externalizing of problem behaviors. Specifically, college students who primarily share information on platforms such as TikTok or Sina Weibo tend to have higher levels of internalizing and externalizing problem behaviors.

Materials and Methods

Participants and Procedure

The research protocols were approved by the Research Ethics Committee of the corresponding author's institution. Individuals were invited to participate anonymously in a longitudinal survey via the Fengniao online survey websites during 2022. By clicking the link to the survey, all participants were informed that their participation was completely voluntary and that they had the right to opt out at any time, and informed consent was obtained from all the subjects at data collection phase, participants were also provided with information about the study before providing their answers. The link to the survey was published up until a week. All data were saved by the survey agency Fengniao, before passing it on to the research team. A total of 36,139 participants from 10 universities in three Chinese provinces and cities (Liaoning, Sichuan, and Chongqing) participated in the present study. All participants indicated that they were social media users. Participants giving none or partial responses were deleted from the dataset (n=1387). At last, 34,752 (Mage = 19.04, SDage = 1.32, 45% male) valid questionnaires were obtained, with a response rate of 96.16%. The study was carried out in accordance with the Helsinki Convention and China Health Research Act.

Measures

Information Sharing

The information-sharing status of college students on WeChat Moments, Sina Weibo, and TikTok was measured using part of the information sharing on social media section in the questionnaire on the social media combination of youth groups compiled by Li.[31] The scale utilized consisted of three questions, 1."How often do you share information on WeChat Moments in the past year?" 2."How often do you share information on TikTok in the past year?" 3."How often do you share information on Sina Weibo in the past year?" 7 points were used, 1 meant "never share", 2 meant "share 1–3 items in a year", 3 meant "share 1–3 items in half a year", 4 meant "share 1–3 items in a month", five meant "share 1–3 items in a week", six meant "share 4–7 items in a week", and 7 meant "share more than seven items in a week". Higher scores indicated a higher level of information sharing among college students. The internal consistency coefficient (α) of the questionnaire was 0.60.

Problem Behaviors

The internalizing problem behaviors subscale (five questions measuring depression, anxiety, sleep problems, post-traumatic stress disorder, and suicidal ideation) and the externalizing problem behaviors subscale (six questions measuring attention deficit, hyperactivity, impulsiveness, and conduct) were used in Dennis's Global Appraisal of Individual Needs[32] to measure the internalizing and externalizing problem behaviors of college students. Both subscales were scored on a 5-point scale (from 1 = "never experienced" to 5 = "past month"), and participants were asked to answer when they last experienced such behaviors or emotional states, with higher scores indicating a more severe incidence rate of problem behaviors. The questionnaire's internal consistency coefficients (α) were 0.86 and 0.78, respectively.

Statistical Analysis

SPSS 25.0 was used for descriptive statistics and correlation analysis of the main study variables. Mplus8.3 was employed for latent profile analysis (LPA). Specifically, it includes the following two steps. First, LPA was performed for information-sharing for all participants. The initial model assumed that only one profile existed in the sample, and the number of profiles was gradually increased until an optimal fit was reached. The following indices were selected to evaluate the model: Akaike information criterion (AIC), Bayesian information criterion (BIC), sample-size-adjusted BIC (a-BIC), Lo-Mendell-Rubin likelihood ratio test (LMRLRT), and entropy. [33] Second, the Bolck–Croon–Hagenaars (BCH) method (The BCH method in regression mixture models, a statistical technique specifically designed for continuous outcome variables, operates within the framework of regression mixture models. It is capable of capturing the heterogeneity among different latent groups in the data, providing unique regression relationship estimates for each group. By setting the number of latent classes and estimating parameters based on the data, the BCH method enables more accurate prediction and interpretation of outcome variables, especially when there are unobservable group differences in the data.) was used to establish a Regression Mixture Modeling (RMM), and the information-sharing profile of Chinese college students was used as the independent variable. Internalizing and externalizing problem behaviors were considered dependent variables, and sex and subjective socioeconomic status were used as control variables. The objective of this study was to understand the relationship between the information-sharing profiles and problem behaviors of Chinese college students.

