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ARTICLE

How Cyber-Ostracism Ignites the Flame of Aggression: A Moderated Mediation Study in Chinese College Students

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ABSTRACT: Objectives: The prevalence of cyber-aggression is increasing worldwide, resulting in significant negative impacts on both perpetrators and victims. This study aimed to investigate the relationship between cyber-ostracism and cyber-aggression among college students, clarify the role of various types of rumination in this dynamic. **Methods:** A total of 1198 Chinese college students (67.4% female; mean age 20.78 years; SD = 1.12) were recruited through cluster random sampling and completed the Cyber-ostracism Experience Scale (COES), Positive and Negative Rumination Scale (PANRS), and Adolescent Online Aggression Behavior Scale (AOABS). The structural equation model (SEM) was employed to examine the relationship between cyber-ostracism, negative rumination, and cyber-aggression, as well as the moderating effect of positive rumination. **Results:** The results indicate that cyber-ostracism ($\beta = 0.128$, $p < 0.001$) positively predicts cyber-aggression. Negative rumination mediates this relationship (effect size = 0.027, 95% CI = [0.007, 0.014]). Positive rumination moderates the direct effect of cyber-ostracism on cyber-aggression ($\beta = 0.103$, $p < 0.001$). It also moderates both the first half ($\beta = 0.148$, $p < 0.001$) and the second half ($\beta = 0.138$, $p < 0.001$) of the mediating pathway. **Conclusion:** This study suggests that cyber-ostracism influences cyber-aggression through negative rumination among Chinese college students. Positive rumination moderates this effect, although its impact is relatively limited. These findings offer valuable guidance for preventing and intervening in cyber-aggression among college students.

KEYWORDS: Cyber-ostracism; rumination; college student; temporal need-threat model; cyber-aggression

1 Introduction

The internet is a virtual realm that has been created by modern science and technology. Compared to the real world, it overcomes the limitations of time and space, thereby bringing convenience to our lives. From online communication to online shopping, we have become increasingly reliant on the internet. However, the anonymity and other characteristics of the internet can lead individuals to engage in more harmful behaviors [1]. Cyber-aggression (CA) is typically defined as behavior intended to harm or demean others through electronic devices, such as computers and mobile phones, often via social media or email, and is experienced as distressing by victims [2]. From online insults to doxxing and rumors, such incidents are encountered almost daily. Surveys show that the incidence of cyber-aggression among Chinese college students exceeds 50% [3]. In the United States, 19% of college students have reported being victims of cyber-aggression [4]. The incidence in other regions ranges from 5.3% to 66.2% [5,6]. Additionally, cyber-aggression can significantly affect students' physical and mental health [7,8]. Research indicates that individuals who have been targeted by cyber-aggression experience negative emotions such as depression,

anxiety, anger, and loneliness [7,9,10], which may even lead to self-harm or suicidal behaviors [11,12]. Thus, it is crucial to explore the mechanisms behind cyber-aggression among college students to prevent and reduce such behaviors and protect their physical and mental well-being.

1.1 Cyber-Ostracism and Cyber-Aggression

Cyber-ostracism (CO) is an extension of real-world social ostracism in the online interaction environment, which refers to the inability of an individual to receive the expected communication and recognition in non-face-to-face electronically mediated interactions within an acceptable timeframe [13,14]. The main vectors of its occurrence comprise online interaction platforms such as emails, social networking sites, online chat rooms, instant messaging tools, and online games [15]. According to the general attack model, aggressive behavior is influenced by both individual and environmental factors [16]. Cyber-ostracism, as an environmental factor, can work together with individual cognition and emotion to influence an individual's aggressive behavior [17]. Emotional numbing theory proposes [18] that college students are emotionally numbed after social ostracism, experiencing a decrease in self-regulation and attentional control [19]. This leads to maladaptive behaviors, including cyber-aggression [20]. Cyber-ostracism, as an extension of social ostracism in the online world, is not constrained by time or space. Its impact on individuals is more persistent [21]. Previous studies have shown that college students are a high-risk group for experiencing cyber-ostracism [22], and that cyber-ostracism is a significant predictor of cyber-aggression among university students [23]. Based on these findings, this study proposes **Hypothesis 1:** *Cyber-ostracism positively predicts cyber-aggression among college students.*

1.2 Negative Rumination as a Mediator

The integrative cognitive model emphasizes that negative thinking patterns mediate the relationship between hostile stimuli and aggressive behaviors [24]. Nolen-Hoeksema et al. first introduced the concept of rumination in 1991 [25]. They defined rumination as a maladaptive cognitive process. Subsequent research suggests that rumination is both a cognitive pattern and a maladaptive thinking style, with both negative and positive effects [26]. Negative rumination (NR) occurs when individuals repeatedly focus on negative events. This leads to negative emotional states, especially during stressful situations [27]. It is considered a maladaptive cognitive pattern [28]. Individuals with high levels of negative rumination focus more on the negative aspects of problems and often experience emotions such as depression, anxiety, and anger [29]. An attentional scope model of rumination [30] suggests that negative life events, such as cyber-ostracism, trigger rumination. Rumination consumes limited cognitive resources. This reduces self-monitoring and can lead to deviant behaviors, such as cyber-aggression [31]. Moreover, Davis's study indicates that problematic online behaviors, such as cyber-aggression, result from a combination of stressful life events (e.g., cyber-ostracism) and maladaptive cognitive styles (e.g., negative rumination) [32]. Distal causes include cyber-ostracism, while maladaptive patterns include negative rumination. According to the Need Threat Model [33], cyber-ostracism leads to the loss of basic needs. This triggers negative emotions, such as anger, which results in negative rumination. On one hand, individuals in a state of negative rumination amplify their negative emotions. This increases emotional outbursts and reduces their behavioral control. On the other hand, negative rumination depletes cognitive resources. This impairs self-monitoring and can trigger aggressive actions. Existing research shows a significant positive correlation between negative rumination and cyber-aggression among college students [34,35]. Based on the above, this study proposes **Hypothesis 2:** *Negative rumination mediates the relationship between cyber-ostracism and cyber-aggression among college students.*

