

Network Analysis of Association Between Problematic Social Network Use and Alexithymia in Freshmen

Ling Ding¹, Xuelian Ren², Yamei Sun³, Chengjuan Yu¹, Ge Li¹, Chenggang Wang¹

¹School of Health, Shandong University of Traditional Chinese Medicine, Jinan, Shandong, People's Republic of China; ²Office of Academic Affairs, Heze University, Heze, Shandong, People's Republic of China; ³Center for Mental Health Education, Heze University, Heze, Shandong, People's Republic of China

Correspondence: Chenggang Wang, Email wangchg1268@163.com

Objective: Exploring the core and bridge nodes in problematic social network use and alexithymia among freshmen to provide a basis for understanding the relationship and interventions.

Methods: A total of 4057 first-year students from four universities in Shandong Province were chosen and surveyed with the Problematic Mobile Social Media Use Assessment Questionnaire and the Toronto Alexithymia Scale (TAS). Network analysis was performed using R to estimate the connections between nodes. Centrality and predictability indicators were used to identify key nodes, with accuracy and stability validation techniques applied. Gender and residence differences in the network structure were also examined.

Results: In the problematic social network use network, the nodes with the highest expected influence were P16 (excessive swiping) and P14 (lack of control over phone usage). In the problematic social network use-alexithymia network, cognitive failure had the highest strength (strength = 1.155) and centrality. Difficulty identifying feelings (bridgestrength = 0.32), externally oriented thoughts (bridgestrength = 0.24), and cognitive failure (bridgestrength = 0.19) were key bridge nodes. No significant differences were found in the network structure across gender and residence, though the network was tightly connected.

Conclusion: Cognitive failure plays a central role in problematic social network use among freshmen. Difficulty identifying feelings, externally oriented thoughts, and cognitive failure are critical in linking problematic social network use with alexithymia.

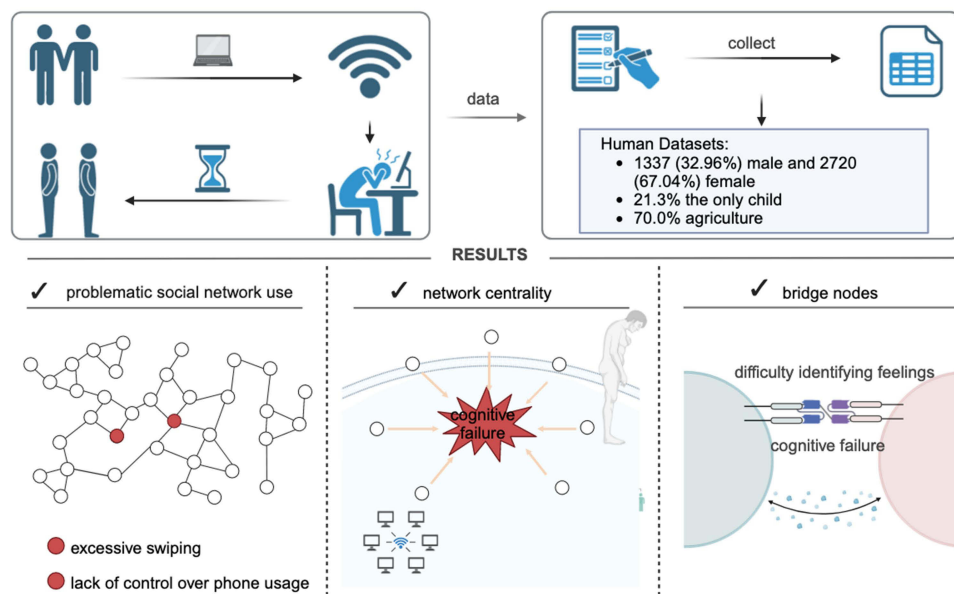
Plain Language Summary: In a study with over 4000 freshmen from four universities in Shandong Province, researchers examined the link between problematic social media use and alexithymia. The study used the method of network analysis to analyze data. The key findings were that “cognitive failure”—reduced mental processing due to excessive mobile use—is central to problematic social network use. The most significant issues identified were difficulty identifying feelings, engaging in externally oriented thinking, and cognitive failures. These factors are consistent across different genders and residences, indicating a common pattern among freshmen. The results suggest that interventions to reduce excessive social media use and improve emotional awareness should focus on these areas to help alleviate alexithymia symptoms and enhance student well-being.

Keywords: problematic social network use, alexithymia, freshmen, network analysis

Introduction

In contemporary society, the experience of attending university is characterized by a multitude of difficulties and the need to adjust, especially for new students. Statistics indicate that China achieved a gross enrolment rate of 54.4% in higher education in 2020, surpassing expectations and entering a new phase of widespread access to higher education.¹ As freshmen, students undergo a notable transition from high school to college, necessitating adaptation to a novel academic setting, social network, and way of life. During this critical period, numerous freshmen may encounter difficulties arising

Graphical Abstract



from academic, social, and life stressors that can profoundly affect their mental well-being and behavior. Problematic social network use refers to an individual's negative impact on mental health, social adjustment, and daily life as a result of excessive use of the network.² This behavior is common among college students and can be reversed.³ To prevent college students from becoming addicted to the Internet and losing their motivation, it is important to identify problematic social network use in freshmen as early as possible.