Results

Descriptive Statistics and Correlation Analysis

Descriptive statistics (means and standard deviations) and Pearson correlations for the main variables are presented in Table 1. Sex had a significant positive correlation with subjective socioeconomic status and a negative correlation with information sharing on WeChat Moments, Sina Weibo, TikTok, and internalizing problem behaviors. Subjective socioeconomic status was positively correlated with information sharing on WeChat Moments and Sina Weibo, but significantly negatively correlated with information sharing on TikTok, as well as on internalizing problem behaviors and

Table 1 Mean, Standard Deviations, and Correlations of the Main Variables

	Mean	SD	1	2	3	4	5	6	7
1. Sex			1						
2. Subjective socioeconomic status	2.60	0.68	0.07**	1					
3. WeChat Moments information sharing	2.97	1.64	0.20**	0.04**	1				
4. Sina Weibo information sharing	1.68	1.41	0.08**	0.02**	0.31**	1			
5. TikTok information sharing	2.06	1.69	0.08**	0.05**	0.36**	0.32**	1		
6. Internalizing problem behaviors	2.51	1.20	0.07**	0.06**	0.11**	0.05**	0.05**	1	
7. Externalizing problem behaviors	2.01	0.92	0.01	0.05**	0.09**	0.08**	0.08**	0.68**	1

Notes: **$p<0.01$, *sex* is dummy variable "0" = female, "1" = male.

externalizing problem behaviors. There was a significant positive correlation between information sharing on WeChat Moments, Sina Weibo, and TikTok, as well as on internalizing problem behaviors, and externalizing problem behaviors.

Identifying the Social Media Information Sharing Profiles

Mplus8.3 software was used for LPA, and a robust maximum likelihood estimation method was adopted. The LPA started with a one-profile model and gradually increased the number of classes in the model until it identified the model with the optimal fitting index. Taking the three information-sharing questions as observation variables, profile models 1–6 were extracted. The model-fitting index is shown in Table 2. With an increase in the number of profiles, the information indices AIC, BIC, and aBIC decreased continuously, and the Lo-Mendell-Rubin (LMR) and bootstrap likelihood ratio test (BLRT) results were significant, indicating that the model had improved. However, the proportion of minimum classes in profiles five and six was less than 5%. Therefore, considering the fitting parameters and practical significance, the four-profile model was the optimal solution for the data. The four-profile model had an entropy value of 0.97, indicating high classification accuracy. We plotted a graph of the four-profile LPA model to aid interpretation. In this graph (see Figure 1), compared with the other three profiles, college students in the first profile had the lowest level of reported information sharing on the three social media platforms, among which information sharing on WeChat Moments was higher than that on Sina Weibo and TikTok and was at a low frequency. Thus, the first profile was named WeChat Moments low-frequency information sharing (71.06%). College students in the second profile had similar information-sharing scores on the three social media platforms, all in the middle frequency. The second profile was thus named middle-frequency comprehensive information sharing (10.76%). College students in the third profile shared more information on TikTok than on the other two social media platforms and were at a high frequency, so this profile was named TikTok high-frequency information sharing (11.12%). The students in the fourth profile shared more information on Sina Weibo at a higher frequency than on the other two social media platforms, with the fourth profile subsequently named Sina Weibo high-frequency information sharing (7.06%). The average scores of college students on WeChat Moments for low-frequency information sharing, middle-frequency comprehensive information sharing, TikTok high-frequency information sharing, and Sina Weibo high-frequency information sharing across the three social media platforms were 1.64, 3.41, 3.47, and 3.75, respectively. This shows that, in terms of general information sharing among college students, WeChat Moments low-frequency information sharing at low frequency. In contrast, the other

