

Problematic Social Media Use effects Social Emotional Competence in Adolescents through Internalizing Problems and Fear of Missing Out

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Abstract

Purpose

There is growing apprehension that social media use adversely affects the social emotional development of adolescents. This study examined the relationship between Problematic Social Media Use (PSMU) and Social Emotional Competence (SEC) among Chinese adolescents, focusing on the mediating roles of Internalizing Problems (IP) and Fear of Missing Out (FoMO).

Methods

A cross-sectional study was conducted with 1448 high school students. The participants completed validated measures assessing PSMU, SEC, IP, and FoMO via an online survey. The data were analyzed via correlation analyses and structural equation modeling (SEM).

Results

The PSMU was significantly negatively correlated with SEC ($r = -0.490$, $p < 0.01$). Both IP and FoMO fully mediated the relationship between PSMU and SEC. Specifically, PSMU positively effected IP ($\beta = 0.827$, $p < 0.001$) and FoMO ($\beta = 0.332$, $p < 0.001$), which in turn negatively effected SEC (IP: $\beta = -0.266$, $p < 0.001$; FoMO: $\beta = -0.266$, $p < 0.001$). The direct effect of PSMU on SEC was non-significant ($\beta = -0.053$, $p = 0.082$), whereas the indirect effects through IP and FoMO were significant, accounting for 89.18% of the total variance.

Conclusion

This study underscores the critical roles of IP and FoMO as full mediators in the negative association between PSMU and SEC. These findings suggest that interventions targeting PSMU-related impairments in SEC should address underlying emotional issues and FoMO, rather than focus solely on reducing screen time.

Introduction

With the rapid advancement of mobile internet technology worldwide, smartphones have evolved from traditional communication tools to indispensable digital platforms in daily life. According to the Digital 2024 Global Overview Report jointly released by Data Reportal, Meltwater, and We Are Social, as of January 2024, there were 5.61 billion mobile phone users worldwide, accounting for 69.4% of the global population. By June 2025, the number of mobile internet users in China had reached 1.12 billion, representing 79.2% of the national population(1). Compared with December 2023, the average weekly internet usage per capita increased to 30.6 hours, a rise of 4.5 hours. Notably, adolescents aged 10 to 19 years account for 13.7% of these internet users (2). Social applications have become the most widely used type of online product, with a penetration rate of 98.6%. Furthermore, platforms such as online video streaming, mobile payments, e-commerce, and food delivery services have also integrated social

interactive features. This finding indicates that regardless of the primary function being used, social interaction has become an almost inescapable component of smartphone engagement. This environment poses significant challenges to adolescents' self-regulatory capacities and socialization processes. As primary users of the mobile internet during a critical period of self-regulation and social development, adolescents are continuously exposed to the influence of social media. Research indicates that social media use is associated with increased sleep disturbances among teenagers, and individuals with higher levels of social media addiction and fatigue report significantly poorer sleep quality (3). Moreover, excessive smartphone use can distort time perception and exacerbate maladaptive usage behaviors, particularly among those with elevated levels of loneliness and fear of missing out (4–5). Additionally, adolescents experiencing emotional distress are more likely to adopt smartphone use as a maladaptive coping strategy, rather than engaging in activities that more effectively buffer psychological stress, such as physical exercise, adequate sleep, or offline social interaction (6–7). When offline interactions are replaced by social media, a lack of authentic engagement can impair the development of empathy and affective empathy in adolescents (8). The absence of direct visual and auditory cues in online communication makes it difficult to provide genuine emotional feedback (9–10). Concurrently, poorer quality social relationships are associated with increased reliance on digital devices (11). Neurocognitive evidence suggests that individuals with smartphone addiction exhibit reduced cognitive regulation capacity, leading to impaired responses to facial expressions and difficulties in daily communication, which further compromises social emotional functioning (12). However, relatively few studies have investigated limited research on how problematic social media use, internalizing problems, and fear of missing out jointly affect the development of social-emotional competencies in adolescents. Therefore, this study aims to investigate the impact of problematic social media use on adolescents' social-emotional development, and to examine the potential mediating roles of internalizing problems and FoMO. The findings will not only help elucidate the mechanisms through which social media use influences social-emotional competence, but also inform interventions aimed at fostering healthy social emotional development in the digital age.