Alexithymia refers to an individual's inability to recognize, experience, and express emotions in real-world social situations.⁴ It is also known as "affective dysphoria" and can be observed in three main areas: difficulty identifying feelings, difficulty describing feelings and externally oriented thoughts.⁵ Li et al's study on secondary school students confirmed that individuals with alexithymia are likely to struggle with perceiving and pursuing the meaning of life, lacking goals, values, and ideals,⁶ and subsequently developing an addiction to the Internet. Nevertheless, this study specifically examines middle school pupils and does not have confirmation in college students. A study conducted by Cheng Peng et al on college students revealed that individuals with alexithymia tend to alleviate their anxiety by avoiding real social activities and instead increasing their use of the Internet and cell phones. This behavior, in turn, increases their risk of developing cell phone addiction.⁷ In addition, it was found that individuals with alexithymia have a diminished ability to perceive their own and others' emotions, as well as a lower cognitive assessment ability⁸ and that they are more likely to resort to negative coping mechanisms,⁹ such as smoking, drinking, and Internet addiction. These studies fail to consider the specific impact of different characteristics of alexithymia on problematic social network use among college students. Besides, research methods based on common cause theory¹⁰ or latent variable theory,¹¹ which primarily rely on composite scores to assess the severity of a specific psychological trait or problem, do not sufficiently consider the correlations and distinctions between various psychological problems. As a result, they are unable to accurately portray the intricate and nuanced interactions between psychological traits.^{12,13} In short, traditional research methods have trouble to identify the connection and the intensity of the connection between problematic social network use and specific disorders (such as difficulty identifying feelings) within the context of alexithymia.

Based on the theoretical framework of psychopathology, network analysis constructs a network consisting of nodes that represent psychological traits, and edges that represent the connections between these traits.¹⁴ It is a novel approach to exploring the complex interactions between problematic social network use and alexithymia.¹⁵ By identifying key

nodes, connecting nodes, and delving into the interaction between problematic social network use and alexithymia in freshmen, this approach opens up new avenues for research. Using the network analysis approach, Luo validated the catastrophizing and the externally oriented thoughts as bridging nodes between the alexithymia and cognitive emotion regulation strategies in a group of college students with Internet addiction.¹⁶ However, previous studies have not confirmed a specific link between problematic social network use and alexithymia, especially among freshmen. We explored the importance of components in the context of problematic social network usage by creating a network, and identified core and bridge nodes in the network of problematic social network use - alexithymia in freshmen, with the aim of providing a reference basis for the intervention of psychological problems in freshmen.

Research Participants and Methods

Participants

From September 7, 2023 to November 7, 2023, a cluster sampling method was employed to choose first-year students from four universities in Shandong Province. The selection was done per class using the Questionnaire Star platform. The inclusion criteria for this study are as follows: no history of neurological or psychiatric diseases; no use of psychoactive and narcotic drugs and active substances within one week of the study; knowledge of the content of the study and informed consent to voluntarily participate. 4496 questionnaires were sent, and out of those, 4057 were considered valid, resulting in an effective recovery rate of 90.24%. Among them, 1337 (32.96%) were male and 2720 (67.04%) were female. The percentage of individuals who were just children was 21.3%, and the percentage of households engaged in agriculture was 70.0%.

Research Tools

The Problematic Mobile Social Media Use Assessment Questionnaire

The questionnaire was used to assess problematic use of social networks. It comprised of 20 items categorized into five dimensions: increased viscosity, physiological damage, misplaced anxiety, cognitive failure, and guilt.¹⁷ The questionnaire was rated on a 5-point Likert scale, with 1 indicating “not at all consistent” and 5 indicating “completely consistent”. The higher the score, the more serious the tendency of mobile social network overuse behavior. The scale used in this study has been found to be reliable and valid, and the Cronbach’s alpha coefficient of the scale is 0.95, which meets the psychometric standard.

The Toronto Alexithymia Scale (TAS-20)

The scale is used to assess difficulties in describing emotions or difficulties in expressing emotions.¹⁸ It includes 20 items and 3 dimensions, include difficulty identifying feelings (7 items), difficulty describing feelings (5 items), and externally oriented thoughts (8 items). The scale is scored on a five-point Likert scale, ranging from one to five, with a total score range of 20 to 100 points. A higher score indicates a higher level of emotion expression disorder, with scores equal to or greater than 61 being considered indicative of such a disorder. The Cronbach alpha coefficient for the total scale in this study was 0.81.

