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Do Men Have More Cyber-Deviant Behaviors? A Network Analysis Based on the Reciprocal Determinism Model

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ABSTRACT

Previous research has explored the associations between cyber-deviant behaviors and various psychological or social factors. However, few studies have examined gender differences in cyber-deviant behaviors using a network analysis approach. Therefore, the present study examined the reciprocal relationships between these variables using network analysis and attempted to verify the reciprocal determinism model. The study's sample comprised 1664 university students from multiple provinces of China. The survey included demographic information and several psychometric scales, such as the Cyber-Deviant Behaviors Questionnaire (CDBQ), Online Need Satisfaction Questionnaire (ONSQ), and Ostracism Screening Scale (OSS). In the total network, cyber-deviant behaviors were significantly and positively associated with low psychological needs satisfaction, social ostracism, moral disengagement, depressive mood, loneliness, poor peer relationships, and low self-control. Males showed a stronger network structure than females in the total network and in the cyber-pornography deviance network, as well as more global strengths in cyber-social deviance network, cyber-verbal deviance network, and cyber-pornography deviance network. The results of interaction between cyber-deviant behaviors and psychological and social factors verified the reciprocal determinism model, and suggests that prevention and intervention measures need to be considered for decreasing cyber-deviant behaviors, especially specific methods for different genders.

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Introduction

Cyber-deviant behaviors

Over the past two decades, cyber-deviant behavior has increasingly attracted the attention of scholars. Cyber-deviant behavior is defined as a behavior that *"violates or destroys the internet norms"* (Denegri-Knott and Taylor 2005:98) and *"harms oneself or others"* (Jin and Zou 2013:63). Some scholars have classified cyber-deviant behaviors into multiple types, such as cyber-flaming, cyberbullying, cyber-pornography, and cyber-deception (Jin et al. 2022; Kim and Han 2021; Udris 2017; Yang et al. 2021). Mitchell, Becker-Blease, and Finkelhor (2005:498) proposed 11 types of cyber-deviant behaviors, including "overuse," "pornography," "infidelity," "sexual exploitation and abuse," "gaming, gambling, and role-playing," "harassment," and "fraud/stealing/deception." In addition, among Chinese populations, three-factor (i.e., cyber-flaming, cyber-pornography, and cyber-deception; Ma and Lei 2010)

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and four-factor (i.e., cyber-social deviance, cyber-verbal deviance, cyber-pornography deviance, and cyber-use deviance; Zhang 2015) models of cyber-deviance have been frequently used.

The present study was conducted in China, and Statista (2023) reported that approximately 40% of Chinese individuals had experienced online abuse when they used social media, and that students and part-time employees were regarded as the primary targets of online abuse. Research has found that cyber-deviant behaviors are closely associated with poor academic performance, mental health problems, and interpersonal problems, as well as criminal behaviors (Chen et al. 2021; Dvoryanchikov et al. 2020; Wang et al. 2021). Cyber-deviant behaviors may be influenced by both psychological and social factors, such as individual psychological needs, cognition, emotion, and peer effects (Chan et al. 2023; Holt, Bossler, and May, 2012; Wang et al. 2022; Zhang et al. 2024).

Associations with cyber-deviant behaviors

Basic psychological need theory (BPNT) posits that humans achieve growth, development, and well-being by satisfying three basic psychological needs (i.e., autonomy, competence and relatedness) (Deci and Ryan 2000; Ryan and Deci 2017). Wang et al. (2022) indicated that need satisfaction mediated the association between cyber-ostracism and psychological well-being among Chinese students. As a typical biological and social phenomenon, social ostracism is closely associated with negative psychological and physical health (Bastian and Haslam 2010; Lau, Moulds, and Richardson 2009; Schepke, Shackelford, and Vonk 2021; Schneider et al. 2017).

Some research has indicated that social ostracism may also cause negative emotions, such as anger, jealousy, sadness, anxiety, depression (Leary 2015), low self-esteem (Ferris et al. 2015), maladaptive cognitions (e.g., poor cognitive performance) (Hawes et al. 2012), and other undesirable behaviors (e.g., impaired self-regulation and aggression) (Chen et al. 2025; Oaten et al. 2008), which may further exacerbate the psychological toll and increase cyber-deviant behavior. As a cognitive process of information re-interpretation, moral disengagement results in individuals behaving unethically without sense of unsavory behaviors and experiencing distress (Bandura 1999). Moral disengagement has been found to be closely associated with various personality characteristics and behaviors, such as psychopathy (Stevens, Deuling, and Armenakis 2012), Machiavellianism (Moore et al. 2012), callousness, impulsivity (Kokkinos, Voulgaridou, and Markos 2016), external locus of control (Detert, Treviño, and Sweitzer 2008), and cyber-deviant behavior (Runions and Bak 2015).

Risky cyber-behaviors including cyberbullying, cyber-victimization, and disordered gaming have been found to be significantly associated with depression among adolescents (Uçar et al. 2020). Psychological loneliness and age have also been found to predict cyberbullying among university students (Al Qudah et al. 2020). Moreover, Zhang et al. (2024) indicated that negative emotion may positively predict cyber-deviant behaviors and that high self-control decreases the direct effect of negative emotions on cyber-deviant behaviors. Poor peer relationships have also been closely associated with cyber-deviant behaviors among adolescents (Holt, Bossler, and May 2012; Wang et al. 2021). Furthermore, depression and prosocial peer affiliation have been found to mediate and moderate the association between cyberbullying and internet addiction among adolescents, respectively (Wang et al. 2020b).

Gender differences in cyber-deviant behaviors

Some studies have indicated that males have higher cyberbullying perpetration than females (Barlett and Gentile 2012; Donner 2016; Li 2006). Wang et al. (2021) reported that gender moderated the relationship between peer alienation and cyber-flaming/cyber-pornography/cyber-deception, especially among boys. It has also been shown that males are more likely to experience cyber-deviant behaviors or to be perpetrators than females (Nam 2023). However, a meta-analysis on cyber-bullying perpetration asserted that caution is needed when interpreting these findings due to poor study quality and inconsistent results (Sun, Fan, and Du 2016). Hen et al. (2020) indicated that males tended to

over-report the extent of their engagement to cyber-pornography, whereas females tend to under-report it, which has also been found in other studies (e.g., Hald 2006; Short et al. 2012). Taken as a whole, these findings indicate that further examination of gender differences in cyber-deviant behaviors is needed.