1.1 Problematic Social Media Use and Social Emotional Competence

Problematic Social Media Use (PSMU) is defined as excessive preoccupation with social media platforms, accompanied by an uncontrollable urge to access and use them. Empirical studies suggest that PSMU may produce symptoms analogous to those of substance use disorders and other addictive behaviors (13), but not equivalent to severe addictive disorders such as substance dependence (14). A cross-lagged study revealed that while PSMU may initially alleviate emotional distress, it exacerbates emotional problems over time (15). Moreover, persistent psychological distress can reinforce PSMU, creating a self-perpetuating negative cycle (16–17) that further impairs overall life satisfaction and functioning.

Social Emotional Competence (SEC), defined by the Collaborative for Academic, Social, and Emotional Learning (CASEL) as a five-dimensional construct comprising self-awareness, self-management, social awareness, relationship skills, and responsible decision-making, plays a crucial role in the psychosocial development of adolescents. (18). Empirical studies have demonstrated that well-developed SECs are associated with increased academic engagement and improved learning outcomes (19–20), facilitate the formation of high-quality interpersonal relationships (21), and reduce behavioral problems. While social media offers a self-exploration “testing ground,” excessive use impedes SEC development. It dilutes real-world experiences, complicates self-identity integration(22), and heightens risks of social withdrawal and loneliness (23). The platforms' algorithm-driven reward mechanisms can also exacerbate impulsivity, impairing decision-making in developing adolescents (24).

In summary, while considerable progress has been made in research on SEC and PSMU both domestically and internationally, significant research gaps remain regarding the in-depth investigation of their interactions and the development of comprehensive intervention strategies. On the basis of evidence that PSMU can negatively affect adolescent self-development and socialization processes, the following hypotheses is proposed:

Hypothesis 1

PSMU adversely affects the development of SEC in adolescents.

1.2 Internalizing Problems

Internalizing Problems (IP) refers to the troubles encountered by an individual in his or her own emotions (25)with a global prevalence of approximately 13.4% (26). When facing negative affect, difficulties in interpersonal emotion regulation may lead individuals to rely on others to modulate their emotions. Such regulatory difficulties are associated with anxious attachment, social anxiety, and depression (27). Early studies have indicated that individuals often turn to smartphones to avoid feelings of anxiety, sadness, or dissatisfaction, which may lead to problematic usage patterns (28). Further evidence supports a positive correlation between emotional dysregulation and problematic smartphone use (29). People frequently seek and obtain social support online when it is lacking in their offline environments. However, in the long term, this behavior may contribute to the development of addictive tendencies (30). Over the past decade, the sharp increase in the prevalence of anxiety and depression among adolescents has coincided closely with the rise of social media. Analyses of the relationships among adolescents' SEC, engagement with online emotional content, cyber victimization, and cyber aggression have revealed that higher levels of SEC are negatively correlated with both cyber victimization and cyber aggression, whereas excessive consumption of online emotional content is a risk factor for cyberbullying (31). Furthermore, recent studies have confirmed an association between IP and PSMU in adolescents, suggesting that IP may be a risk factor for such behavior (32). Thus, the IP can influence an individual's social media use and may also negatively impact the development of the SEC.

Hypothesis 2

IP negatively affect SEC and mediates the relationship between PSMU and SEC.

1.3 Fear of Missing Out

Fear of Missing Out (FoMO) is defined as pervasive anxiety arising from the concern that one might miss novel experiences or positive events experienced by others, manifesting as a persistent desire to stay continually connected with others and remain updated about their activities in real-time (33). A recent study reported that 56% of social media users have experienced FoMO, particularly when they are disconnected from their accounts, resulting in sustained anxiety and a compelling urge to reconnect (34). A study focusing on university students revealed that Fear of Missing Out (FoMO) significantly and positively effects smartphone addiction. This direct effect was found to be mediated by depression, while the indirect effect of FoMO on mobile phone addiction was moderated by loneliness particularly among students with high levels of loneliness, in whom this indirect pathway was stronger (35). Individuals with high levels of FoMO typically exhibit lower interpersonal security and reduced engagement in prosocial behaviors (36), and are more likely to develop social media addiction (37). Similarly, support from parents and the broader social environment, along with psychological resilience, can mitigate the negative effects of FoMO and excessive screen time (38). In summary, complex interdependence exists among FoMO, PSMU, and SEC (39). FoMO may amplify the negative effects of PSMU and IP, thereby hindering the development of adolescents' SEC. Thus, the third hypothesis of this study is proposed as follows:

Hypotheses 3: FoMO mediates the effects of both PSMU and the IP on the SEC.

Methods

2.1. Participants and procedure

This study employed a convenience sampling method to recruit participants from high schools across various regions in Yunnan Province, China. A total of 1,715 questionnaires were distributed in this study. After excluding invalid responses (e.g., those with identical answers throughout, completion times shorter than 5 minutes or longer than 30 minutes, or participants less than 16 years old), 1448 valid responses were retained, resulting in a valid response rate of 84.43%. The study protocol was reviewed and approved by the institutional ethics committee of the researcher's institution.

The demographic characteristics of the sample were as follows: 778 males and 670 females, with a mean age of 16.62±0.73 years. The complete demographic details are presented in Table 1.

Table 1
The basic demographic information(N = 1448)

Item	Characteristics	Frequency	Ratio
Gender	Male	778	53.7%
	Female	670	46.3%
Age	16	758	52.3%
	17	478	33.0%
	18	212	14.6%
Duration of Social Media Use	Less than 1 year	148	10.2%
	1 to 2 years	432	29.8%
	2 to 3 years	574	39.6%
	More than 3 years	294	20.3%

2.2 Measurements

This study employed four primary scales or questionnaires to measure the key variables of interest: the Problematic Social Media Use Scales, the Social Emotional Competence Questionnaire, the Internalizing Problems Scales, and the Fear of Missing Out Scale.

Problematic Social Media Use Scales

The severity of problematic social media use was assessed via the Chinese version of the Problematic Social Media Use Scale, which was adapted from the Facebook Addiction Scale (40). This scale consists of 8 items rated on a 5-point Likert scale, where 1 indicates “strongly disagree”, 2 “disagree”, 3 “uncertain”, 4 “agree”, and 5 “strongly agree”. Higher total scores indicate a greater severity of problematic social media use. In this study, the scale demonstrated good internal consistency, with a *Cronbach's* α of 0.792.

Social Emotional Competence Questionnaire

The Social Emotional Competence Questionnaire, revised by Zhou et al. and based on the CASEL model (41), was used to assess participants' SEC. It consists of 25 items distributed across five dimensions: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Each dimension contains 5 items, rated on a 6-point Likert scale ranging from 1 (not at all true of me) to 6 (totally true of me). In this study, the scale exhibited excellent internal consistency with a *Cronbach's* α of 0.939.

Internalizing Problems Scales

IP in adolescents was assessed via the Anxious/Depressed subscale of the Child Behavior Checklist (CBCL) for Ages 6 to 18, developed by Achenbach (42). The subscale consists of 3 items, each rated on a 3-point scale: 0 for never, 1 for sometimes, and 2 for often. Higher total scores indicate more severe internalizing problems. In this study, the subscale demonstrated good internal reliability, with a *Cronbach's* α of 0.866.

Fear of Missing Out Scale

The Fear of Missing Out scale (FoMOs), developed by Przybylski et al. in 2013, is a unidimensional instrument and the first tool designed to measure fear of missing out (33). The scale consists of 10 items rated on a 5-point Likert scale, with responses ranging from 1 (not at all true of me) to 5 (extremely true of me). Higher total scores indicate greater levels of FoMO. Subsequent studies have consistently supported its good reliability and validity (43). In the current study, the scale demonstrated good internal consistency, with a *Cronbach's* α of 0.845.