Methods of Statistical Analysis

Various R packages in R version 4.2.0 were utilized to conduct four types of network analyses: network estimation (ie, constructing a network),¹⁹ centrality and predictability measures (ie, analyzing network metrics),²⁰ accuracy and stability assessment (ie, validating a network),²¹ and network comparison.²²

Network Estimation

The qgraph package version was used to construct biased correlation networks and perform network estimation and visualization. Data fitting and item network construction were performed using a Gaussian graphical model (GGM), which is an undirected network where each symptom is treated as a node (ie, the difficulty identifying feelings) and the association between two nodes is seen as an edge. The GGM was computed using a nonparametric Spearman correlation

matrix employing the graphical Least Absolute Shrinkage and Selection Operator (gLASSO) and the Extended Bayesian Information Criterion (EBIC), resulting in a sparser and more interpretable symptomatic network. The F-R algorithm layout was used to present the network structure. In the visualized network, green edges indicate positive correlation, while red edges indicate negative correlation. Thicker edges indicate a stronger association between two nodes.

Centrality and Predictability Measures

The centrality metrics of a node are calculated using bootnet packets, including strength, closeness centrality, and betweenness centrality. Higher strength means that the node is more connected to other nodes in the network and plays a more significant role. Closeness centrality is the reciprocal of the sum of shortest path lengths from all other nodes to the given node. If a node has a small shortest distance to all other nodes, its closeness centrality is high. Betweenness centrality represents the frequency of a node being on the shortest path of any two other nodes. The relative importance of a node is evaluated using Expected Influence (EI). This is calculated by summing the weights (ie, regularized partial correlation coefficient) of all the edges connected to that node. A larger Expected Influence value indicates a higher degree of centrality and greater importance in the network structure.

Accuracy and Stability Assessment

The bootnet package was utilized to evaluate the precision and consistency of the observed network model. Initially, the precision of the edge weights was evaluated by computing 95% confidence intervals (CIs) using a nonparametric self-help method (1000 bootstrap). Secondly, the centrality indices of the expected impacts and the expected impacts of the bridges were evaluated using correlation stability (CS) coefficients. CS coefficients greater than 0.25 indicate moderate stability, while values greater than 0.5 indicate strong stability.

Network Comparison

The Network Comparison Test (NCT) was performed using the R software Network Comparison Test package to assess the differences in network structure between problematic social network use and alexithymia among freshmen of various genders and places of residence.

Results

The Network of Problematic Social Network Use

A network was created using the 20 entries of the Problematic Network Use Scale as nodes. The network analysis revealed that the connection strengths between P19 (feeling regret and guilt when using mobile social networks to swipe the screen or chat for too long and delaying study or work) and P20 (regretting delaying to do the right thing due to the use of social networks and instead playing with the cell phone) are the highest; see [Figure 1](#) for details. The two nodes with the greatest expected impact in this network are P16 (frequently and extensively using mobile social networks to swipe the screen and view friends' updates, resulting in less time for deep problem-solving) and P14 (constantly desiring to control the time, frequency, and intensity of using the cell phone to swipe the screen on mobile social networks, but being consistently unsuccessful); see [Figure 2](#) for details.

The Relationship Between Problematic Social Network Use and Alexithymia Network Structure, Centrality and Predictability

The network analysis revealed that out of the 28 connections, 18 (64.2%) were non-zero connections, consisting of 17 positive connections and 1 negative connection; see [Figure 3](#) for details. Among the connection strengths, two connections stood out: the difficulty identifying feelings and the difficulty describing feelings (weight = 0.71), the increased viscosity and the misplaced anxiety (weight = 0.34). The bootstrap 95% confidence intervals indicate that the stability of edge weights is relatively reliable and accurate.

[Figure 4](#) illustrates the values of the centrality metrics. The findings indicate that the two nodes with the highest strengths and expected impacts: the cognitive failure (strength = 1.155), and the difficulty identifying feelings (strength =

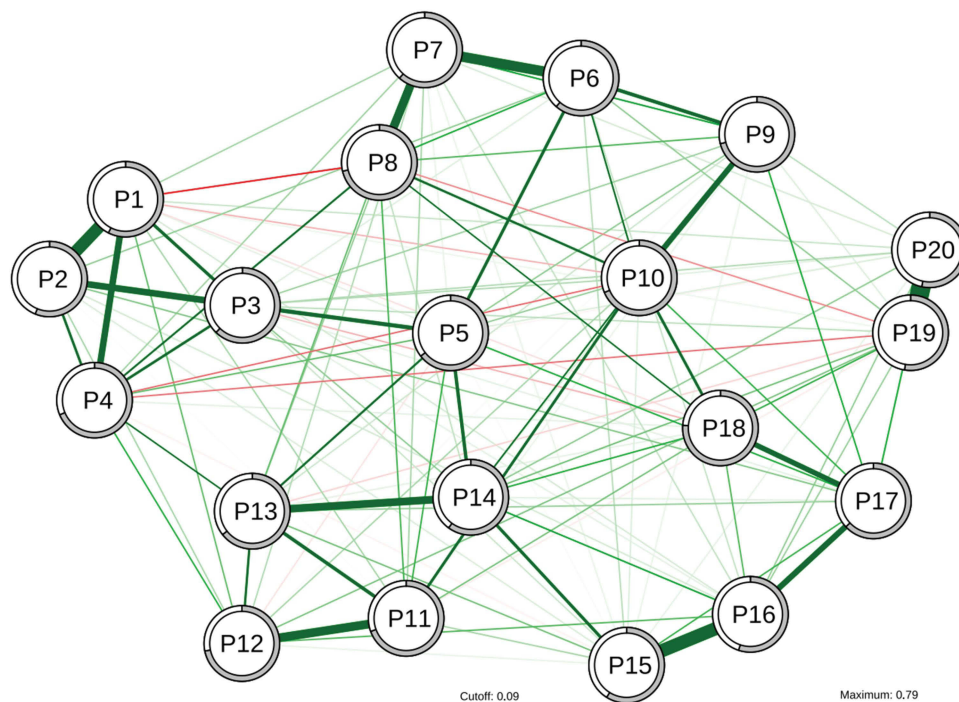


Figure 1 The network structure of the problematic social networks use.