Related theories of cyber-deviant behaviors

A systematic review of 61 studies by Cioban et al. (2021) reported that general strain theory (Agnew 1985), social learning theory (Akers 2017; Akers and Lee 1999; Bandura 2017), self-control theory (Akers 1991), and social control theory (Hirschi and Gottfredson 2017) were frequently used to explain the occurrence and process of cyber-deviant behavior. General strains (i.e., stressors or inability to achieve societal goals) were found to be closely associated with cyber-deviant and problematic behaviors on social media sites based on general strain theory (Mubarak and Quinn 2019). Prior strains/stresses have also been associated with illegal uploading of online content (e.g., video and music) and general cyber-offending (Parti and Dearden 2024). In addition, cyber-violence is often viewed as the strain source in a general strain theory perspective (Lianos and McGrath 2018; Paez 2018). For social control theory and self-control theory, low self-control was reported to have a significant impact on university students in increasing digital piracy and cyber-offending behaviors (Nodeland and Morris 2020).

Reinforcement sensitivity theory (Palmieri, Shortland, and McGarry 2021) and Cue-Filtered-Out theories including social presence theory, lack of social context cues, and the social identity model of deindividuation effects (Walther 2011) have also been used to explain cyber-deviant behaviors. In addition, positivists argue that individuals' predispositions may lead to various deviant behaviors, while constructivists consider social factors as the most important cause of deviance (Thio, Taylor, and Schwartz 2019). However, person-situation interactions theory (Furr and Funder 2021) states that the interaction of person and situation may cause stronger effects on individuals' behavior than the model of person-situation competition in many social contexts, which is accord with the principles of Gestalt psychology that *"the whole is greater than the sum of its parts"* (Wong 2010:863). A study of the association between peer-related computer hacking and proactive criminal thinking also found that the combined effect was greater than the sum of the two individual parts (Walters 2023). As Gammon et al. (2011) pointed out, individual characteristics (e.g., narcissistic personality and psychopathic traits) and situational events (e.g., ego or physically threatening events) may come together and result in cyber-harassment through the processing of cognition (e.g., cognitions of reduced self-worth or vengeance) and affect (e.g., anger).

Reciprocal determinism model

Reciprocal determinism originates from social learning theory (Akers 2017; Akers and Lee 1999; Bandura 1978; Krohn 1999), and describes the interaction and mutual influence between individuals' cognition, behaviors, and environment. Reciprocal determinism is superior to unidirectional explanations of behaviors in many fields of psychological and criminal science due to providing more comprehensive and integrated exposition (Akers 2017; Bandura 1978). Individuals' personality, cognition, motivation, emotion, and peer influence, as well as context events may cause cyber-deviant behaviors, while cyber-deviant behaviors may also reinforce or worsen the aforementioned variables (e.g., psychological need satisfaction, social ostracism, moral disengagement, and negative mood). Moreover, reciprocal determinism is also viewed as a basic analytic principle for examining psychosocial phenomena (Bandura 1978). Runions and Bak (2015) indicated that individual's behaviors (e.g., cyberbullying and cyber-aggression) may affect and be affected by both personal and social factors, and proposed that the social-technological context may facilitate moral disengagement to interact with cyber-deviant behaviors.

Network analysis

Network analysis as a graph visualization approach may be conducted to help explain reciprocal determinism or causal interaction of multi-variables (McNally 2021), which may provide statistical association of variables via nodes (i.e., different variables) and edges (i.e., lines between two variables) (Borsboom et al. 2021). For example, network analysis can display complex interactions of multi-variables among biological, psychological, and social factors (Briganti et al. 2024; Fried 2022), establish robust empirical phenomena, as well as develop related theories to better explain such phenomena (Robinaugh et al. 2020). Lu et al. (2010) examined a criminal hacker community using social network analysis and found a decentralized network and deviant team organization structures.

Hypotheses development

The association between cyber-deviant behaviors and basic psychological need satisfaction

Deci and Ryan (2000) indicated that basic psychological needs are the most important internal driving force for human beings and determine the actions of individuals. When psychological needs are not met, individuals are prone to disruptive behaviors, low learning motivation, declining academic achievement level, poor social relationships, and other problems. The motivation of internet use should be an important influencing factor of cyber-deviant behavior (Lei and Li, 2008). Liu (2011) also reported a significant association between cyber-deviant behaviors and basic psychological need satisfaction (i.e., autonomy, competence, and relatedness). Therefore, it was hypothesized that cyber-deviant behaviors would be positively associated with basic psychological need satisfaction (H_1).

The association between cyber-deviant behaviors and social ostracism

Social ostracism may obstruct belonging and relatedness of psychological needs, which further lead to negative effects on individuals, such as depression and anxiety, alcohol addiction, and aggression (Gabbiadini and Riva 2018; Niu et al. 2016 Williams 2009). Wang et al. (2020a) found that social ostracism was positively associated with cyber-deviant behaviors. Shi et al. (2023) also reported a highly significant association between social ostracism and cyber-deviant behaviors. Therefore, it was hypothesized that cyber-deviant behaviors would be positively associated with social ostracism (H_2).

The association between cyber-deviant behaviors and moral disengagement

Pornari and Wood (2010) reported that the moral mechanism within individuals is more likely to lose the role of self-regulation with the weakening of moral consciousness and the decrease of moral standards, resulting in moral disengagement and showing more cyber-deviant behaviors. Yang, Wang, and Gao (2015) also showed that moral disengagement was positively associated with cyber-deviant behaviors and that moral identity moderated the association between moral disengagement and cyber-deviant behaviors among Chinese university students. Califano, Capasso, and Caso (2022) indicated that cyber-moral disengagement and sexual preoccupation positively predicted sexting motivation and behaviors. Martínez-Bacaicoa et al. (2024) also found that moral disengagement levels were different across different types of technology-facilitated sexual violence (e.g., higher gender-based hate speech and lower cyber-sexual coercion). Therefore, it was hypothesized that cyber-deviant behaviors would be positively associated with moral disengagement (H_3).

The association between cyber-deviant behaviors and depressive mood and loneliness

Zhang et al. (2024) reported that emotion may drive different cyber-social behaviors including deviant and prosocial behaviors. A few studies have found significant positive associations between negative emotions and cyber-deviant behaviors (e.g., Vranjes et al. 2018; Zhou, Pindek, and Ray 2022). Nam (2023) reported that depression and self-esteem were

significantly different among different groups of cyber-deviant behaviors (i.e., internet users who experienced wrongdoing and damage in cyberspace had higher depressive mood). Loneliness may also predict levels of cyberbullying victimization and perpetration (Brewer and Kerslake 2015). Therefore, it was hypothesized that cyber-deviant behaviors would be positively associated with depressive mood and loneliness (H_4).

The association between cyber-deviant behaviors and peer relationship

Adolescents desire to acquire peer acceptance and a sense of belongings for good interpersonal relationships. Some studies have reported that peer alienation is closely associated with cyber-deviant behaviors, such as cyber-flaming and cyber-pornography (Lee 2018; Wang et al. 2021). Chen, Guo, and Yu (2024) reported that interpersonal difficulties in real-life may significantly increase cyber-deviant behaviors among Chinese adolescents. Therefore, it was hypothesized that cyber-deviant behaviors would be closely associated with poor peer relationships in real life (H_5).