Table 2 Fit Statistics for the Latent Profile Analysis

Profile	AIC	BIC	aBIC	Entropy	LMR	BLRT	Proportions Min
1	390,887.07	390,937.80	390,918.73	1			1
2	353,852.74	353,937.30	353,905.52	0.97	0.0000	0.0000	13.63%
3	332,699.65	332,818.03	332,773.54	1	0.0000	0.0000	7.06%
4	318,909.09	319,061.30	319,004.09	0.97	0.0000	0.0000	7.06%
5	305,381.01	305,567.04	305,497.13	0.98	0.0000	0.0000	3.57%
6	288,758.41	288,978.26	288,895.63	0.98	0.0000	0.0000	3.57%

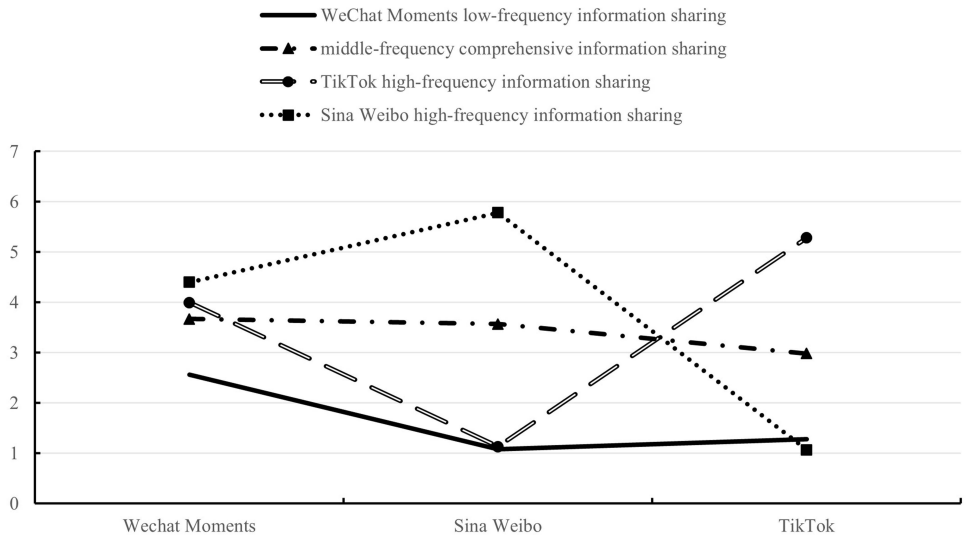

Figure 1 Latent Profile Indicator Means for the Four-Profile Model.

three profiles exhibited middle-frequency information sharing, and the information sharing frequencies were relatively close.

Influence of Information Sharing Profiles on Internalizing Problem Behaviors and Externalizing Problem Behaviors

Using college students' social media information sharing profiles as independent variables, internalizing and externalizing problem behaviors as dependent variables, and subjective socioeconomic status and sex as control variables, a BCH mixed regression model was constructed. The results showed that (as shown in Table 3) there were significant differences in the level of internalizing problem behavior (χ^2[3, 34,752] = 168.29, $p < 0.001$) and externalizing problem behavior (χ^2[3, 34,752] = 256.31, $p < 0.001$) among the Chinese college students surveyed with different types of social media information sharing evident. Specifically, in terms of internalizing problem behaviors of college students, the middle-frequency comprehensive information sharing ($p < 0.001$), TikTok high-frequency information-sharing group ($p < 0.001$), and Sina Weibo high-frequency information-sharing group ($p < 0.001$) were significantly higher than WeChat Moments low-frequency information sharing. The level of internalizing problem behaviors of college students in TikTok high-frequency information sharing ($p < 0.001$) and Sina Weibo high-frequency information sharing ($p < 0.001$) was significantly higher than in middle-frequency comprehensive information sharing. In terms of the externalizing problem behaviors of Chinese college students, middle-frequency comprehensive information sharing ($p < 0.001$), TikTok high-frequency information sharing ($p < 0.001$), and Sina Weibo high-frequency information sharing ($p < 0.001$) were significantly higher than WeChat Moments low-frequency information sharing, while Sina Weibo high-frequency