Notes: P1-P20 represent 20 nodes of the problematic social networks use.

1.069). Cognitive failure also has the highest closeness centrality and betweenness centrality. Externally oriented thoughts had low closeness centrality, betweenness centrality and strength centrality. The predictability analysis reveals that the average predictable value of the nodes is 0.65. The two most predictable nodes are externally oriented thoughts and guilt; see [Table 1](#) for details.

Estimation of Bridge Nodes

Difficulty identifying feelings (bridge strength=0.32) had the highest bridge strength in the network, followed by externally oriented thoughts (bridge strength=0.24) and cognitive failures (bridge strength=0.19), suggesting that they are the bridge nodes in the network of problematic social network use - alexithymia. Additionally, difficulty identifying feelings has the highest expected influence of 0.62, and cognitive failures have an expected influence of 0.35; see [Figure 5](#) for details. This suggests that the difficulty identifying feelings can greatly contribute to problematic social network use, while cognitive failures can significantly contribute to alexithymia in this network structure.

Estimation of Accuracy and Stability

The stability of the network analysis was evaluated using the correlation stability coefficient (rcS). The rcS for the expected impact of nodes was found to be 0.75, indicating that 75% of the participants could be excluded from the analysis without significantly affecting the results. Additionally, the metrics maintained a correlation of at least 0.7 for 95% of the samples, demonstrating a high level of stability.; see [Figure 6](#) for details. To assess the accuracy of the network structure, this study utilized the estimation of 95% confidence intervals (CIs) for the edge weights. The results of the variance test conducted using Bootstrap sampling showed that the confidence intervals of the resulting sample set closely matched those of the original dataset. This indicates that the constructed network model provides statistically reliable estimates of the edge weights.

Network Comparison

There was no significant difference between males and females in terms of problematic social network use and alexithymia network structure, as indicated by the Network Invariance Test ($M = 0.0636$, $P = 0.723$) and the Global

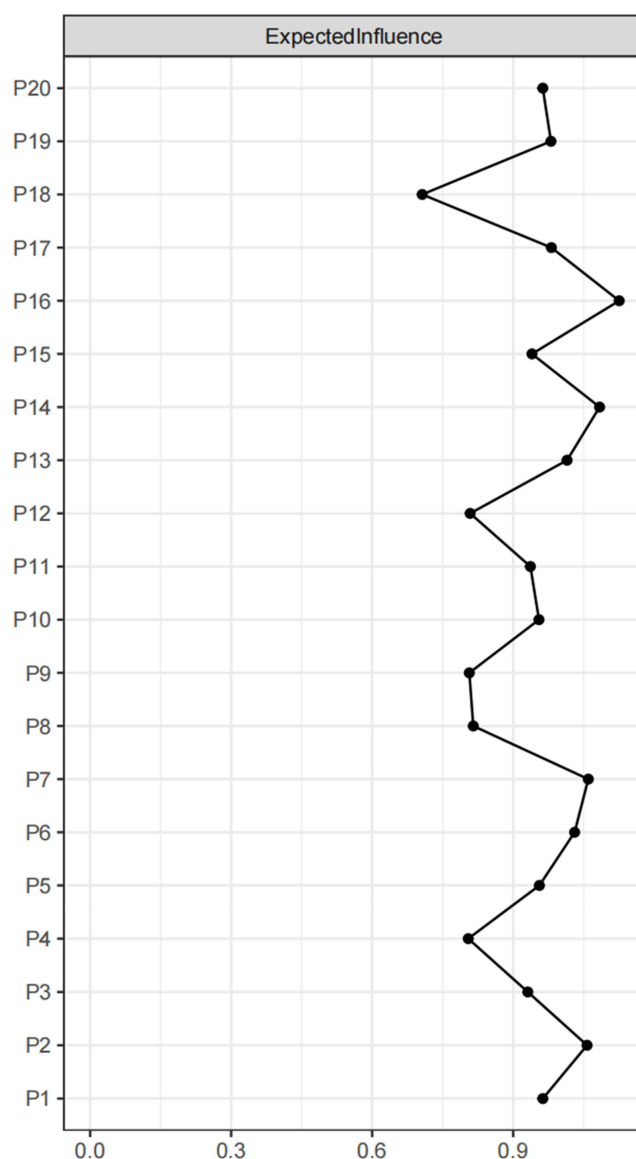


Figure 2 The expected influence of the problematic social networks use.