The association between cyber-deviant behaviors and self-control

Self-control theory has been used to explain cyber-deviant behaviors (i.e., low self-control may cause more cyber-deviant behaviors) (Cioban et al. 2021; Holt, Bossler, and May 2012; Lee 2018; Wolfe and Higgins 2009). A study of American middle and high school youth showed that youth with low self-control were more likely victims of sexting and more likely to view online pornography (Holt et al. 2016). Therefore, it was hypothesized that cyber-deviant behaviors would be positively associated with low self-control (H_6).

The association between cyber-deviant behaviors, basic psychological need satisfaction, social ostracism, moral disengagement, depressive mood, loneliness, peer relationships, and self-control

Because adolescents are heavy internet users, their cyber-deviant behaviors have become the focus of worldwide attention. Many factors including personal characteristics, online environment (e.g., risky posts containing sexual or violent content, blogs encouraging self-harm, etc.), and peer relationship, all influence individual or group's cyber-behaviors, especially their psychological needs, emotions and/or interpersonal relationships which may lead to different cyber-deviant behaviors. The reciprocal determinism model supports the interaction of multi-variables (i.e., personal characteristics [cognition and other internal events], behavioral variables, and environmental factors) in many studies (Pajares and Usher 2008; Wardell and Read 2013; Williams and Williams 2010), which also need to be verified for the interaction of cyber-deviant behaviors with psychological and social factors. Therefore, it was hypothesized that there would be a close and reciprocal relationship between cyber-deviant behaviors, basic psychological need satisfaction, social ostracism, moral disengagement, depressive mood, loneliness, peer relationships, and self-control (H_7).

Gender differences in cyber-deviant behaviors, basic psychological need satisfaction, social ostracism, moral disengagement, depressive mood, loneliness, peer relationships, and self-control

Wang et al. (2021) reported that gender moderated the association between peer alienation and cyber-flaming, cyber-pornography, and cyber-deception, and only males had significant and predictive effects on cyber-deviant behaviors. In addition, Gómez-Bellvís and Castro-Toledo (2024) also reported that there was a gender difference in cyber/online deviant behaviors. Moreover, Louderback and Antonaccio (2021) also reported gender as moderator between cyber-deviance and victimization. Therefore, it was hypothesized that there would be gender differences in the network structure and the global strength of the cyber-deviant behaviors networks (H_8).

Methods

Participants and procedure

A total of 1732 participants completed a cross-sectional online survey hosted on the *Wenjuanxing* platform via convenience sampling from different provinces across China including Jiangxi (51.56%), Liaoning (39.2%), Heilongjiang (3.46%), Zhejiang (2.54%), Shannxi (2.02%) and others (1.22%), who were recruited by their teachers sending a QR code invitation to complete the survey via the *WeChat* social media platform. Participants were informed about the study's purpose and provided informed consent. The inclusion criteria were being vocational college students ($n = 224$), undergraduates ($n = 1438$) or postgraduate students ($n = 70$) enrolled in the universities, who were aged 18 years or older. The exclusion criteria were completing the survey quickly and/or giving all same responses ($n = 45$), and not completing the personal information questions ($n = 23$). Therefore, the final sample comprised 1664 participants (938 males and 726 females; $M_{age} = 20.0$ years, $SD = 1.3$).

Measures

The demographic information including gender, age, and educational degree. In addition, peer relationship, loneliness and self-control were assessed based on single item questions by developed the first author. Single-item measures have been found to be as effective as multiple-item measures in some previous studies (Bergkvist and Rossiter 2007; Fuchs and Diamantopoulos 2009; Matthews, Pineault, and Hong 2022; Milton, Bull, and Bauman 2011). Questions related to peer relationships (one item: *"I have a harmonious relationship with my peers"* assessed based on 5-point scale from 1 [*never*] to 5 [*always*]; which had high content validity and one-week test-retest reliability of 0.87 for 64 participants), loneliness (one item: *"I often feel lonely*" assessed based on 7-point scale from 1 [*never*] to 7 [*always*]) and self-control (one item: *"I am a person with poor self-control"* assessed based on 7-point scale from 1 ["*never*"] to 7 ["*always*"]; which had one-week test-retest reliability of 0.90 and 0.89 for 64 participants, respectively) were asked. Peer relationships as one of social factors was assessed based on a 5-point scale, whereas loneliness and self-control as psychological factors were assessed on a 7-point scale.

Cyber-Deviant Behaviors Questionnaire (CDBQ)

The 19-item CDBQ (Zhang 2015) was used to assess cyber-deviant behavior. The scale has four factors comprising cyber-social deviance (e.g., *"Make friends with strangers online"*), cyber-verbal deviance (e.g., *"Verbal aggression to others online"*), cyber-pornography deviance (e.g., *"Browse pornography websites"*) and cyber-use deviance (e.g., *"Post or repost false comments online"*). The CDBQ has been verified as having good reliability and validity among Chinese university students (Shi et al. 2023). Items are rated on a 5-point Likert scale from 1 (*never*) to 5 (*always*). Higher scores indicate greater cyber-deviant behavior. In the present study, the Cronbach's alpha and McDonald's ω were 0.945 and 0.930 (total CDBQ), 0.868 and 0.868 (cyber-social deviance), 0.900 and 0.909 (cyber-verbal deviance), 0.911 and 0.926 (cyber-pornography deviance), and 0.975 and 0.976 (cyber-use deviance).

Online Need Satisfaction Questionnaire (ONSQ)

The 12-item ONSQ (Liu et al. 2016) was used to assess online need satisfaction. The scale has 12 items and three factors comprising autonomy (e.g., *"I can decide which activities I want to do on the mobile net"*), competence (e.g., *"I think I am pretty good at using the mobile net"*) and relatedness (e.g., *"When I was on the internet, I feel I was understood by others online"*). Items are rated on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Higher scores indicate greater online need satisfaction. In the

present study, the Cronbach's alpha and McDonald's ω were 0.937 and 0.936 (total scale), 0.802 and 0.807 (autonomy), 0.840 and 0.844 (competence), and 0.901 and 0.902 (relatedness).

Ostracism Screening Scale (OSS)

The four-item OSS was used to assess social ostracism. The four items originate from the Bullying and Ostracism Screening Scales (Saylor et al. 2012). Items (e.g., *"I have experienced verbal, physical, or social bullying online/offline"*) are rated on 5-point scale from 1 (*never*) to 5 (*always*). Higher scores indicate greater social ostracism. In the present study, the Cronbach's alpha and McDonald's ω for the scale were 0.829 and 0.843.