1.3 Positive Rumination as a Moderator

In the stress response model [36], Robinson et al. classified rumination into three dimensions: negative attributions, perceptions of hopelessness, and positive coping and problem-solving tendencies. Notably, the dimension related to problem-solving addresses positive rumination in stressful situations [37]. Feldman et al. proposed that rumination on positive emotions plays an equally important role in the development of psychological disorders. They also introduced the concept of positive rumination [38]. Positive rumination (PR) refers to the repetitive thinking about positive self-qualities, emotional experiences, and the amplification of positive influences in the environment. This type of rumination generates positive emotional states when individuals face stressful events [39]. It is considered a positive cognitive resource and an adaptive response style [40]. Individuals with high levels of positive rumination demonstrate better emotional regulation and awareness of behavior [41], enabling them to recognize and adjust deviant behaviors more promptly [42,43]. Studies have shown that college students with strong positive rumination tendencies perceive emotions and life events more optimistically [44] and are better equipped to handle negative experiences. When individuals experience cyber-ostracism, university students with high positive rumination can view the event in a positive light. This helps them reduce negative emotions. According to the temporal need-threat model [45], individuals often experience negative emotions—such as anger, sadness, and depression—following social exclusion, as this threatens the fulfillment of basic psychological needs. A substantial amount of negative emotion can arise if these needs are perceived as endangered. Research has shown that negative emotions, coupled with negative rumination, can contribute to more aggressive behaviors [46]. Cognitive factors within individuals, such as positive rumination, influence this evaluative process. Therefore, this study proposes **Hypothesis 3A:** *Positive rumination moderates the relationship between cyber-ostracism and cyber-aggression*.

Positive rumination involves actively thinking about emotions, while negative rumination involves negative thoughts about emotions [47]. According to the cognitive resource appropriation theory [48], positive rumination reduces the likelihood that negative emotions will deepen an individual's negative rumination. Specifically, compared to individuals with low positive rumination, individuals with high positive rumination can enhance positive thinking about emotions after experiencing cyber-ostracism [49]. This process helps to reduce negative emotions and minimizes the risk of getting trapped in the cycle of negative rumination [50]. In other words, positive rumination may buffer the impact of cyber-ostracism on negative rumination. Previous study supports this view. A study by Ghaznavi et al. found that individuals with high positive rumination had low levels of negative rumination and that interventions in positive rumination reduced negative rumination [51]. The abolition effect of positive emotions also suggests that positive rumination helps individuals recover from negative emotions after experiencing adverse life events [52]. In conclusion, this study proposes **Hypothesis 3B:** *Positive rumination moderates the effect of cyber-ostracism on negative rumination*.

Moreover, positive rumination may also moderate the impact of negative rumination on individuals' deviant behavior. Compared to individuals with low levels of positive rumination, those with high levels are better able to cope with the consequences of negative emotions [53]. This ability helps improve mental health and reduce negative emotions [54]. Previous research has shown that the relationship between negative emotions and deviant behavior can be mitigated by positive emotions [55]. Additionally, positive rumination enhances self-awareness. It helps individuals understand and analyze their negative emotions. This process may lead to problem-solving strategies [26,56]. Based on these findings, the present study proposes **Hypothesis 3C:** *Positive rumination moderates the effect of negative rumination on cyber-aggression*.

1.4 Goal of the Study

In summary, this study constructs a moderated mediation model. This model is based on the aforementioned theoretical and empirical research. The goal is to examine the impact of cyber-ostracism on cyber-aggression among college students. It also seeks to understand the mediating mechanisms of positive and negative rumination. The aim is to provide insights into mental health education for college students. The research hypothesis model is shown in Fig. 1.

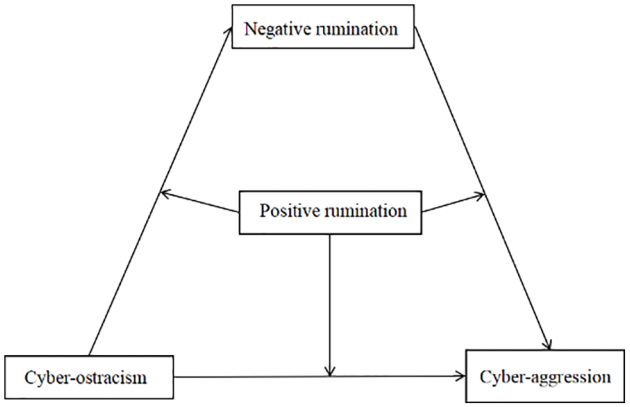

Figure 1: The conceptual model

2 Methods

2.1 Participants and Setting

This study voluntarily recruited college students from five universities across four provinces of China (Jiangxi, Guizhou, Henan, and Guangdong) based on cluster random sampling. The questionnaire was distributed and collected through the Chinese online platform "Wenjuanxing" (www.wjx.cn). Trained graduate students administered the questionnaire by randomly selecting classes for on-site testing. Participants were informed that the questionnaire was anonymous and that all information and answers would be kept confidential. After obtaining informed consent from all participants, the questionnaire QR code was distributed for scanning and completion. The entire process took approximately 30 min.