Table 3 Results for Internalizing and Externalizing Problem Behaviors by Profiles

Variables	Social media Information sharing profiles								
	WeChat Moments low-frequency information sharing		Middle-frequency comprehensive information sharing		TikTok high-frequency information sharing		Sina Weibo high-frequency information sharing		χ^2
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	
Internalizing problem behaviors	2.46	0.01	2.55	0.02	2.70	0.02	2.67	0.03	168.29***
Externalizing problem behaviors	1.95	0.01	2.14	0.02	2.11	0.02	2.19	0.02	256.31***

Note: ***$p < 0.001$.

information sharing ($p < 0.01$) was significantly higher than TikTok high-frequency information sharing. No other significant differences were found between the variables assessed.

Discussion

The present study explored the subcategories of college students' social media information sharing, distinguishing the influence of recommendation algorithms across different subcategories and the effect of these subcategories on internalizing and externalizing problem behaviors. The research findings revealed four subcategories of college students' social media information sharing, including WeChat Moments low-frequency information sharing, middle-frequency comprehensive information sharing, TikTok high-frequency information sharing, and Sina Weibo high-frequency information sharing. The college students belonging to the subcategory influenced by recommendation algorithms exhibited higher levels of internalizing and externalizing of problem behaviors. These findings provide evidence for the positive impact of recommendation algorithms on the internalizing and externalizing of problem behaviors among college students.

Subcategories of Social Media Information Sharing in College Students

As mentioned above, WeChat Moments is a private and closed information space built on acquaintance relationships, its contents mainly displaying personal life status, sharing hobbies and interests, and interacting with friends, without involving recommendation algorithms. In contrast, Sina Weibo and TikTok are more open information spaces that utilize sophisticated algorithmic recommendation mechanisms to provide users with relevant content based on analysis of their interests, preferences, historical behaviors, and social relationships on the platforms. Based on this, college students in the WeChat Moments low-frequency information sharing group, who engage in infrequent information sharing on WeChat Moments but hardly share any information on TikTok and Sina Weibo, are not influenced by recommendation algorithms in their information sharing. However, college students in the other three subcategories, who exhibit moderate or high-frequency information sharing behaviors on TikTok and Sina Weibo, are influenced by recommendation algorithms in their information sharing.

The number of college students in the low-frequency information sharing subgroup on WeChat Moments is the highest. This may be because WeChat Moments is the most popular application in China's social media platforms and has become an indispensable part of college students' daily lives. College students in the middle-frequency comprehensive information sharing subgroup share relatively balanced information across the three social media platforms identified, all in the medium frequency, the frequency of their overall information sharing behavior is close to that of the TikTok and Sina Weibo high-frequency information sharing. On one hand, this group of college students exhibits a higher frequency of information sharing behavior influenced by the recommendation algorithms, compared to the WeChat Moments low-frequency information sharing group. On the other hand, this group of college students is likely to engage in cross-platform social media information sharing more frequently, rather than focusing solely on one social media platform. However, their time is limited. Therefore, they tend to exhibit a more balanced distribution of social media information sharing.[6]