Moral Disengagement Scale (MDS)

Eight items from the 32-item MDS were used to assess moral disengagement (Bandura et al. 1996). The scale comprises eight factors. Only two factors (i.e., euphemistic labeling and displacement of responsibility) were assessed. Items (e.g., *"Slapping and shoving someone is just a way of joking"* [euphemistic labeling], and *"If kids are living under bad conditions they cannot be blamed for behaving aggressively"* [displacement of responsibility]) are scored on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score indicates greater moral disengagement. In the present study, the Cronbach's alpha and McDonald's ω for the scale were 0.837 and 0.836.

Short Depression-Happiness Scale (SDHS)

Three items from the six-item SDHS (Joseph et al. 2004) were used to assess depressive symptoms. Items (e.g., *"I felt that life was meaningless"*) are scored based on a 4-point scale from 1 (*never*) to 5 (*often*). A higher score indicates greater depressive mood. In the present study, the Cronbach's alpha and McDonald's ω for the scale were 0.812 and 0.814.

Data analysis

Frequency statistics and chi-square (χ^2) tests of cyber-deviant behaviors, and means and standard deviations of all variables were calculated using SPSS 20.0. Pearson's heatmap of correlation was conducted using JASP 0.18.3.0. The network analysis and network comparison test (NCT) were performed using R 4.4.2.

The present study used an ego network as opposed to whole network analysis (Everett and Borgatti 2005). The network analysis was performed based on the EBICglasso (i.e., Extended Bayesian Information Criterion and Least Absolute Shrinkage and Selection Operator [LASSO]), which can be used for the estimation of the partial correlation networks and to select the optimal network model. The Extended Bayesian Information Criterion (EBIC) uses a hyperparameter (γ, < 0.5) which indicates how much the EBIC prefers sparser models (Epskamp et al. 2018).

Nodes and edges were regarded as important network characteristics. The tuning parameter was set to 0.5 for sensitivity and specificity. The network accuracy and stability were verified including the edge-weight accuracy, significant differences of nodes and edges (i.e., a non-parametric bootstrap with 1000 samples), and centrality stability (i.e., a case-dropping subset bootstrap). For the node centrality stability, the correlation stability coefficient (CS-coefficient, ≥ 0.25) was calculated (Epskamp et al. 2018). In addition, the network comparison test (NCT) was conducted to assess the network structures and global strengths between genders (Van Borkulo et al. 2023).

Ethics

The Gannan Medical University's Research Ethics Committee approved the study (Ref: 20BY184), which was in accordance with the Declaration of Helsinki. Informed consent was provided by every participant.

Results

Descriptive/Correlation analysis

For cyber-deviant behaviors, 626 participants comprising 318 males (50.8%) and 308 females (49.2%) responded "never" on all items. The proportions of the sample scoring at high-risk of cyber-deviant behaviors was low ("high-risk" were those reporting "often" or "always" to every item in the subscale) (Table 1). Among the total sample, 0.9% were high-risk for cyber-social deviance ($n = 15$; 11 males and 4 females), 0.5%, were high-risk for cyber-verbal deviance ($n = 9$; 7 males and 2 females), 1.7% were high-risk for cyber-pornography deviance ($n = 29$; 26 males and 3 females), and 0.4% were high-risk for cyber-use deviance ($n = 7$; 6 males and 1 female). Males were significantly more likely than females to be high-risk for cyber-verbal deviance and cyber-pornography deviance (both p-values < 0.001) (Table 1).

In the t-test group comparisons, (i) males scored significantly higher than females on moral disengagement, and females scored significantly higher than males on depressive mood, and (ii) males scored significantly higher than females on subscales of cyber-verbal deviance and cyber-pornography deviance (all Cohen's $d > 0.2$) in (Table 2). All four types of cyber-deviant behavior were significantly and positively associated with three types of psychological needs (i.e., autonomy, competence and relatedness), social ostracism, moral disengagement, depressive mood, poor peer relationships, loneliness, and low self-control (all p-values < 0.001) (see Figure 1).

Table 1. Descriptive characteristics of high-risk cyber-deviant behavior and group comparison ($n = 1,664$).

	Total ($n = 1664$)	%	Males ($n = 938$)	%	Females ($n = 726$)	%	χ^2	P
Cyber-social deviance	15	0.9	11	1.2	4	0.6	14.27	0.505
Cyber- verbal deviance	9	0.5	7	0.7	2	0.3	55.01	< 0.001
Cyber- pornography	29	1.7	26	2.8	3	0.4	73.24	< 0.001
Cyber-use deviance	7	0.4	6	0.6	1	0.1	24.59	0.217

Table 2. Descriptive characteristics of the variables and group comparison ($n = 1,664$).

Variable	Min	Max	Skewness	Kurtosis	Males ($n = 938$)	Females ($n = 726$)	t	P	Cohen's d
Csd	4	20	1.908	4.691	5.98 ± 2.72	5.61 ± 2.33	2.94	0.003	0.145
Cvd	5	25	2.912	11.139	6.59 ± 2.99	5.84 ± 1.98	5.86	< 0.001	0.290*
Cpd	4	20	2.267	5.816	6.05 ± 3.25	5.01 ± 2.00	7.56	< 0.001	0.374*
Cud	6	30	4.415	24.323	6.99 ± 2.99	6.59 ± 1.94	3.18	0.002	0.157
Aut	4	28	−0.97	0.305	15.27 ± 5.20	15.79 ± 4.37	2.17	0.030	0.107
Rel	4	28	−0.246	0.273	13.86 ± 5.26	14.31 ± 4.32	1.88	0.061	0.093
Co	4	28	−0.270	0.702	14.56 ± 4.90	14.78 ± 4.02	0.97	0.334	0.048
Os	4	20	0.979	0.642	7.34 ± 3.51	7.08 ± 2.98	1.59	0.113	0.078
Md	8	40	0.584	0.440	16.37 ± 5.76	14.72 ± 5.03	6.15	< 0.001	0.304*
De	3	12	0.173	−0.641	6.13 ± 2.23	6.59 ± 2.07	4.36	< 0.001	0.215*
Pe	1	5	0.965	0.958	2.03 ± 1.02	2.13 ± 0.88	1.99	0.047	0.098
Lo	1	7	0.321	−0.259	3.54 ± 1.64	3.38 ± 1.41	2.16	0.031	0.107
Sc	1	7	0.009	−0.340	3.97 ± 1.58	4.10 ± 1.45	1.78	0.075	0.088

csd = cyber-social deviance, cvd = cyber-verbal deviance, cpd = cyber-pornography, cud = cyber-use deviance, aut = autonomy, rel = relatedness, co = competence, os = social ostracism, md = moral disengagement, de = depressive mood, pe = peer relationship, lo = loneliness, sc = self-control.