Results

First, we conducted confirmatory factor analysis (CFA) via Amos 24.0. The results indicated excellent model fit: GFI = 0.962, RMR = 0.037, CFI = 0.996, TLI = 0.996, NFI = 0.947, and RMSEA = 0.007, all of which meet standard psychometric criteria. Harman's single-factor test was subsequently performed via exploratory factor analysis on all variables. The results showed that the variance explained by the first factor was 29.048%, which is below the 40.00% threshold, indicating that there was no significant common method bias in the data.

Correlation

The factor scores and correlation analysis results are presented in Table 2. SEC showed significant negative correlations with PSMU ($r = -0.490, p < 0.01$), FoMO ($r = -0.539, p < 0.01$), and IP ($r = -0.539, p < 0.01$), whereas it was positively correlated with gender ($r = 0.083, p < 0.01$). FoMO was significantly positively correlated with PSMU ($r = 0.818, p < 0.01$) and IP ($r = 0.862, p < 0.01$). IP was also significantly positively correlated with PSMU ($r = 0.827, p < 0.01$) and negatively correlated with gender ($r = -0.095, p < 0.01$).

Table 2
Descriptive Statistics and Correlation Analysis (N = 1448)

Variable	M	SD	1	2	3	4	5	6
1 Gender	1.46	0.50						
2 Age	16.62	0.73	-0.008					
3 Duration of Social Media Use	2.70	0.91	-0.001	0.005				
4 PSMU	24.75	6.16	-0.041	-0.005	-0.025			
5. FoMO	33.25	8.43	-0.026	-0.037	-0.038	0.818**		
6. SEC	86.14	20.19	0.083**	0.051	0.014	-0.490**	-0.539**	
7. IP	11.94	6.52	-0.095**	-0.034	-0.026	0.827**	0.862**	-0.539**
*p<0.05, **p<0.01								

The Chain Mediator Model

We examined the mediating roles of the IP and the FoMO in the relationship between the PSMU and the SEC. The analysis was conducted via the PROCESS macro for SPSS (Model 6) to test the proposed mediation model (44). Bootstrap confidence intervals (CIs) were estimated on the basis of 5,000 random samples to determine the significance of the indirect effects; an effect was considered statistically significant if the 95% CI did not include zero. All variables were standardized prior to analysis. The results are presented in Table 3, Table 4 and Fig. 1.

PSMU significantly and negatively effected adolescents' SEC ($\beta = -0.490$, $t = -21.397$, $p < 0.001$), supporting Hypothesis 1. With IP as a mediator, PSMU significantly and positively effects IP ($\beta = 0.827$, $t = 55.853$, $p < 0.001$), and IP significantly and positively effects FoMO ($\beta = 0.587$, $t = 26.666$, $p < 0.001$). PSMU also significantly and positively effected FoMO ($\beta = 0.332$, $t = 15.090$, $p < 0.001$), supporting Hypothesis 2. When both IP and FoMO were included as mediators, IP ($\beta = -0.266$, $t = -5.612$, $p < 0.001$) and FoMO ($\beta = -0.266$, $t = -5.750$, $p < 0.001$) significantly and negatively effected SEC, supporting Hypothesis 3. However, PSMU no longer significantly effected SEC ($\beta = -0.053$, $t = -1.270$, $p = 0.204$). A structural equation model was constructed with PSMU as the independent variable, SEC as the dependent variable, and IP and fear of missing out as mediators. The path coefficients indicated that the direct effect of PSMU on SEC was not significant ($\beta = -0.053$, $p = 0.204$). However, the specific indirect effects through IP ($\beta = -0.220$, $p < 0.001$) and FoMO ($\beta = -0.089$, $p < 0.001$), as well as the serial mediation effect ($\beta = -0.129$, $p < 0.001$), were all significant. Thus, IP and FoMO fully mediated the relationship between PSMU and SEC, accounting for 89.18% of the total effect, which supports Hypothesis 3.