A total of 1385 questionnaires were received. To ensure the authenticity of the responses, two lie detection questions were included (e.g., "Please select 'often' for this question"). Based on the average response time, questionnaires with response times outside of three standard deviations were excluded. In total, 187 invalid questionnaires were discarded, leaving 1198 valid responses, resulting in a response rate of 86.5%. Participants' ages ranged from 18 to 26 years, with an average age of 20.78 ± 1.12 years. The sample included 390 males and 808 females, with participants spanning from first-year undergraduates to third-year master's students.

2.2 Measures

2.2.1 Cyber-Ostracism

The Cyber-ostracism Experience Scale (COES) developed by Niu et al. was used [57]. The questionnaire includes 14 items rated on a 5-point scale. It measures three dimensions of cyber-ostracism: cyber-group exclusion, cyber-personal space exclusion, and cyber-individual chat exclusion. For cyber-group exclusion, an example item is: "When notifications are sent in online chatrooms (such as QQ groups, WeChat groups),

they are not responded to". For cyber-personal space exclusion, an example is: "When comments are made on someone's posts in online personal spaces (such as QQ Space, Moments, Weibo), no feedback is received". For cyber-individual chat exclusion, an example is: "When I try to chat with someone online, I do not receive a response". Higher scores indicate a greater level of perceived social exclusion. In this study, Cronbach's alpha coefficients for each dimension were 0.891, 0.919, and 0.881, respectively. The overall Cronbach's alpha coefficient for the questionnaire was 0.946. The validity indices for the questionnaire were all satisfactory. The values were: χ^2/df = 3.97, RMSEA = 0.026, TLI = 0.994, CFI = 0.997, and SRMR = 0.023. Previous research by Xu et al. has shown that this questionnaire demonstrates good reliability and validity among Chinese university students [58].

2.2.2 Rumination

Rumination was evaluated using the Positive and Negative Rumination Scale (PANRS) [59]. The scale consists of 23 items. There are 10 items for positive rumination and 13 items for negative rumination. A 4-point scale was used to measure responses. The positive rumination subscale has two dimensions: enjoying happiness (Think "How wonderful life is") and positive coping (Think to calm down). The negative rumination subscale includes three dimensions: suppressing happiness (Think "Happy days do not last long"), negative attribution (Think "Bad just turns to worse"), and self-rejection (Do not accept yourself). Higher scores indicate a higher level of rumination. The Cronbach's alpha for the positive rumination subscale was 0.855 in this study. The alpha values for individual dimensions were 0.907 and 0.711, respectively. The validity indicators of the questionnaire showed a good fit: χ^2/df = 4.68, RMSEA = 0.047, TLI = 0.974, CFI = 0.980, SRMR = 0.033. The Cronbach's alpha for the negative rumination subscale was 0.894. The alpha values for its dimensions were 0.816, 0.802, and 0.809, respectively. Confirmatory factor analysis showed a good fit for the model: χ^2/df = 4.35, RMSEA = 0.034, TLI = 0.981, CFI = 0.985, SRMR = 0.032. The scale has good reliability and validity in the Chinese adolescent groups [59].

2.2.3 Cyber-Aggression

This study used the Adolescent Online Aggressive Behavior Scale (AOABS), developed by Zhao et al. [60]. The scale consists of 14 items and uses a 4-point scoring system. It has two dimensions: instrumental aggression and reactive aggression. Instrumental aggression includes behaviors such as "I have initiated or participated in cyber manhunts". Reactive aggression includes behaviors such as "I have stolen other players' in-game equipment while playing online games". Higher scores reflect higher levels of cyber-aggression behavior. In this study, the Cronbach's alpha coefficient for the entire questionnaire was 0.939, while the Cronbach's alpha coefficients for each dimension were 0.893 and 0.883, respectively. The validity indicators also showed a good fit (χ^2/df = 4.75, RMSEA = 0.079, TLI = 0.935, CFI = 0.947, SRMR = 0.067). Zhao et al. found that the scale demonstrated good reliability and validity among Chinese university students [60].

2.3 Procedure

This study adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Jiangxi University of Chinese Medicine (JUCM) (protocol code JZFYLL202405240067, 24 May 2024). All participants provided informed consent. Before data collection, participants received a link to an online survey that included information about the study and the consent statement: "I voluntarily participated in this survey and gave my informed consent to the content of the study". After reading and agreeing to this statement, participants proceeded with the survey.

In this study, researchers took several measures to ensure the confidentiality and anonymity of the participants. Firstly, all personal identifying information was removed from the data prior to analysis. Participants were assigned unique identification codes, and these codes were used instead of any personal details. The raw data was restricted to the research team only. Researchers also assured participants that all data would be reported in aggregate form, ensuring that no individual could be identified based on their responses. Data collection took place between May and June 2024.