Intensity Invariance Test ($S = 0.0186$, $P = 0.798$). Similarly, there was no significant difference between rural and urban freshmen in terms of problematic social network use and alexithymia network structure, as indicated by the Network Invariance Test ($M = 0.1002$, $P = 0.100$) and the Global Intensity Invariance Test ($S = 0.0350$, $P = 0.646$).

Discussion

The network analysis of the problematic social network usage revealed that the two nodes with the greatest expected influence were P16 (often engaging in friend-swiping without much consideration) and P14 (desiring to reduce mobile phone swiping but lacking control over it). These two nodes are the most central nodes in the network. Strengthening or weakening these nodes can have a substantial impact on the entire network, and intervening in these nodes can greatly improve the problematic social network utilization of freshmen. Research has demonstrated that the application of “smart” thinking, namely the Doctrine of the Mean, can enhance individuals’ cognitive abilities and overall mental well-being. This, in turn, enables individuals to effectively resist the allure of the Internet and decrease their frequency of Internet usage.^{23,24} Consequently, it is advisable to employ certain psychological counseling techniques to encourage students to engage in critical thinking and enhance their cognitive abilities, while also discouraging excessive reliance on

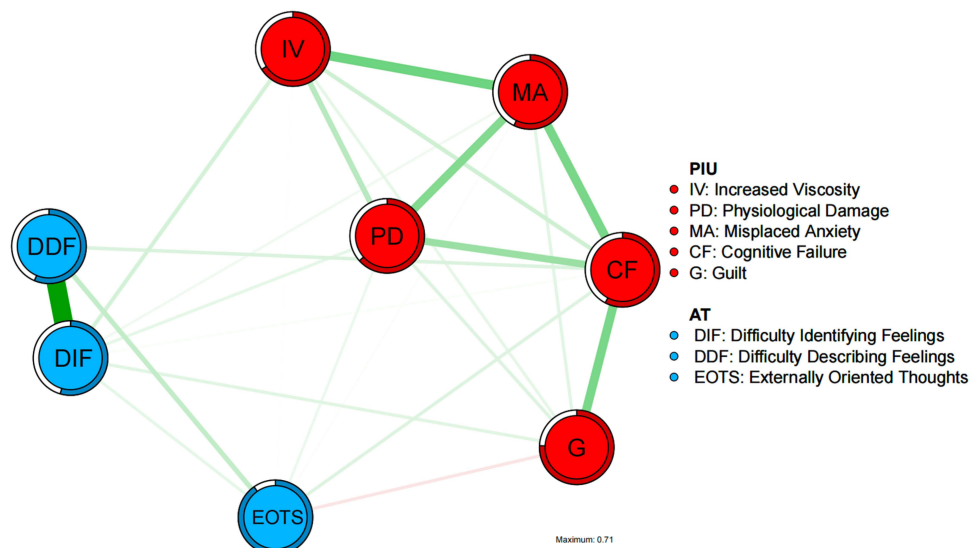


Figure 3 The network structure of the problematic social networks use – alexithymia.

Notes: PIU represents problematic social networks use; AT represents alexithymia.