Table 3
Hierarchical regression analysis (N = 1448)

	β	SE	t	95%CI	ΔR^2	F
Step1 Total effects: SEC						
PSU	-0.490	0.08	-21.397***	[-1.75,-1.46]	0.240	457.81***
Step2 Dependent variable: IP						
PSU	0.827	0.02	55.853***	[0.84,0.91]	0.683	3119.51***
Step3 Dependent variable: FoMO						
PSU	0.332	0.03	15.090***	[0.40,0.51]	0.778	2532.22***
Internalizing Problems	0.587	0.03	26.666***	[0.70,0.82]		
Step4 Full model effecting SEC						
IP	-0.266	0.15	-5.612***	[-1.11,-0.54]	0.313	218.94***
FoMO	-0.266	0.11	-5.750***	[-0.86,-0.42]		
PSU	-0.053	0.14	-1.270	[-0.44,-0.09]		
*p<0.05, **p<0.01, ***p<0.001						

Table 4
Path analysis of mediating effects (N = 1448)

Total	Path	Effect Size	SE	95% CI	Relative Effect Size
	PSMU→SEC	-0.490	0.08	[-1.75,-1.46]	
Direct	PSMU→SEC	-0.053	0.14	[-0.44, 0.09]	10.82%
Indirect	PSMU→IP→SEC	-0.220	0.13	[-0.97,-0.47]	44.90%
	PSMU→ FoMO→ SEC	-0.089	0.05	[-0.40,-0.18]	18.16%
	PSMU→ IP→ FoMO→ SEC	-0.129	0.08	[-0.57,-0.28]	26.33%

Discussion

This study indicates that PSMU adversely affects the development of SEC in adolescents. On the one hand, PSMU consumes psychological resources, leading to diminished self-regulatory capacity among adolescents (45). Driven by the algorithm curated “filtered world” of social media, adolescents frequently engage in upward social comparison, which heightens their self-dissatisfaction and ultimately results in decreased self-esteem and identity confusion (46). Online interactions, which rely primarily on text and emojis, lack the multidimensional emotional cues (e.g., tone, facial expressions, and body language)

present in face-to-face communication, thereby impairing the cultivation of empathy or even reducing empathic ability (47). Although online communication allows users to easily exit, block, or avoid conflicts, this avoidance deprives adolescents of opportunities to practice compromise, apology, and relationship repair. Consequently, their interpersonal skills stagnate, and those who rely heavily on social media for intimate communication exhibit poorer real-life relationship quality. The anonymity of online interactions and their distracting nature may further inhibit the development of emotional competence (48). Furthermore, the likes and comments mechanism on social platforms reinforces a preference for immediate gratification, leading adolescents to prioritize short-term rewards over long-term planning and risk assessment, such as choosing entertainment over academic responsibilities, which undermines responsible decision-making (49). On the other hand, PSMU before bedtime contributes to late-night usage and reduced sleep quality. Chronic sleep deprivation directly impairs prefrontal cortex function, resulting in emotional instability, attentional deficits, and reduced impulse control (50). Individuals experiencing nighttime loneliness may turn to social media for solace, yet pervasive social comparison and cyberbullying within these platforms further exacerbate negative emotions. These psychological issues consume considerable cognitive and emotional resources, leaving insufficient energy for the development of SEC and creating a downward spiral (51). Over time, as adolescents invest excessive time in virtual interactions during this sensitive period for IP, they miss critical opportunities to develop real-world competencies, resulting in delayed social emotional development. Adolescents with underdeveloped SEC are more likely to encounter frustration in real-life social situations, which in turn drives them back to the comfort of the virtual world, further reinforcing PSMU and forming another self-perpetuating vicious cycle. Ultimately, prolonged PSMU erodes deep family communication, reduces participation in school activities, and damages the quality of offline friendships, thereby systematically undermining the external support essential for healthy social emotional development. The study also revealed that IP are associated with PSMU and significantly negatively effect SEC in adolescents. Individuals with internalizing disorders often turn to social media as an emotional escape, compensating for deficiencies in offline social interactions by prolonging their online engagement. A 2025 study from the University of Cambridge reported that adolescents with IP spend more time on social media, engage in more social comparisons, and are more emotionally affected by social media feedback. They also reported lower satisfaction with their number of online friends and exhibited less honest self-disclosure than did adolescents without mental health difficulties (52). When adolescents excessively use social media to escape distressing emotional states such as sadness stemming from loneliness their life satisfaction decreases. Elhai et al emphasized that such negative expectations regarding smartphone use are associated with more severe patterns of use (53). Moreover, a meta-analysis revealed a significant positive correlation between social media use and internalizing symptoms ($r = 0.08$, $p = 0.03$) (54). Although social media may temporarily serve as a “refuge,” the underlying issues remain unresolved, ultimately exacerbating internalizing problems. Thus, a mutually reinforcing cycle emerges between problematic social media use and internalizing problems, which collectively amplify each other and lead to negative impacts on real-world functioning. Furthermore, Hypothesis 3 was supported, with IP and FoMO identified as complete mediators in the model. The relationship between FoMO and PSMU has been well-documented in numerous studies, most of which indicate that frequent online social