2.4 Data Analysis

This study uses SPSS 26.0 to perform descriptive statistics, correlation analysis, and common method bias tests, and Mplus 8.3 is employed to construct a structural equation model (SEM) for testing model fit and hypotheses in a moderated mediation model. The analysis steps are as follows: The latent moderated structural equation (LMS) method is used to test the moderated mediation effect [61]. Traditional regression models often overlook measurement errors, which may lead to distorted parameter estimates [62]. Using latent variables for testing moderated effects provides a more accurate estimation of parameters. The LMS method has the following advantages: It does not require manual construction of product terms, which avoids estimation inconsistencies arising from different construct methods. Additionally, LMS does not require interaction terms to follow a normal distribution, thus preventing estimation bias when the product terms are non-normal [63]. Since the LMS method does not provide traditional fit indices such as CFI, TLI, and RMSEA, the following steps are used to test the moderated model: First, the Bootstrap method is employed to test the model without interaction terms (restricted model), calculating the likelihood ratio (LogL) for the restricted model. Then, the LMS method is used to test the model with interaction terms (full model), calculating the likelihood ratio (LogL) for the full model. Finally, the −2LL values of the two models are compared for significance testing. If the restricted model fits well and the −2LL test is significant, the model with the added latent moderator is considered to fit well as well [64]. The bias-corrected non-parametric Bootstrap method is used to estimate the confidence interval of the moderated mediation effect [65]. If the 95% confidence interval does not include zero, statistical significance is indicated. The fit indices of this study include the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standardized Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA). When the CFI and TLI are greater than 0.90, and the SRMR and RMSEA are less than 0.08, the model fit is considered good [66]. Additionally, the LMS method constrains the mean of the latent variables to 0 and the standard deviation to 1. Simulation studies have shown that the LMS method still provides unbiased standard error estimates when latent variables are non-normally distributed. The $p < 0.05$ was considered statistically significant.

3 Results

3.1 Test of Common Method Bias

Given that the data were gathered through self-reported measures, common method bias was a potential concern. To assess this, Harman's single-factor test was applied [67]. Results indicated nine factors with eigenvalues over 1, with the first factor explaining 25.84% of the variance, well below the 40% threshold. Thus, no significant common method bias was detected.

3.2 Descriptive Statistics and Correlation Analysis

Regarding gender differences, boys scored significantly higher than girls in both cyber-ostracism (t (1196) = 2.88, $p < 0.01$) and cyber-aggression (t (1196) = 3.43, $p < 0.001$). Age differences also emerged in both cyber-ostracism (F (8, 1189) = 7.65, $p < 0.001$) and cyber-aggression (F (8, 1189) = 34.12, $p < 0.001$). Gender and age showed significant correlations with both the independent ($r = -0.083$, $P < 0.01$; $r = 0.153$, $p < 0.01$) and

dependent variables ($r = -0.11$, $p < 0.01$; $r = 0.189$, $p < 0.01$), leading us to include gender and age as control variables. Table 1 presents the Pearson correlations after controlling for these variables. Cyber-ostracism was significantly positively correlated with negative rumination ($r = 0.438$, $p < 0.01$) and cyber-aggression ($r = 0.326$, $p < 0.01$), and significantly negatively correlated with positive rumination ($r = -0.205$, $p < 0.01$). Negative rumination correlated positively with cyber-aggression ($r = 0.244$, $p < 0.01$) and negatively with positive rumination ($r = -0.283$, $p < 0.01$). Positive rumination, however, showed no significant correlation with cyber-aggression ($r = -0.003$, $p = 0.918$).

Table 1: Mean value, standard deviation (SD), and correlations (r) of each variable (N = 1198)

	Mean ± SD	Gender	Age	1	2	3	4
Gender	1.67 ± 0.469	1					
Age	20.78 ± 1.131	—	1				
Cyber-ostracism	1.963 ± 0.691	−0.083**	0.153***	1			
Negative rumination	2.965 ± 0.503	−0.005	−0.002	0.438***	1		
Positive rumination	2.172 ± 0.522	−0.021	0.008	−0.205***	−0.283***	1	
Cyber-aggression	1.134 ± 0.294	−0.11***	0.189***	0.326***	0.244***	−0.003	1

Note: ** $p < 0.01$, *** $p < 0.001$.

3.3 Test the Moderated Mediation Effect

In this study, gender and age were significantly correlated with cyber-ostracism, negative rumination, positive rumination, and cyber-aggressive behaviors. Therefore, gender and age were included as control variables when testing for moderated mediation effects. Based on dimensional categorization, each variable was packaged accordingly, and the results indicated significant standardized loadings on the corresponding factors. The bias-corrected nonparametric percentile bootstrap method was employed to estimate the confidence intervals for each coefficient, with 5000 resamples. Following the moderated mediation model testing steps summarized by Fang et al. [64], gender and age were included as control variables, cyber-ostracism as the independent variable, negative rumination as the mediator, positive rumination as the moderator, and cyber-aggression as the dependent variable to construct the structural equation model. (1) A baseline model without latent interaction terms (only the main effect of positive rumination) was constructed, and the results showed good model fit: $\chi^2/df = 5.61$, RMSEA = 0.078 (90% CI = 0.066, 0.089), CFI = 0.958, TLI = 0.944, SRMR = 0.056. (2) On the basis of the baseline model, latent interaction terms (cyber-ostracism × positive rumination, negative rumination × positive rumination) were added to construct the moderated mediation model, and tests were conducted using the Akaike Information Criterion (AIC) and likelihood ratio methods. The results indicated that the log-likelihood for the moderated mediation model was −10,214.98, while the log-likelihood for the baseline model was −10,223.95, with −2LL = 19.76, 3 additional degrees of freedom, and a significant −2LL chi-square test ($p < 0.001$). Simultaneously, the AIC for the moderated mediation model (30,305.96) was reduced by 11.76 compared to the baseline model (30,317.90), and both methods indicated an improved model fit for the moderated mediation model. Therefore, the moderated mediation model is deemed acceptable. The specific results of the moderated mediation effect are shown in Table 2. In Model 1, the model remained significant ($R^2 = 0.247$, $p < 0.001$). Cyber-ostracism significantly predicted higher levels of negative rumination ($\beta = 0.296$, $p < 0.001$), while positive rumination predicted lower levels of negative rumination ($\beta = -0.216$, $p < 0.001$). The interaction between cyber-ostracism and positive rumination also significantly predicted higher negative rumination ($\beta = 0.148$, $p < 0.001$).