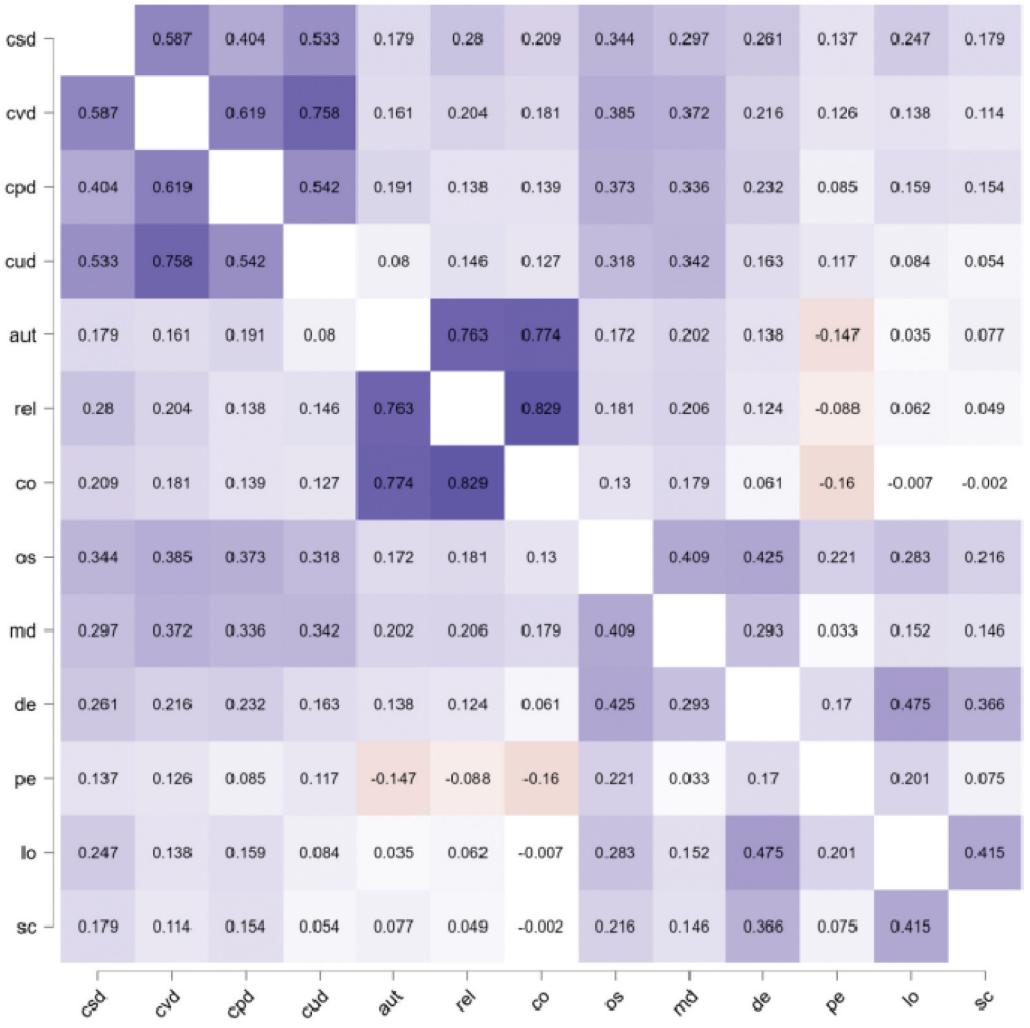

Figure 1. The heatmap of multivariables. Note: csd = cyber social deviance, cvd = cyber verbal deviance, cpd = cyber pornography, cud = cyber use deviance, aut = autonomy, rel = relatedness, co = competence, os = social ostracism, md = moral disengagement, de = depressive mood, pe = peer relationship, lo = loneliness, sc = self-control.

Network analysis

The total networks comprising cyber-deviant behaviors, psychological needs, social ostracism, moral disengagement, depressive mood, peer relationships, loneliness and self-control are shown in Figure 2 (A = total participants, B = males, and C = females). In the total network, stronger edges were identified for relatedness (“*rel*”) – competence (“*co*”) ($r = 0.558$ [total sample], $r = 0.564$ [male sample], $r = 0.529$ [female sample]), cyber-verbal deviance (“*cvd*”) – cyber-use deviance (“*cud*”) ($r = 0.524$ [total sample], $r = 0.492$ [male sample], $r = 0.597$ [female sample]), and depressive mood (“*de*”) – loneliness (“*lo*”) ($r = 0.321$ [total sample], $r = 0.327$ [male sample], $r = 0.330$ [female sample]). The strongest centrality was the cyber-verbal deviance node (“*cvd*”) for the total sample (EI = 1.827), male sample (EI = 1.785), and female sample (EI = 1.813) (Appendices S1–7).

Good edge-weight accuracy is shown in Figure 3A based the narrow width of CI parameter estimates. In addition, the CS-coefficient (CS = 0.75 for the total sample, CS = 0.751 for male sample, CS = 0.749 for female sample) indicated better centrality stability in the network (Figure 3B). In

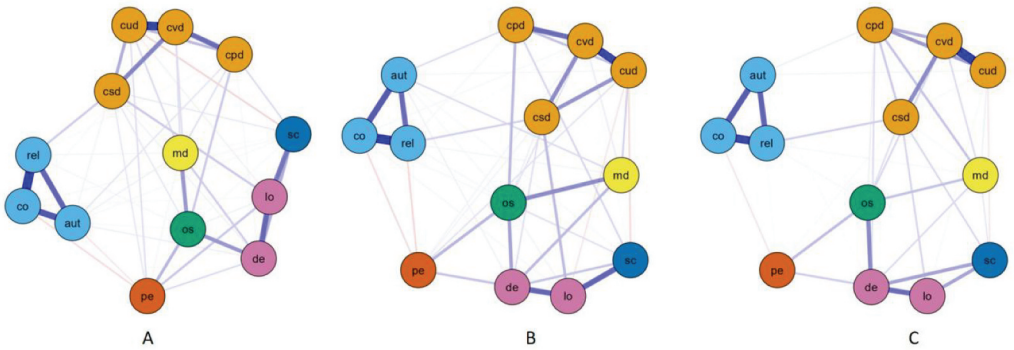

Figure 2. EBICglasso model based on network analysis according to the relationship between variables among total participants (A), males (B), and females (C). Note: csd = cyber social deviance, cvd = cyber verbal deviance, cpd = cyber pornography, cud = cyber use deviance, aut = autonomy, rel = relatedness, co = competence, os = social ostracism, md = moral disengagement, de = depressive mood, pe = peer relationship, lo = loneliness, sc = self-control.