activity is a key behavioral manifestation of FoMO (55). As a form of pervasive anxiety, FoMO does not contribute to the resolution of internalizing problems; rather, it serves as both a core manifestation and a maintaining factor of such issues, while also being fueled by underlying feelings of insecurity and low self-worth. FoMO can exacerbate anxiety, depressive moods, and diminished self-esteem, whereas preexisting internalizing problems, such as insecurity, pathological shame, and high sensitivity may predispose individuals to develop FoMO. Ultimately, FoMO-driven and compulsive social media use depletes adolescents' cognitive resources and psychological energy, significantly impairing their capacity for self-reflection and self-regulation. These individuals struggle to identify and understand their own emotions and needs and tend to escape or suppress negative emotions through instant scrolling rather than managing them adaptively. These ineffective emotional regulation strategies further aggravate their internalizing problems. Simultaneously, FoMO anchors adolescents' attention to constant updates in the virtual world at the expense of face-to-face interactions. As a result, they miss critical opportunities to practice interpreting nonverbal social cues such as facial expressions, tone of voice, and body language, which are essential for developing empathy, a cornerstone of social awareness. Moreover, their excessive concern with online feedback (e.g., likes and comments) and FoMO reduce both their willingness and patience to engage in deep, authentic social interactions. This leads to superficial and fragile real-life relationships, and impedes the development of crucial interpersonal skills such as conflict resolution, cooperation, and trust-building. Additionally, under the influence of FoMO, adolescents' behaviors are increasingly driven by immediate impulses and emotions (e.g., Fear of Missing Out) rather than deliberate and responsible decision-making. For example, they may frequently check their phones during class to stay updated compromising academic commitment and concentration or conform to peer-induced online behaviors that are unsuitable for them. This impulsive decision-making pattern undermines their ability to weigh trade-offs and consider long-term consequences. In conclusion, the triadic interaction between FoMO, PSMU, and internalizing problems deprives adolescents of both the opportunities and the cognitive-emotional resources necessary to practice and master core social-emotional skills during a critical developmental period, posing a substantial threat to their psychosocial development and mental health. In conclusion, FoMO plays a pivotal role within this relational framework. Its interaction with both PSMU and IP deprives adolescents of crucial opportunities and psychological resources needed to practice and master core SEC during a critical developmental period, thereby posing a substantial threat to their psychosocial development and mental health.

Limitations and Further research

This study focused primarily on the relationship between PSMU and adolescents' SEC, as well as the roles of IP and FoMO. However, no significant correlations were detected between the psychological constructs examined and demographic variables such as gender, age, or duration of media use. Furthermore, potential moderating variables (e.g., motives for social media use) were not explored. Future research should investigate social media usage patterns and psychological developmental

characteristics across different demographic subgroups. As a cross-sectional study, the present research lacks longitudinal follow-up and does not capture the developmental plasticity of the SEC throughout adolescence. In addition, the use of online surveys and convenience sampling limited the participant pool to southwestern China, which may restrict the generalizability of the findings and introduce regional bias. Future studies would benefit from employing nationwide sampling strategies and incorporating longitudinal designs to increase the representativeness and temporal validity of the results.