Table 2: Test of moderated mediating effect

	Negative rumination (Model 1)			Cyber-aggression (Model 2)		
	β	***SE***	**95% CI**	***β***	***SE***	**95% CI**
Control variable						
Gender	0.015	0.028	[−0.040, 0.071]	−0.056*	0.016	[−0.088, −0.024]
Age	−0.031*	0.012	[−0.054, −0.008]	0.032*	0.007	[0.019,0.046]
Predictor variable						
Cyber-ostracism	0.296***	0.020	[0.257,0.335]	0.093***	0.013	[0.068,0.117]
Negative rumination				0.074***	0.017	[0.041,0.106]
Positive rumination	−0.216***	0.027	[−0.268, −0.163]	0.037*	0.016	[0.006,0.069]
CO × PR	0.148***	0.034	[0.081,0.214]	0.103***	0.022	[0.059,0.147]
NR × PR				0.138***	0.030	[0.079,0.197]
R^2	0.247***			0.209***		

Note: * $p < 0.05$, *** $p < 0.001$. CO, Cyber-ostracism; NR, Negative rumination; PR, Positive rumination.

In Model 2, the model remained significant (R^2 = 0.209, $p < 0.001$). Cyber-ostracism and negative rumination each significantly predicted higher levels of cyber-aggression ($\beta = 0.093$, $p < 0.001$; $\beta = 0.074$, $p < 0.001$), while positive rumination also positively predicted cyber-aggression, though with a smaller effect ($\beta = 0.037$, $p < 0.05$). Additionally, the interaction between cyber-ostracism and positive rumination, as well as the interaction between negative rumination and positive rumination, significantly predicted higher levels of cyber-aggression ($\beta = 0.103$, $p < 0.001$; $\beta = 0.138$, $p < 0.001$).

To further examine the moderating role of positive rumination, a simple slope test was conducted by dividing participants into high (Mean + 1SD) and low (Mean − 1SD) positive rumination groups based on one standard deviation. First, for the direct pathway, results showed that cyber-ostracism significantly predicted increased cyber-aggression among students with low positive rumination (β = 0.041, Boot SE = 0.017, 95% CI = [0.007, 0.075]) and had an even stronger predictive effect at the high positive rumination level (β = 0.144, Boot SE = 0.17, 95% CI = [0.112, 0.177]). Second, regarding the first half of the indirect pathway (cyber-ostracism → negative rumination), the analysis indicated that cyber-ostracism significantly predicted negative rumination in the low positive rumination group ($\beta = 0.222$, Boot SE = 0.028, 95% CI = [0.167, 0.277]), with an enhanced predictive effect in the high positive rumination group ($\beta = 0.370$, Boot SE = 0.024, 95% CI = [0.323, 0.418]). Finally, for the second half of the indirect pathway (negative rumination → cyber-aggression), the effect of negative rumination on cyber-aggression was not significant in the low positive rumination group ($\beta = 0.004$, Boot SE = 0.023, 95% CI = [−0.041, 0.049]), but became significant and positive in the high positive rumination group ($\beta = 0.143$, Boot SE = 0.022, 95% CI = [0.099, 0.187]). Figs. 2–4 provide further details on these findings.

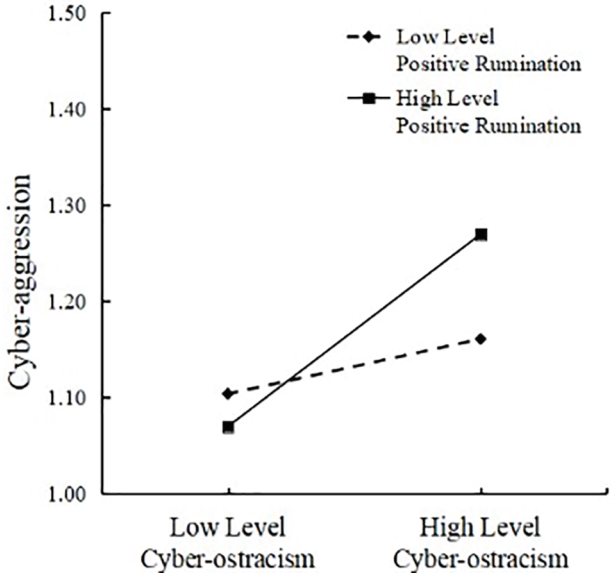

Figure 2: Moderation of positive rumination between cyber-ostracism and cyber-aggression