College students in the TikTok high-frequency information sharing and Sina Weibo high-frequency information sharing subgroups have high-frequency information sharing on TikTok and Sina Weibo, respectively. Furthermore, the use of TikTok and Sina Weibo by these two subgroups of college students is mutually exclusive. College students in the high-frequency TikTok information sharing group hardly engage in information sharing on Sina Weibo, and similarly, college students in the high-frequency Sina Weibo information sharing group hardly share information on TikTok. There are two aspects possible explanations. On one hand, both social media platforms have open information environments, and their content circulates mutually on the internet, thus users can access the same information content. Moreover, TikTok and Sina Weibo both utilize recommendation algorithms systems which take a role of enhancing user engagement and prolonging their usage time to categorize users and recommend information content that meets their needs, enabling users to conveniently access information. However, college students' time is limited, and when they are heavily influenced by recommendation algorithms to use one social media platform, they often have little time left to use another. On the other hand, according to the Media Dependency Theory,[34] college students rely on the information

provided by media to satisfy their needs. When users fulfill their information needs through a particular social media platform, they no longer need to other platforms to meet their needs. Additionally, while enjoying the convenience and habitual changes brought about by recommendation algorithms, users also gradually modify the algorithms to meet their information needs. As a social media platform becomes more attuned to a user's information needs, and the user becomes more accustomed to using the algorithm to satisfy their needs, a mutual dependency between users and social media platform emerges. It is difficult for users to disengage from their current platform and devote time to adapting to a new one.

The Predictive Effect of Information Sharing Influenced by Different Recommendation Algorithms on Internalizing and Externalizing of Problem Behaviors Among College Students

The present study employed the BCH regression mixture model to investigate the predictive effect of subcategories of college students' information sharing on internalizing and externalizing problem behaviors. The results indicate that college students belonging to the subcategory influenced by recommendation algorithms exhibited higher levels of internalizing and externalizing problem behaviors. Specifically, TikTok and Sina Weibo high-frequency information-sharing had the highest levels of internalizing problem behaviors. Due to the influence of recommendation algorithms, college students from the two aforementioned subgroup may spend excessive amounts of time on social media, potentially leading to social media overuse, which subsequently increases the risk of developing internalizing problem behaviors. Furthermore, according to the immersion theory,[35] algorithms continuously push information content that satisfies college students' needs, facilitating their immersion in this state. However, this state is primarily a virtual experience that consumes significant time among college students, potentially causing academic crises and ultimately leading to negative emotions such as anxiety and depression.

College students in the subgroups of TikTok high-frequency information sharing, and Sina Weibo high-frequency information sharing may be influenced by recommendation algorithms, resulting in the Information Cocoon.[36] According to Sunstein, discussions among people with the same views tend to make users' emotions more negative.[37] Bessi's research also showed that when users' content production is centered on a specific worldview, this promotes the formation of a homogeneous community; in which the question of whether users are faced with facts or rumors, the degree of content they produce, and the length of their discussion time will contribute to producing more negative emotions over time.[38] Moreover, the long-term communication of homogeneous views may lead to the polarization of college students' perspectives. When they return to reality and encounter diverse opinions, conflicts of perspectives may arise, resulting in the confusion of self-identity and an increase in the level of internalizing problem behavior. Regarding externalizing problem behaviors, the level of problem behavior among the other three groups of college students was higher than those among the WeChat Moments of low-frequency information sharing subgroup. The format limitations of TikTok and Sina Weibo on college students' information contents make their main information content fragmented.[39] Relying on recommendation algorithms, college students will face an increasing amount of fragmented information and need to make immediate decisions on whether to forward or comment, which will undoubtedly increase their cognitive load. As processing and filtering relevant information and irrelevant disturbing information requires sustained attention, over time, these college students who face fragmented information in a long-term will be more easily distracted,[40] resulting in impaired sustained attention. Furthermore, unlike WeChat Moments, which is built upon acquaintances, the fully open social media platforms of TikTok and Sina Weibo are more likely to accept negative information shared by strangers, such as money worship, pornography, and violence. And recommendation algorithms make them susceptible to negative information. Based on the cognitive behavioral model and the General Aggression Model, negative information on TikTok and Sina Weibo can have an arousal effect on problem behaviors exhibited by college students in real life. Recommendation algorithms also provide convenience for college students to access negative information. Therefore, the more college students share information on TikTok and Sina Weibo, indicating a longer usage time of these platforms, the deeper the impact of negative information on them, which can directly and indirectly affect their externalizing problem behaviors.[41]