Figures 3C and 3D, the strongest edge (relatedness-competence) and node strengths were also verified to be significantly different from other pairwise edges and from other nodes (centrality of nodes from 0.5 to 1.3), respectively. The accuracy results of different gender networks are shown in Appendices S8 and S9.

In the cyber-social deviance (*"csd"*) network, the loneliness node (*"lo"*) had the strongest correlation with depressive mood (*"de"*) ($r = 0.4$ [total sample], $r = 0.394$ [male sample], $r = 0.383$ [female sample]) (Figure 4A1,2). In the cyber-verbal deviance (*"nl"*) network, the social ostracism node (*"os"*) had the strongest correlation with depressive mood ("*de*") ($r = 0.288$ [total sample], $r = 0.275$ [male sample], $r = 0.295$ [female sample]) (Figure 4B1,2). In the cyber-pornography deviance ("*cpd*") network, the self-control node (*"sc"*) had the strongest correlation with depressive mood ("*de*") ($r = 0.307$ [total sample], $r = 0.278$ [male sample], $r = 0.310$ [female sample]) (Figure 4C1,2). In the cyber-use deviance ("*nu*") network, the social ostracism node ("*os*") had the strongest correlation with moral disengagement ("*md*") in the total sample ($r = 0.306$), and male sample ($r = 0.336$), while the cyber-use deviance node ("*cud*") had the strongest correlation with moral disengagement ("*md*") in the female sample ($r = 0.252$) (Figure 4D1,2). The strongest centrality was social ostracism ("*os*") for different cyber-deviance networks. For females, depressive mood ("*de*") was the strongest central node in the cyber-social deviance (*"csd"*) network and the cyber-pornography deviance (*"cpd"*) networks (Appendices S10–31).

Network comparison between genders

The network structures of the total network ($M = 0.206$, $p = 0.011$) and the cyber-pornography deviance network ($M = 0.151$, $p = 0.046$) showed significant gender differences, with males showing a more significant connection than females in the total network using the network comparison test. In addition, the global strengths of cyber-social deviance network (2.54 vs. 1.92, $p = 0.017$), cyber-verbal deviance network (2.19 vs. 1.47, $p = 0.009$), and cyber-pornography deviance network (1.88 vs. 1.53, $p = 0.027$) also showed significant gender differences, with males also showing more significant connections than females in these networks.

Discussion

The present study examined the prevalence of cyber-social deviance, cyber-verbal deviance, cyber-pornography deviance, and cyber-use deviance. The findings indicated that the prevalence of high-risk cyber-deviant behaviors was low and ranged from 0.4% (cyber-use deviance) to 1.7% (cyber-pornography deviance). Chen et al. (2021) reported Taiwan adolescents engaged in much higher

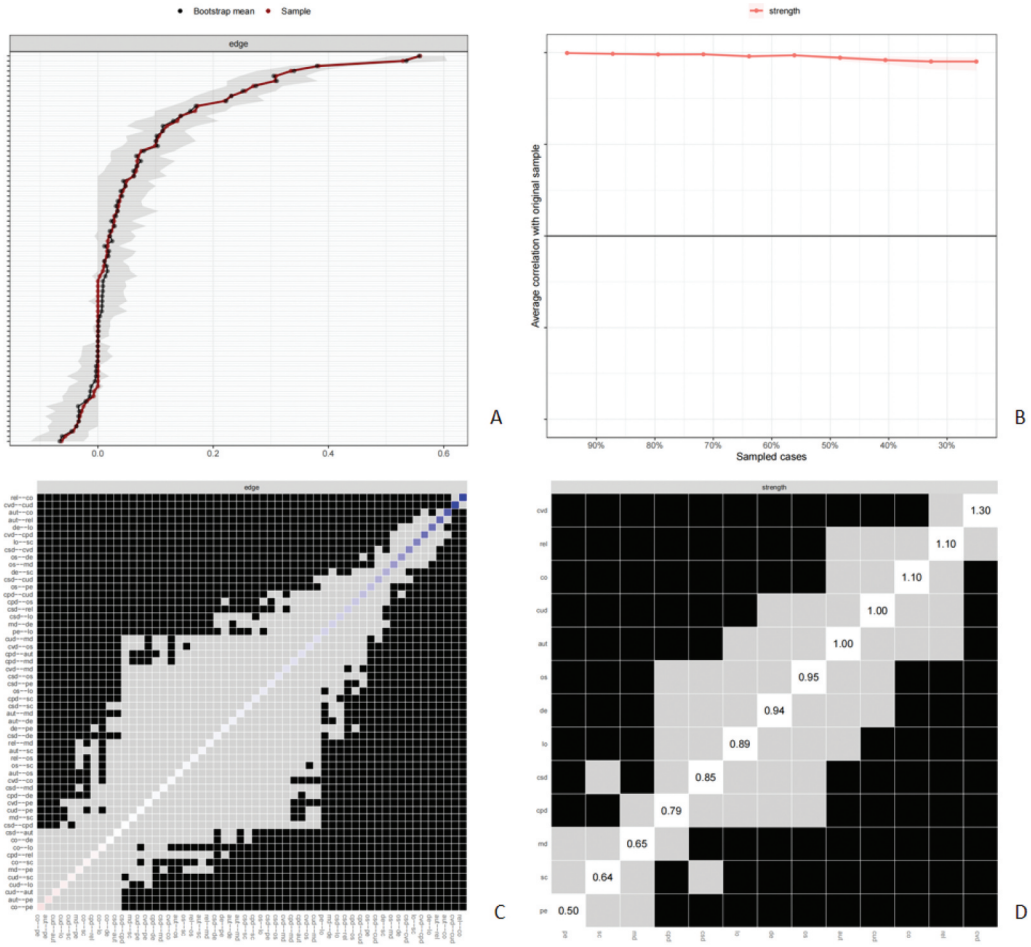

Figure 3. Bootstrapped confidence intervals of estimated edge-weights (A) and Case-dropping bootstrap procedure for node strength (B), bootstrapped difference tests (α = 0.05) between edge-weights that were non-zero in the estimated network (C) and node strength of the items (D).

rates of cyber-deviance from 24.2% (i.e., pornography website at least once) to 68% (e.g., illegally downloaded videos, music or pictures at least once) but these figures were in relation to having ever engaged in the behavior (unlike the present study which looked at very frequent engagement). Zhang et al. (2023) reported 4.3% cyber-deviance among Chinese secondary vocational students using a five-dimension cyber-deviance scale (i.e., at least average score of one dimension ≥ 3). These different results are due to differences in assessment instruments and screening criteria.