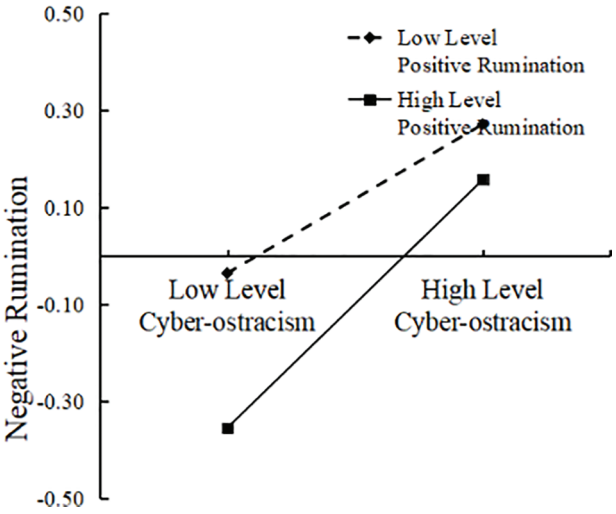

Figure 3: Moderation of positive rumination between cyber-ostracism and negative rumination

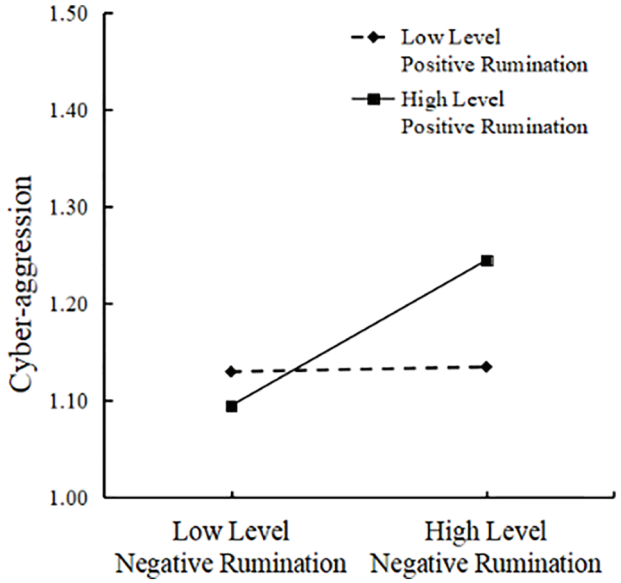

Figure 4: Moderation of positive rumination between negative rumination and cyber-aggression

4 Discussion

According to the results of this study, cyber-ostracism positively predicts cyber-aggression among college students and constitutes a moderated mediation model with negative rumination and positive rumination. The result is shown in Fig. 5.

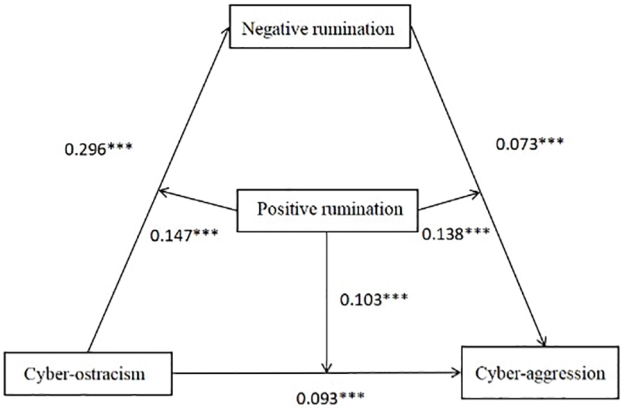

Figure 5: Path factor (***$p < 0.001$)

This study found that male college students would perceive higher levels of cyber-ostracism than female college students and that male students reported more cyber-aggressions than female students, which is consistent with previous findings [68,69]. The reasons may be as follows: On one hand, because males' basic psychological needs are higher than those of females, they may experience a heightened sense of cyber-ostracism after facing cyber-ostracism [70]. Compared to female students, male students are more familiar with online information technology and it is easier to commit cyber-aggressions, in addition, male students are more likely to identify with the expected rewards from aggressive behaviors [69]. Therefore, male college students will show more cyber-aggressions. In terms of age, the results of the study indicated

that cyber-ostracism and cyber-aggressions among college students increased with age, which is consistent with previous studies [71]. This may be because individuals become more reliant on social media as they get older [72]. As a result, the amount of time spent on social media and the likelihood of aggression both increases. Furthermore, the older students get, the greater the pressures from life and employment become, which may contribute to increased aggressive behavior [73]. Therefore, to reduce cyber-aggression among college students, it is crucial to address the factors contributing to male students' higher levels of cyber-ostracism and aggression. College mental health educators should implement targeted interventions for male students, focusing on emotional regulation and promoting healthy online behavior. Additionally, offering programs that foster social media awareness and responsible use, especially for older students facing increased life pressures, could help mitigate aggression. Encouraging positive online engagement and providing support for stress management can reduce cyber-aggressions and enhance overall well-being.

The research findings indicate that, after controlling for demographic variables, cyber-ostracism significantly predicted cyber-aggression among college students. This supports Hypothesis 1 and aligns with the results of the previous study [21]. These findings suggest that, regardless of the form in which social exclusion occurs, individuals who are excluded experience emotional pain and a corresponding deprivation of their psychological needs. While some scholars argue that cyber-ostracism, as an online form of social exclusion, has characteristics distinct from those of offline social exclusion [18], the results of the present study demonstrate that both forms of social exclusion lead to similar negative outcomes. Both contribute to the deterioration of emotional well-being and the alteration of social needs. According to the Need-Threat Model [45], following experiences of social exclusion, college students may engage in aggressive behaviors as a means of alleviating negative emotions or fulfilling unmet psychological needs. Similarly, students subjected to cyber-ostracism may experience unmet psychological needs and a reduction in behavioral control, which ultimately results in cyber-aggression.