Conclusion and Practical Implications

The present study found that there are four subgroups of college students in terms of social media information sharing: WeChat Moments low-frequency information sharing, middle-frequency comprehensive information sharing, TikTok high-frequency information sharing, and Sina Weibo high-frequency information sharing. Among them, the groups of middle-frequency comprehensive information sharing, TikTok high-frequency information sharing, and Sina Weibo high-frequency information sharing displayed a higher frequency of information sharing behaviors influenced by recommendation algorithms. Additionally, these college students affected by algorithmic recommendations also exhibited higher levels of internalizing and externalizing problem behaviors. These research findings broaden our understanding of college students' social media usage and problem behaviors from a technological perspective, thereby increasing the awareness of relevant researchers and algorithm practitioners regarding the potential negative impacts of recommendation algorithms on users. Consequently, this can lead to a more comprehensive approach to improving excessive social media use among college students and preventing or reducing their internalizing and externalizing problem behaviors. On one hand, through education and advocacy, we can enhance college students' awareness of social media recommendation algorithms and help them establish healthy social media usage habits. On the other hand, psychology researchers should actively collaborate with algorithm practitioners to assist them in optimizing recommendation algorithms from the perspective of users' rational usage, reducing negative impacts on users.

Research Limitations and Future Research

This study has some limitations. First, the research object of this study was Chinese college students. Whether the research results can be extended to other age demographics and heterogeneous groups with different cultural backgrounds needs to be verified by more studies using different age demographics and participants with different cultural backgrounds. Second, the results of this study were based on self-reported data, meaning the subjects may have provided inaccurate answers under the influence of social expectations. The reliability of the results must be verified through multiagent data collection (such as peer and teacher evaluations). Third, this study explored the impact of recommendation algorithms on college students' social media information sharing and internalization and externalization problem behaviors through a relatively indirect questionnaire approach, yet it cannot eliminate the interference of some influencing factors (such as the characteristics of social media platforms and college students' usage patterns of social media). Future research can further elaborate the effects of recommendation algorithms on users' social media usage and mental health through experimental design.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics Statement