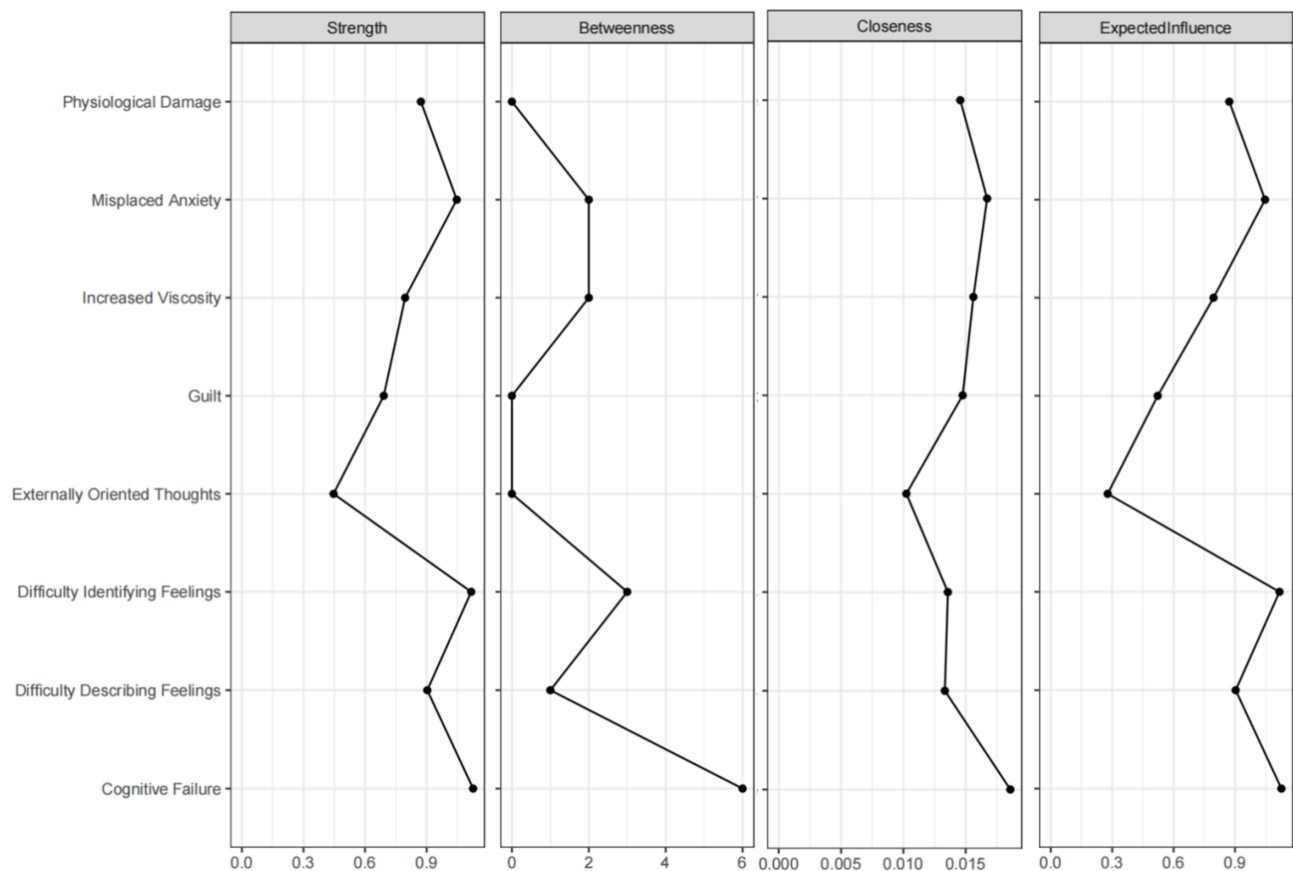


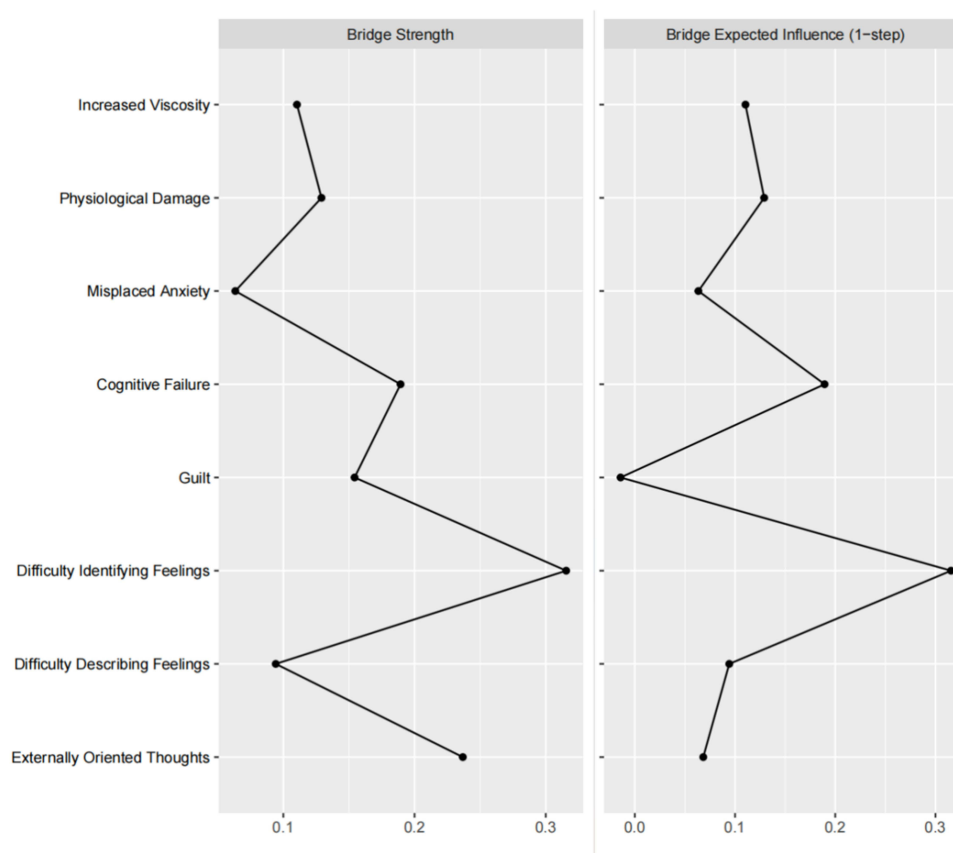
Figure 4 The network centrality of the problematic social networks use – alexithymia.