The findings of this study suggest that cyber-ostracism not only directly influences cyber-aggression in college students but also contributes indirectly through negative rumination. These results confirm Hypothesis 2 and align with prior research [74], thus providing further support for the general aggression model. According to information processing theory [75], individuals who experience rejection, isolation, or conflict often experience sadness, anger, and pain, which can lead to negative cognitive strategies and a tendency toward rumination. As a form of negative thinking, rumination intensifies psychological and interpersonal stress by keeping individuals focused on negative thoughts and emotions. This worsens individuals' perception of adverse events and creates a self-reinforcing cycle of negativity. Previous research also indicates that individuals facing higher levels of social exclusion are more likely to adopt negative cognitive styles [76], which heighten interpersonal conflict and stress, further increasing the likelihood of cyber-aggression.

Negative rumination has been identified as playing a partial mediating role in the relationship between cyber-ostracism and cyber-aggression. However, previous research suggests that only anger-driven rumination, or rumination centered on provocation, is associated with aggression [77]. Other forms of negative rumination, such as sad rumination, are generally considered unrelated to aggression. This disparity may be attributed to cultural differences, especially when compared to individual behaviors in Western societies. The present study focuses on college students, with an emphasis on the situational context of cyber-ostracism. Cultural backgrounds and social environments are likely to influence how negative rumination manifests and its underlying mechanisms. For instance, in an online setting, individuals may experience increased social isolation and emotional suppression. This specific type of rumination, particularly when focused on negative emotions, is more likely to cause emotional distress, which may, in turn, trigger cyber-aggression. While Western cultures often emphasize individual anger responses, sad rumination may be more prominent

in China and have deeper consequences. Reducing cyber-aggression among college students requires a two-pronged approach: improving online social skills and addressing the indirect effects of cyber-ostracism through negative rumination. By cultivating a positive mindset and assisting students in adjusting their cognitive responses in a timely manner, the tendency to engage in negative thought patterns can be reduced, thereby preventing cyber-aggression. Mental health interventions should target both social exclusion and negative rumination. Programs that foster emotional regulation, resilience, and healthy coping strategies may help mitigate the impact of isolation. Furthermore, promoting positive social connections and reducing rejection sensitivity may prevent the escalation of cyber-aggression.

Positive rumination was found to moderate three specific pathways among college students: from cyber-ostracism to cyber-aggression, from cyber-ostracism to negative rumination, and from negative rumination to cyber-aggression. This finding validated Hypotheses 3A–C.

Specifically, it was found that positive rumination moderates the relationship between cyber-ostracism and cyber-aggression. When students are exposed to low levels of cyber-ostracism, higher positive rumination tends to reduce cyber-aggression. Conversely, in high cyber-ostracism contexts, positive rumination is associated with increased online aggression. This finding corroborates existing literature [78], but it also contrasts with another study [53]. Positive rumination is generally regarded as a beneficial psychological mechanism that helps individuals reinterpret negative experiences positively, reducing emotional distress, and enhancing self-regulation [79]. In environments with lower cyber-ostracism, positive rumination helps mitigate cyber-aggression by aiding emotional regulation and boosting psychological resilience [80]. However, in high cyber-ostracism contexts, positive rumination has the opposite effect, promoting cyber-aggression. This challenges the conventional view that positive rumination is universally beneficial and suggests that its impact varies across different contexts. In situations of high social exclusion, individuals' ability to regulate emotions is significantly diminished. When students experience significant cyber-exclusion, positive rumination fails to alleviate negative emotions and may instead exacerbate them, leading to emotional numbness and diminished self-control. This finding is consistent with Bossi et al. [18], who noted that in high-exclusion settings, positive rumination may amplify negative emotions, increasing impulsivity and aggression. In such contexts, positive rumination may cause individuals to internalize their negative emotions, thereby triggering more aggressive behavior.

The results of the study show that positive rumination plays a moderating role in the relationship between cyber-ostracism and negative rumination. When individuals encounter low levels of cyber-ostracism, higher levels of positive rumination can mitigate negative rumination, helping to reduce negative emotions. In contrast, under conditions of high cyber-ostracism, positive rumination may amplify negative rumination, exacerbating emotional distress. This pattern aligns with the findings of Yang et al. [81], which suggest that positive rumination is beneficial in low-stress situations, but it may have detrimental effects in high-stress contexts. This observation challenges the traditional view of positive rumination as always beneficial. While existing literature typically emphasizes the value of positive rumination in coping with emotional difficulties [47,82], some studies argue that in situations like social exclusion, emotional and cognitive processes can be disrupted. In these cases, positive rumination can shift into excessive self-reflection or self-blame, intensifying negative rumination [83]. Specifically, in the context of cyber-ostracism, where social support is often diminished, positive rumination may fail to guide individuals out of negative emotions and instead contribute to a greater accumulation of distress. The effectiveness of positive rumination, therefore, appears to depend on the level of cyber-ostracism. When individuals experience lower levels of exclusion, positive rumination helps them reframe their emotions, reducing negative rumination [81]. On the other hand, at higher levels of exclusion, excessive positive rumination may worsen emotional distress. In such circumstances, interventions should focus on providing emotional guidance and psychological support to

alleviate negative emotions. Once individuals' emotional states are stabilized, training in positive rumination may become more effective in helping them recover and diminish negative rumination.