All participants in the study provided informed consent, and all the methods and research procedures were conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethical Committee of Affiliated Cancer Hospital of Chongqing University.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. KAWO. 2023; China Social Media Platform Guide. Available from: https://t.cj.sina.com.cn/articles/v-iew/1577794853/5e0b3d2501901wcsn?autocallup=no&isfromsina=no&. Accessed July 16, 2024.
2. Chen JX, Dong JF. Research on the influential factors of social media users' information sharing behavior from the perspective of information ecology. *Lib Work Coll Unive*. 2023;04:54–66 doi:10.3969/j.issn.1003-7845.2023.04.007.
3. Zhang T, Yan FJ. Youth values molding in the perspective of algorithm recommendation: challenges and optimization strategies. *Stud Core Socialist Values*. 2022;8(5):32–41 doi:10.16513/j.shzyhxjzgyj.2022.05.006.
4. Zou X, Xie JW. The Impact of Group Pressure on WeChat Users' Information Sharing Behavior. *J Res*. 2019;09:69–82+120.
5. Zhang H, Jiang T, Wan XY, Sheng HG. The influence of Microblog information emotion type on user' willingness to share: Analysis based on research on microblog hot events. *J Intelligence*. 2019;05:169–176. doi:10.3969/j.issn.1002-1965.2019.05.025
6. Huang W, X. BID, Yang T, et al. Mechanism of the influence of platform features on UGC information sharing behavior across social media. *J Mod Inform*. 2024;02:115–129. doi:10.3969/j.issn.1008-0821.2024.02.010
7. Chen M, Zhen H, J P, Qi X. Research on the continuity of information sharing desire on mobile social media. *Inform Stud*. 2017;04:37–43. doi:10.16353/j.cnki.1000-7490.2017.04.007
8. Xue X, Ma H, Zhao Y, Y X, Zhu QH. Investigation the influence of health misinformation features on users' sharing willingness in social media. *Lib Inform Serv*. 2024;04:70–82. doi:10.13266/j.issn.0252-3116.2024.04.006
9. Su C, Zhou H, Gong L, Teng B, Hu Y, Hu Y. Viewing personalized video clips recommended by TikTok activates default mode network and ventral tegmental area. *Neuroimage*. 2021;237(6):118–136. doi:10.1016/jneuroimage.2021.118136
10. Hasan MR, Jha AK, Liu Y. Excessive use of online video streaming services: impact of recommender system use, psychological factors, and motives. *Comp Human Behav*. 2018;80:220–228. doi:10.1016/j.chb.2017.11.020
11. Marttila E, Koivula A, Rsnen P. Does excessive social media use decrease subjective well-being? A longitudinal analysis of the relationship between problematic use, loneliness, and life satisfaction. *Telematics Inform*. 2021;59(1):101556. doi:10.1016/jtele.2020.101556
12. Boursier V, Gioia F, Musetti A, Schimmenti A. Facing loneliness and anxiety during the COVID-19 isolation: the role of excessive social media use in a sample of Italian adults. *Front Psych*. 2020;11:11. doi:10.3389/fpsyt.2020.586222
13. Chen BZ, Zheng X, Sun XJ. The relationship between problematic social media use and online social anxiety: the role of social media cognitive overload and dispositional mindfulness. *Psyc Develop Educ*. 2023;39(05):743–751. doi:10.16187/j.cnki.issn1001-4918.2023.05.16
14. Huang C. A meta-analysis of the problematic social media use and mental health. *Inter J Social Psych*. 2022;68(1):12–33. doi:10.1177/0020764020978434
15. Mohamed AH. The excessive use of social media and its relationship to insomnia among female students at Hail University. *Refund Stud Res Develop*. 2021;3. doi:10.31559/EPS2021.9.3.16
16. Gao QF, Zhao JJ, Zhang DD, Zhang D. Inhibitory control in excessive social networking users: evidence from an event-related potential-based go-nogo task. *Front Psych*. 2019;10:1810. doi:10.3389/fpsyg.2019.01810
17. Masood A, Luqman A, Feng Y, Ali A. Adverse consequences of excessive social networking site use on academic performance: explaining underlying mechanism from stress perspective. *Comp Human Behav*. 2020;113. doi:10.1016/j.chb.2020.106476
18. Chan TKH, Cheung CMK, Lee ZWY, Neben T Why do I keep checking my Facebook? The role of urge in the excessive use of social networking sites. *2015 48th Hawaii International Conference on System Sciences*. IEEE.
19. Sharif SP, Yeoh KK. Excessive social networking sites use and online compulsive buying in young adults: the mediating role of money attitude. *Young Cons*. 2018;19(3):310–327. doi:10.1108/YC-10-2017-00743
20. She L, Rasiah R, Waheed H, Sharif SP. Excessive use of social networking sites and financial well-being among young adults: the mediating role of online compulsive buying. *Young Cons*. 2021;22(2):272–289. doi:10.1108/YC-11-2020-1252
21. Meshi D, Elizarova A, Bender A, Verdejo-Garcia A. Excessive social media users demonstrate impaired decision-making in the Iowa gambling task. *J Behav Addict*. 2019;8(1):169–173. doi:10.1556/2006.7.2018.138
22. Drouin M, Miller DA. Why do people record and post illegal material? Excessive social media use, psychological disorder, or both? *Comp Human Behav*. 2015;48:608–614. doi:10.1016/j.chb.2015.02.030
23. Ren QJ, Zhao X, Han Y. Analysis on the causes of the information cocoons under user perspectives. *Lib Inform Serv*. 2021;65:120–127. doi:10.13266/jissn.0252-3116.2021
24. He YQ, Liu DR, Guo RT, Guo SP. Information Cocoons on Short Video Platforms and Its Influence on Depression Among the Elderly: a Moderated Mediation Model. *Psyc Res Beh Manag*. 2023;16:2469–2480. doi:10.2147/PRBM.S415832
25. Chen S, Qiu H, Zhao S, et al. When more is less: the other side of artificial intelligence recommendation. *J Manag Scien Engin*. 2022;7(2):20. doi:10.1016/j.jmse.2021.08.001
26. Merowitz J. *Vanishing Territories: The Impact of Electronic Media on Social Behavior*. Beijing: Tsinghua University Press; 2002.
27. Cargnino M, Neubaum G. Are we deliberately captivated by homogeneous cocoons? An investigation on political tie building on Facebook. *Mass Comm Society*. 2020;24(2):187–209. doi:10.1080/15205436.2020.1805632
28. Wu Y, Wu L, Niu GF, Chen ZZ, Liu LZ. The effect of WeChat Moments use on depression among college students: The role of negative social comparison and self-concept clarity. *Psychol Develop Educ*. 2020;4:486–493 doi:10.16187/j.cnki.issn1001-4918.2020.04.12.
29. Institute of Psychology, Chinese Academy of Sciences. China National Mental Health Development Report; 2021:Social Sciences Academic Press.
30. Imedia Research. Ranking of monthly operational data of China APP Market in 2022. Iimedia. Availabe from www.iimedia.cn/c880/91597.html. Accessed February 1, 2023
31. Li WJ. Based on the share of young users of social media content combination research [Doctoral Thesis]. Tsinghua University; 2021.
32. Dennis ML, Chan Y-F, Funk RR. Development and validation of the GAIN Short Screener (GSS) for internalizing, externalizing, and substance use disorders and crime /violence problems among adolescents and adults. *Am J Addict*. 2006;15(1):80–91. doi:10.1080/10550490601006055