Table I The Scores, Expected Influence, and Predictability of Nodes in the Network of the Problematic Social Networks Use – Alexithymia

Code	Item	Score ($\bar{x} \pm s$)	Expected Influence	Predictability
IV	Increased Viscosity	14.20 \pm 4.745	0.800	0.658
PD	Physiological Damage	12.23 \pm 4.242	0.890	0.634
MA	Misplaced Anxiety	9.87 \pm 3.587	1.053	0.572
CF	Cognitive Failure	10.14 \pm 3.568	1.155	0.577
G	Guilt	5.87 \pm 2.254	0.524	0.757
DIF	Difficulty Identifying Feelings	16.75 \pm 5.844	1.069	0.545
DDF	Difficulty Describing Feelings	13.25 \pm 3.778	0.942	0.564
EOTS	Externally Oriented Thoughts	21.02 \pm 3.400	0.280	0.903

the internet. Self-discipline has a broad impact on various aspects of human life and is associated with positive psychological outcomes. It plays a crucial role in promoting a calm and non-anxious lifestyle. Conversely, a lack of self-control, such as being addicted to the Internet and unable to break free from it, diminishes life satisfaction.²⁵ Hence, cultivating self-control is important for freshmen's mental health and future development.

Previous studies on the relationship between problematic social network use and alexithymia have primarily employed structural equation modeling to investigate their mediation effect. It is generally recognized that problematic social network use is positively associated with alexithymia, a conclusion that has been verified in studies of college students and medical students both at home and abroad.^{26,27} In the network structure of problematic social network use - alexithymia, the items “the difficulty identifying feelings” and “the difficulty describing feelings” have the strongest connection. Difficulties in recognizing and describing emotions are closely related, mostly arising simultaneously, and

**Figure 5** The bridge strength and bridge expected influence of the problematic social networks use – alexithymia.

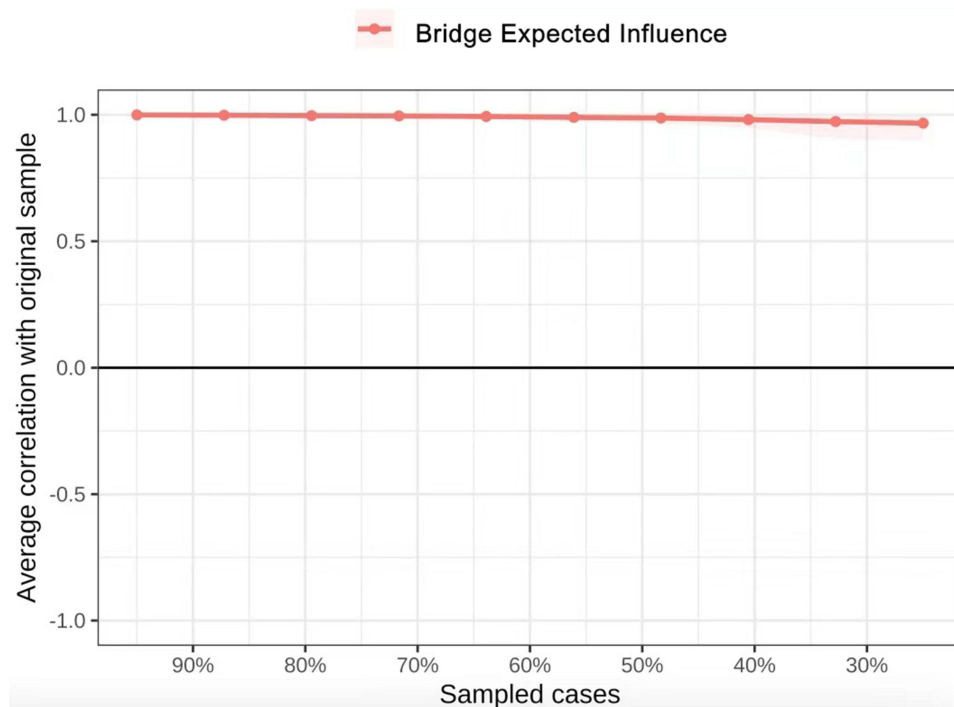


Figure 6 The stability of the bridge expected influence.

can also undergo transformation and causal interdependence. Emotional Intelligence Theory emphasizes the importance of the ability to recognize, understand, and manage one's own and other people's emotions for personal achievement. Individuals with low emotional intelligence may struggle to identify and communicate their emotions. Treatment approaches for this condition often focus on improving emotional recognition and expression abilities. This can be achieved through techniques like emotion recognition training, acquiring emotion expression skills, and developing the ability to articulate emotions. Cognitive behavioral therapy and other methods may also be utilized.

The network analysis revealed that cognitive failure exhibited the highest strength, closeness centrality, and betweenness centrality within the network. This indicates that, from a mechanistic perspective,²⁸ cognitive failure is the most central node in the network of problematic social network use - alexithymia in freshmen, and it is strongly connected to other items. According to the cognitive school of thought, an individual's behavior is determined by their cognition. A significant number of college students are aware of the risks associated with mobile network addiction. However, their inability to exercise self-restraint and acknowledge their excessive usage creates a discrepancy between their thoughts and actions, ultimately ending in undesirable conduct.²⁹ Furthermore, social cognitive theory³⁰ posits that the environment and an individual's cognition and behavior are mutually influential. Both the surrounding environment and an individual's cognition can impact their behavior, and in turn, an individual's behavior can influence both the environment and their cognition. The activation of the insula is abnormal when the individual has alexithymia.³¹ The insula is responsible for sensory awareness.³² As a result, persons with alexithymia frequently experience cognitive impairments. In this study, the difficulty identifying feelings was the second core node in the network, indicating that it occupies an important position in the freshman network, which is similar to the results of previous network analysis studies related to alexithymia.³³ Difficulty in identifying emotions can lead to challenges in recognizing one's own or others' feelings.⁵ This difficulty among freshmen in recognizing their own emotions can negatively impact their interpersonal relationships in college. This can contribute to feelings of loneliness and boredom, which in turn can escalate levels of depression and other related issues.³⁴ Hence, it is imperative to bolster the development of college students' capacity to discern and manage their emotions, with the aim of augmenting their own aptitude and psychological well-being.