Conclusion

The final results of this study indicate that PSMU is negatively correlated with adolescents' SEC and is detrimental to their development. IP and FoMO serve as significant mediating variables in this relationship. More importantly, the negative effect of problematic social media use on SEC is completely mediated by both IP and FoMO. Therefore, when designing interventions for adolescents with PSMU are designed, greater attention should be given to underlying psychological factors such as anxiety and depression (i.e., internalizing problems) and FoMO, rather than focusing solely on reducing screen time. The complete restriction of social media use should be avoided to prevent potential countereffects; instead, efforts should be made to guide adolescents toward mindful and rational use of these platforms.

Abbreviations

PSMU: Problematic Social Media Use; FoMO: Fear of Missing Out; SEC: Social Emotional Competence; IP: Internalizing Problems.

Declarations

Clinical Trial Registry

Not applicable.

Ethics approval and consent to participate

The study was approved by the Biomedical Research Ethics Committee of Yunnan Normal University, China (Approval number: 2025-068; approval date: 28 October 2025). The research was conducted in accordance with the Declaration of Helsinki and its later amendments, and adhered to the applicable institutional and national ethical principles and guidelines. All participants provided written informed consent to participate in the study before data collection began. The informed consent procedure was reviewed and approved by the ethics committee.

Consent for publication

Not applicable

Competing interests

All authors declare no competing interests.

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Author Contribution

Fu Yuan conceptualized the study, designed the research ideas, managed the project and wrote the original manuscript. Wang Youliang demonstrated the feasibility and research methods of the study, Chang Yiheng, Liu Yuan and Chao Ting contributed to the research tools and data analysis, Wang Ruilin was responsible for the presentation and arrangement of the manuscript language, Xiao Tian conducted strict content review and revision of the manuscript. All authors participated in the content review and confirmed the final draft.

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Data Availability

Considering the privacy concerns and ethical considerations, the data sets involved in this study are not publicly available, but are available by contacting the author Fu Yuan (fuyuan1026@ynnu.edu.cn) upon reasonable research requirements.

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Figures

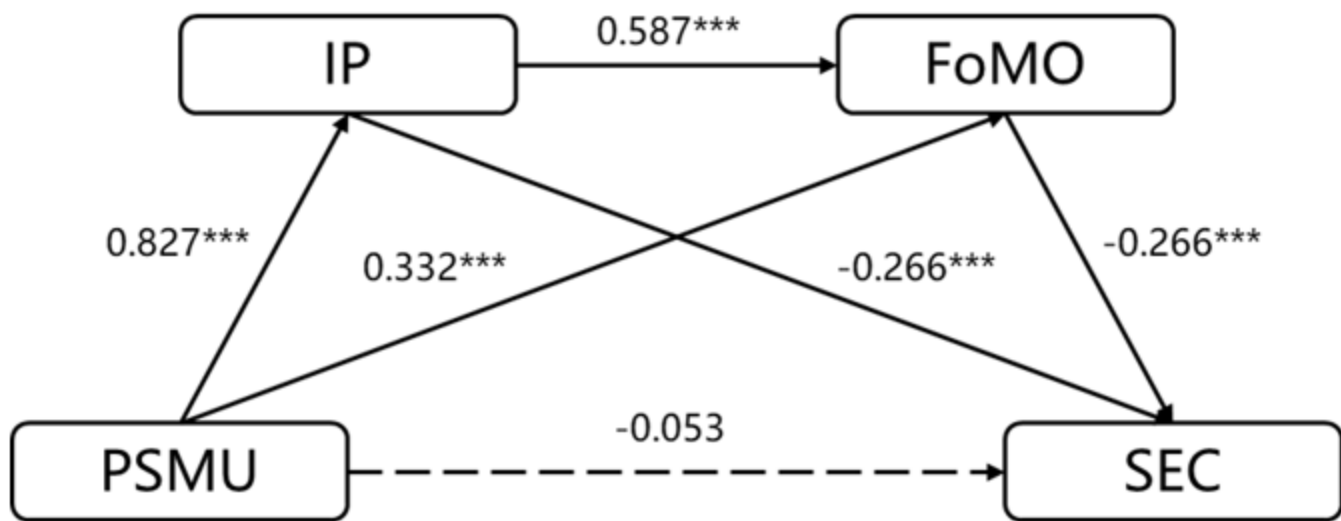


Figure 1

The chain mediation model between PSMU and SEC