33. Nylund KL, Asparouhov T, Muthen BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. *Struct Equ Model*. 2007;14(4):535–569. doi:10.1080/10705510701575396
34. DeFluer ML, Ball-Rokeach SJ. *Theor Mass Comm*. New York: Longman; 1989.
35. Csikszentmihalyi M. *Beyond Boredom Anxiety*. San Francisco: Jossey-Bass; 1975.
36. Piao J, Liu J, Zhang F, Su J, Li Y. Human–ai adaptive dynamics drives the emergence of information cocoons. *Nature Mach Intell*. 2023;5 (11):1214–1224. doi:10.1038/s42256-023-00731-4
37. Sunstein CR. The law of group polarization. In: *Debating Deliberative Centre*. Malden: Blackwell Publishing Ltd; 2003:80–101. doi:10.1002/ 9780470690734.ch4
38. Bessi A, Coletto M, Davidescu GA, Scala A, Caldarelli G, Quattrociocchi W. Science vs conspiracy: collective narratives in the age of misinformation. *PLoSOne*. 2015;10(2). doi:10.1371/journal.pone.0118093
39. Jiang T, Hou Y, Wang Q. Does micro-blogging make us "shallow"? Sharing information online interferes with information comprehension. *Comp Human Beha*. 2016;59(C):210–214. doi:10.1016/j.chb.2016.02.008
40. Xie JQ, Rost DH, Wang FX, Wang JL, Monk RL. The association between excessive social media use and distraction: an eye movement tracking study. *Inform Manag*. 2020;58(2). doi:10.1016/j.im.2020.103415
41. Wang L, Zhou H, Ren L, Me R. The relationship between adolescents' Internet addiction, Internet deviant behavior, and general problem behavior. *Chin J Spec Educ*. 2010;17(8):74–79. doi:10.3969/j.issn.1007-3728.2010.08.015