The bridge nodes in this network have been assigned including the difficulty in identifying feelings, externally directed ideas, and cognitive failure. Alexithymia is associated with problematic social network use by influencing

cognitive failure through difficulty identifying feelings and externally oriented thoughts. Alexithymia is a condition characterized by an individual's struggle to feel and communicate emotions, recognize emotions, and describe them to others. It is primarily defined by a lack of imagination and extroverted thinking.³⁵ Cognitive deficiencies in information processing, as explained by cognitive processing theory, might impact an individual's ability to recognize and comprehend emotions. Individuals with cognitive processing deficiencies may struggle to accurately interpret emotional input, resulting in difficulty in identifying and recognizing feelings. Several studies have demonstrated the positive impact of group cognitive therapies on enhancing alexithymia.³⁶ However, further research is necessary to validate interventions specifically targeting the core node (emotion recognition disorder). In addition, we found that despite the low strength of the externally oriented thoughts, its bridge strength is located in the second place within the network. It indicates that externally oriented thoughts are more closely linked to clusters of problematic social network use. Externally oriented thoughts is positively correlated with cognitive failure. Individuals with extroverted thinking may excel at processing external stimuli in multitasking environments, such as paying more attention to online information.³⁷ However, if there is an excessive amount of external stimuli, it can become distracting and result in cognitive failures. Consequently, individuals may be unaware that they are spending excessive time online. This suggests that educators should enhance the external environment by boosting extracurricular activities and improving interpersonal communication chances, which can help reduce problems related to externally oriented thoughts and avoid the development of Internet addiction.³⁸

There are two strong edges: difficulty identifying feelings and difficulty describing feelings, increased viscosity and misplaced anxiety. It indicates that freshmen who struggle to recognize emotions also have trouble expressing emotions, and students with misplaced anxiety have increased stickiness and dependence on the Internet during Internet use. Nodes with larger edge weights synchronized showed higher predictability, such as difficulty identifying feelings and cognitive failure. According to the notion of predictability,³⁹ it can be deduced that the activation of these nodes can be successfully stopped and repressed by targeting interventions to surrounding nodes connected to highly predictable nodes. This discovery emphasizes the significance and immediacy of taking action on central nodes.

The findings of this study indicate that there were no significant differences in problematic social network use - alexithymia network between genders and residential areas among freshmen. However, the nodes of the network were closely interconnected. This is different from the results of study that traditionally compare based on total scores.⁴⁰ It suggests that therapies targeting problematic social network use and alexithymia in freshmen can be implemented regardless of gender and place of residence. These interventions should focus solely on the core and bridge nodes within the network.

Novelty of This Study

We examined the significance of different elements in problematic social network use by creating a network and identifying core and bridge nodes in the network of problematic social network use - alexithymia in freshmen. The research revealed that the main element of problematic social network use is cognitive failure. Difficulty identifying feelings, externally oriented thoughts and cognitive failure were the primary pathways connecting problematic social network use with alexithymia. The relationship between these two variables is interpreted based on the internal components.

Limitations

This study has certain limitations. First, the self-report methodology used may have been influenced by social desirability bias, making the objectivity of the data limited. Second, due to the cross-sectional design, the study was unable to establish causal relationships between variables and items. Future research should employ cross-lagged modeling through a longitudinal design to track the directed relationship between the items of problematic social network use and alexithymia among freshmen. Third, cultural variability regarding problematic social network use existed across measurement instruments, which may have contributed to the variability in findings. Finally, although the study sample covered freshmen at four colleges and universities, the heterogeneity of the school distribution may have affected the generalizability of the results. Follow-up studies need to balance the sample distribution or use a stratified sampling

method in order to more accurately explore the network structure of problematic social network use and alexithymia among freshmen.

Conclusion

Overall, it is important to enhance college students' capacity to identify and control their emotions through emotion recognition training. This will improve their personal skills and mental well-being. Additionally, the external environment can be enhanced by increasing extracurricular activities and promoting interpersonal interactions. This will help reduce externally focused thoughts and prevent problematic use of social networks.

Ethics Approval and Consent to Participate

This study was reviewed and approved by the Ethics Committee of Shandong University of Traditional Chinese Medicine Affiliated Hospital. Written informed consent was obtained from all participants prior to their inclusion in the study. We confirm that all procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013.

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no competing interests.

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