The study's results indicate that at high levels of positive rumination, negative rumination significantly predicted cyber-aggression among university students. Although this may appear counterintuitive, it is consistent with the findings of Gilbert et al. [84]. According to the Emotional Coherence Effect Theory [56], negative emotional influence can lead to both positive and negative rumination intensifying attentional bias toward negative information. This repetitive cycle depletes limited cognitive resources, impairs self-regulation, and ultimately heightens aggressive behaviors.

For students experiencing elevated negative rumination, professional psychological support is recommended to reduce these negative thought patterns. Once emotional regulation is achieved, further training in positive rumination may promote better mental health and reduce cyber-aggression. In contrast, when students face moderate or low levels of cyber-ostracism, positive rumination tends to yield beneficial effects. Educators are encouraged to implement practices such as mindfulness, gratitude exercises, and cognitive reframing. These strategies assist students in managing their emotions, reframing challenges positively, and reducing aggression. However, the impact of positive rumination in high-exclusion contexts remains uncertain. In such situations, positive rumination may exacerbate negative emotions, which could lead to impulsivity and aggression. Consequently, for students facing high levels of cyber-ostracism, immediate emotional regulation should be prioritized. Educators should focus on interventions such as emotional validation, stress management techniques, and building social support. Once students' emotional states are stabilized, positive rumination techniques can be introduced in a more controlled way. Negative rumination strongly predicts aggressive behaviors. To reduce this thinking style, mental health professionals should offer support to help students break the cycle of negative thinking. Cognitive-behavioral strategies, such as cognitive restructuring and emotional regulation, can be useful in these cases.

5 Research Findings and Limitations

The current investigation examines the impact of cyber-ostracism on college students' cyber-aggression and the role of negative and positive rumination in this dynamic. The findings indicate a significant positive correlation between cyber-ostracism and cyber-aggression, mediated by negative rumination, with positive rumination serving as a moderator in both direct and indirect pathways. Consequently, when college students experience cyber-ostracism, it is important for them to adopt positive cognitive strategies, such as positive rumination, to mitigate negative emotions, prevent negative rumination, increase self-awareness of their behavior, and avoid engaging in cyber-aggression. On the other hand, when faced with prolonged high levels of cyber-ostracism, seeking support from teachers and peers and alleviating negative emotions through communication is essential to prevent cyber-aggression. In addition, the findings contribute scientific evidence to mental health education in universities, the development of innovative intervention strategies, the promotion of cyber civility, and collaboration between schools and families. Strengthening mental health education, implementing training in positive rumination, promoting cyber civility norms, and enhancing school-family cooperation can effectively reduce cyber-aggression, improve mental health and cyber literacy among college students, and contribute to the creation of a harmonious online social environment.

Although certain results have been achieved in the current investigation, several limitations remain, particularly regarding the representativeness of the sample. Firstly, the sample predominantly consists of college students and a significant gender imbalance exists with fewer male participants. This imbalance may introduce gender bias into the findings. Previous research has highlighted that gender can influence the manifestation and cognition of cyber-aggression [85], meaning that such an imbalance could affect

the generalizability of the results. For instance, males and females may exhibit different patterns of cyber-aggression, emotional responses, and coping strategies. Future research should aim to ensure gender balance in the sample to improve the external validity and generalizability of the findings. Secondly, the sample in this study is limited to college students, who, although an important group in online social activities, may demonstrate different behaviors and psychological traits compared to other populations. For example, working adults, adolescents, and the elderly might show distinct emotional responses and behaviors when exposed to cyber-ostracism and cyber-aggression. As a result, the conclusions drawn here may not be directly applicable to other demographic groups. To strengthen the ecological validity of the study, future research could broaden the sample to include individuals from various age groups, professional backgrounds, and cultural contexts, thereby providing a more comprehensive understanding of the factors and mechanisms influencing cyber-aggression. In addition, a cross-sectional design was employed in this study, which limits the ability to establish causal relationships or assess stability over time. Future research should consider adopting longitudinal designs or experimental methods to monitor individual changes and explore the causal pathways between cyber-ostracism, negative rumination, and cyber-aggression. Lastly, while the moderating effect of positive rumination was explored, it varies across different levels. This study did not investigate various types of rumination in depth. Future studies should examine the interaction mechanisms between positive and negative rumination in different contexts, particularly how to balance positive rumination under high exclusion pressure. Furthermore, combining positive rumination with other emotional regulation strategies (e.g., emotional expression, and social support) should be explored to develop more comprehensive intervention plans.

6 Conclusion

Cyber-ostracism in online society not only directly affects college students' cyber-aggression but also indirectly influences it through negative rumination. Furthermore, positive rumination moderates not only the direct impact of cyber-ostracism on cyber-aggression but also the indirect effect of cyber-ostracism on cyber-aggression through negative rumination. However, this moderating effect is limited. This study provides scientific evidence for mental health education in universities, the innovation of intervention strategies, and the promotion of online civil behavior.

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Abbreviation

CA	Cyber-Aggression
CO	Cyber-Ostracism
NR	Negative Rumination
PR	Positive Rumination
COES	Cyber-Ostracism Experience Scale
PANRS	Positive and Negative Rumination Scale
AOABS	Adolescent Online Aggressive Behaviour Scale
JUCM	Jiangxi University of Chinese Medicine
SEM	Structural Equation Model
LMS	Latent Moderated Structural
CFI	Comparative Fit Index
TLI	Tucker-Lewis Index
SRMR	Standardized Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
AIC	Akaike Information Criterion

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