Gender differences in cyber-deviant behavior

Gender differences were found in cyber-verbal deviance and cyber-pornography deviance with males being significantly more likely than females to be engaging in these cyber-deviant behaviors, similar to previous studies (Chen et al. 2021; Zhang 2015). Moreover, the present study found that males had higher moral disengagement score than females, which is consistent with Turner's study (Turner 2008). A meta-analysis of 38 studies also reported that gender was a moderator between moral disengagement and cyberbullying demonstrating that a greater proportion of females increase the effect size (Zhao and Yu 2021). The four dimensions of

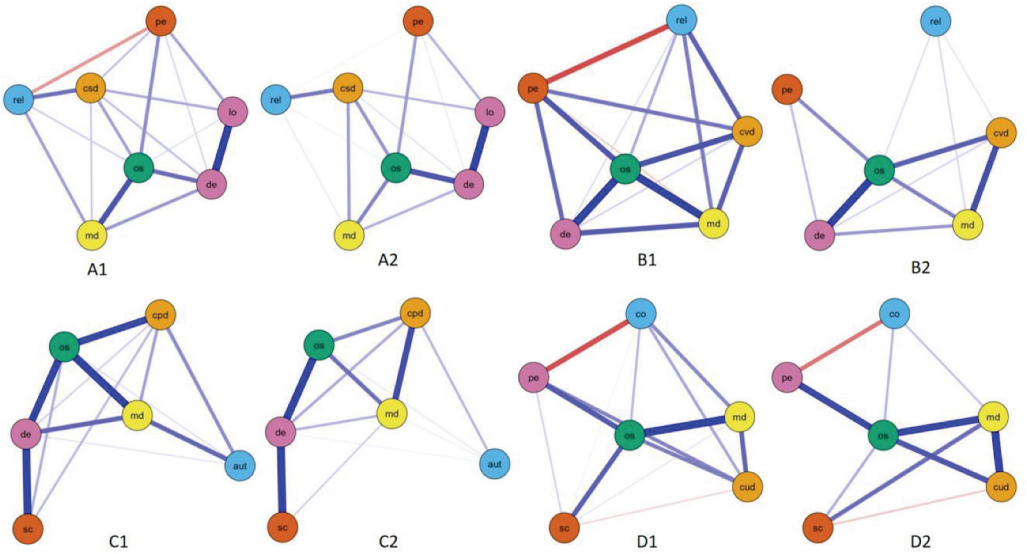

Figure 4. EBICglasso model based on network analysis according to the relationship between variables among males (A1[csd], B1 [cvd], C1[cpd], and D1[cud]) and females (A2[csd], B2[cvd], C2[cpd], and D2[cud]). Note: csd = cyber social deviance, cvd = cyber verbal deviance, cpd = cyber pornography, cud = cyber use deviance, aut = autonomy, rel = relatedness, co = competence, os = social ostracism, md = moral disengagement, de = depressive mood, pe = peer relationship, lo = loneliness, sc = self-control.

cyber-deviant behaviors were found to be significantly and positively associated with low psychological need satisfaction, social ostracism, moral disengagement, depressive mood and loneliness, poor peer relationships, and low self-control, which appear to support the first six hypotheses (H_1–H_6). However, the relationship between these multi-variables needs further examination.

Network analysis of cyber-deviant behaviors

The present study used network analysis to explore the associations between cyber-deviant behaviors and various psychological or social factors (i.e., low psychological needs satisfaction, social ostracism, moral disengagement, depressive mood, loneliness, poor peer relationships, and low self-control), which supported the reciprocal determinism model. There was interaction between cyber-deviant behaviors and psychological and social factors. Males showed more cyber-deviant behaviors than females, especially in cyber-social/verbal/pornography deviant behaviors, which was consistent with previous research (Hen et al. 2020; Nam 2023; Wang et al. 2021).

The total networks showed the interaction between the cyber-deviant behaviors and all the other variables (i.e., psychological needs, social ostracism, moral disengagement, depressive mood, peer relationships, loneliness and self-control). In the total network of cyber-deviant behaviors, the strongest edges included relatedness – competence ("rel"–"co"), cyber-verbal deviance – cyber-use deviance ("cvd"–"cud"), and depressive mood – loneliness ("de"–"lo") which supported the consistent internal structure of assessment instrument (i.e., the CDBQ and ONSQ) and closely related negative emotions. Cyber-verbal deviance ("cvd") was the strongest centrality in the whole network which indicated that offensive, violent and/or uncivilized language were the most prevalent cyber-deviant behaviors among Chinese university students. Some studies have indicated that cyber-verbal aggression is considered as a communication strategy in contemporary digital media spaces (Ferreira et al. 2021; Temirgazina 2013). Different dimensions of cyber-deviant behaviors may have different interactions with other variables, which need to be further examined.

Cyber-social deviant behavior includes the concealing of real information in cyber-social communication and exposing individual's privacy to strangers in virtual worlds (Zhang 2015). In the cyber-social deviance ("nc") network, the strongest edge (i.e., depressive mood – loneliness ["de"–"lo"]) indicated that individuals engaged in cyber-social communication may be for relieving negative emotions in real life, especially avoiding a sense of loneliness and decreasing depressive mood. In a study of 604 adolescents, it was found that girls who were victims of cyber-dating violence reported higher levelS of loneliness and depressive mood (Cava et al. 2020). In addition, Smith, Leonis, and Anandavalli (2021) reported that different forms of online communication may explain loneliness and belonging. Moreover, one study found that cyber-victimization mediated the association between self-disclosure and loneliness among adolescents (Quynh Ho and Nguyen 2023). The present study's findings were similar and partly supported H_7. Cyber-social deviant behavior was only closely connected with the relatedness ("rel") component of psychological need satisfaction, not autonomy, competence or self-control.

Cyber-verbal deviance refers to posting or using inappropriate speech in the internet environment, such as uncivilized, offensive, or aggressive language in chat rooms, social media, or blogs/forums (Zhang 2015). In the cyber-verbal deviance ("cvd") network, the strongest edge (i.e., depressive mood – social ostracism ["de"–"os"]) indicated that individuals who experienced cyberbullying verbally were more likely to feel social ostracism or exclusion and depression. Williams (2009) posited that ostracism can cause aggression, especially in situations where individuals have a sense of being out of control or threatened. Zhang et al. (2019) also indicated that ostracism may increase automatic aggression through anger and low forgiveness. Bucur, Zampieri, and Dinu (2021) also reported that individuals with high depressive symptoms may more frequently use offensive language. The present study's findings are consistent with those of the aforementioned studies and partly supported H_7. However, cyber-verbal deviant behavior was not found to be closely connected with loneliness, autonomy, competence or self-control.

Cyber-pornography deviant behavior refers to participating in pornographic activities on the Internet, such as browsing pornographic websites, chatting using pornographic speech, and watching or downloading pornographic videos and pictures (Zhang 2015). In the cyber-pornography deviance ("cpd") network, the strongest edge (self-control – depressive mood ["sc"–"de"]) indicated that individuals engaged in cyber-pornography activities were more likely to have problems in self-control and experience negative depressive mood. Perry (2018) indicated that males' cyber-pornography and depression had a bidirectional connection, which depended on males' moral evaluation of pornographic content and degree of usage. Buzzell, Foss, and Middleton (2006) found that low self-control significantly influenced cyber-pornography use. The present study also found that cyber-pornography had a positive association with low self-control and depression (partly supporting H_7) but cyber-pornography behavior was not closely connected with relatedness, competence, peer relationships or loneliness.

In the present study, cyber-use deviant behavior included doxxing (i.e., publishing a person's private information online without their consent), and problematic online activities (e.g., gaming, social media use, shopping). The strongest edges for males (i.e., moral disengagement-social ostracism ["md"–"os"]) and females (i.e., cyber-use deviance-moral disengagement ["cud"–"md"]) indicated that there was a gender difference in the cyber-use deviance ("cud") network. These findings indicated that males with cyber-use deviant behaviors showed high levels of moral disengagement and were more likely feel social ostracism or exclusion, whereas females showed more cyber-use deviant behaviors due to bias cognition (i.e., moral disengagement).

For example, doxxing is seen as a form of cyber-abuse and doxxers deliberately seek and publish individuals' personal information with malicious intent (Lee 2022), which is closely related to moral disengagement (Foster and Cross 2024). In addition, moral disengagement has also been found to moderate the association between problematic social media use (i.e., cyber-use deviance) and cyber-bullying (Colella et al. 2024). Moreover, ElSayary (2024) proposed that problematic internet use (i.e., cyber-use deviance) may potentially undermine cyber-moral disengagement among young people.

The present study also found an association between cyber-use deviant behaviors and moral disengagement (partly supporting H_7) but cyber-use deviant behaviors were not closely connected with relatedness, autonomy, depressive mood or loneliness.

In four cyber-deviant behavior networks (i.e., "csd," "cvd," "cpd" and "cud"), the social ostracism node ("os") had all the strongest centralities. The findings showed that different cyber-deviant behaviors were positively associated with social ostracism. Social ostracism may be not only cause of cyber-deviant behaviors, but may also be the result of cyber-deviant behaviors. Social ostracism may originate from being excluded in real life for some individuals, who then need to build new interpersonal relationship through the virtual world to meet their psychological needs and decrease negative emotions (Shi et al. 2023; Wang et al. 2020a). However, some types of individuals engaged in cyber-excessive activities (e.g., doxxing) may experience ostracism online, such as the U.S. gamer who reported cyber-ostracism from gaming teams after the gamer's sex tape was doxxed (Eckert and Metzger-Riftkin 2020). In recent years, cyber-ostracism has been the focus of sociologists and psychologists' attention (Kassner et al. 2012; Wolf et al. 2015). In the present study, ostracized individuals may have experienced exclusion from real or virtual (i.e., cyber/online) situations.

The network structures of the total network and the cyber-pornography deviance network were examined and indicated significant differences between genders. For the total network, males showed a closer connection between self-control and loneliness than females, which was consistent with previous studies (e.g., Nam 2021; Wang et al. 2021). Males may externalize negative emotions and express more deviant behaviors in cyberspace, whereas females display relatively high self-control and internal emotion (Nam 2021). For the cyber-pornography deviance network, males had a closer connection between cyber-pornography and social ostracism, whereas females had a closer connection between cyber-pornography and moral disengagement. The results may indicate that males engaged in cyber-pornographic activities experience more social ostracism and less moral identity, whereas females engaged in cyber-pornographic activities may have higher levels of moral disengagement. Hen et al. (2020) also reported that there was a gender difference in implicit exposure to cyber-pornography (i.e., females tend to understate the extent of exposure than males). In addition, for the global strengths of cyber-social/verbal/pornography deviance network, males showed a closer connection with most variables than females. These findings supported H_8 and further demonstrated gender differences in cyber-deviance, which is consistent with previous research (e.g., Wang et al. 2021).

Implications

The present study is the first to use network analysis to explore the associations between cyber-deviant behaviors and various psychological or social factors (i.e., low psychological needs satisfaction, social ostracism, moral disengagement, depressive mood, loneliness, poor peer relationships, and low self-control), which supported the reciprocal determinism model of cyber-deviant behaviors. The results showed that males had more cyber-deviant behaviors than females, especially in cyber-social/verbal/pornography deviant behaviors. Males appear to exhibit a higher risk preference and a tendency to seek out stimulation in cyberspace, which may result in the interaction between biological, psychological and social factors. Educational intervention and prevention programs are needed to inhibit and/or mitigate such behaviors, and the results suggest that males should especially be targeted. Such initatives could take place within schools and colleges as part of personal, social, and health education classes.

Limitations

The present study had some limitations. First, the cross-sectional nature of the study design means that causal relationships between the study variables could not be determined. Second, the sampling method was convenience sampling, which means the participants were not representative of the

Chinese population. Third, the use of self-report data may lead to participant bias (e.g., social desirability and expectancy effects). Fourth, the study did not propose an integrated theory and intervention measures on cyber-deviant behaviors. Therefore, future studies should employ longitudinal designs and include representative samples. In addition, more objective research methods could also be employed, such as the use of ecological momentary assessment. Moreover, a more integrated theory needs to be constructed, and effective intervention measures to minimize cyber-deviant behaviors should be also developed for populations of different gender and age.

Conclusion

The present study using a network analysis approach identified the interactions between cyber-deviant behaviors, basic psychological need satisfaction, social ostracism, moral disengagement, depressive moods, loneliness, peer relationships, and self-control. Significant gender differences of network structures and global strength were found in network comparison test. The results suggest that prevention and intervention measures need to be considered for decreasing cyber-deviant behaviors, especially specific methods for different genders.

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Author contributions

CRediT: **Li Li:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft; **Zhimin Niu:** Data curation, Formal analysis, Investigation, Writing – original draft; **Liangqing Wang:** Investigation; **Mark D. Griffiths:** Supervision, Writing – review & editing; **Songli Mei:** Methodology, Supervision.

Disclosure statement

There are no financial or non-financial competing interests except for MDG. MDG has received research funding from Norsk Tipping (the gambling operator owned by the Norwegian government). MDG has received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling and gambling treatment from Gamble Aware (formerly the Responsibility in Gambling Trust), a charitable body which funds its research program based on donations from the gambling industry. MDG undertakes consultancy for various gambling companies in the area of player protection and social responsibility in gambling. None of the research staff received incentives for recruiting participants or for any other purpose directly associated with the study.

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Availability of data and materials

The datasets are available from the corresponding author upon reasonable request.

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