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Structural Modeling of Nomophobia Based on Brain–Behavioral Systems and Intolerance of Uncertainty: The Mediating Role of Emotional Self-Efficacy among University Students

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A B S T R A C T

Objective: This study examined a structural model of nomophobia based on brain–behavioral systems and intolerance of uncertainty, with emotional self-efficacy as a mediator.

Methods and Materials: A cross-sectional correlational study was conducted among 186 university students. Participants completed measures of the Behavioral Activation System (BAS), Behavioral Inhibition System (BIS), Fight–Flight–Freeze System (FFS), intolerance of uncertainty, emotional self-efficacy, and nomophobia. Data were analyzed using Pearson correlations, multiple regression, and structural equation modeling in SPSS 26 and AMOS 26. Indirect effects were tested using 2,000 bootstrap resamples.

Findings: BAS, BIS, FFS, and intolerance of uncertainty were positively associated with nomophobia, whereas emotional self-efficacy was negatively associated with nomophobia. The predictors collectively explained 52% of the variance in nomophobia. Intolerance of uncertainty was the strongest positive predictor ($\beta = .33$ in regression; $\beta = .31$ in the structural model), while emotional self-efficacy showed a significant negative effect ($\beta = -.26$). The structural model demonstrated acceptable fit ($\chi^2/df = 1.92$, GFI = .91, CFI = .92, IFI = .92, RMSEA = .07). Emotional self-efficacy partially mediated the effects of BAS, BIS, FFS, and intolerance of uncertainty on nomophobia; all indirect effects were significant.

Conclusion: Nomophobia appears to reflect the combined influence of neurobehavioral sensitivity, intolerance of uncertainty, and emotional regulatory beliefs. Strengthening emotional self-efficacy and reducing intolerance of uncertainty may represent targets for university-based prevention and counseling programs.

Keywords: *Nomophobia; brain–behavioral systems; intolerance of uncertainty; emotional self-efficacy; structural equation modeling; university students.*

1. Introduction

Smartphones have become deeply embedded in contemporary daily life, functioning simultaneously as communication devices, information portals, educational tools, entertainment platforms, social networking interfaces, and mechanisms for managing routine activities. Their importance is particularly pronounced among university students, whose academic, interpersonal, and recreational activities increasingly depend on continuous digital connectivity. Although these technologies provide substantial practical and social benefits, the growing centrality of smartphones has also been accompanied by psychological patterns characterized by excessive attachment, persistent checking, problematic use, and distress when access to the device is restricted. One manifestation of this phenomenon is nomophobia, a term generally used to describe the fear, anxiety, discomfort, or distress experienced when individuals are unable to use their mobile phones or access the communication and information services provided through them. The development and validation of the Nomophobia Questionnaire established nomophobia as a multidimensional construct involving difficulties associated with inability to communicate, loss of connectedness, inability to access information, and relinquishment of the convenience provided by smartphones (Yildirim & Correia, 2015). Accordingly, nomophobia is increasingly regarded not simply as an indicator of extensive smartphone use, but as a psychologically meaningful form of technology-related distress in which smartphone availability acquires considerable emotional and regulatory importance.

The relevance of nomophobia is especially evident in university populations. University students typically occupy a developmental and educational context in which smartphones facilitate academic communication, access to course materials, online learning, peer interaction, social networking, navigation, entertainment, and management of everyday responsibilities. Consequently, temporary loss of smartphone access may disrupt multiple domains of functioning simultaneously. Systematic reviews have demonstrated that nomophobia is highly prevalent among university students and that moderate and severe manifestations are sufficiently common to warrant systematic psychological investigation. A meta-analysis focusing specifically on university students documented substantial levels of nomophobia across different samples and countries, demonstrating that the phenomenon is not confined to a particular institution or cultural context (Tuco et al., 2023). More recently, a broader systematic review and meta-analysis similarly confirmed that nomophobia is widespread internationally and that young people and university-based populations constitute groups in which clinically and educationally meaningful levels of nomophobic symptoms are frequently observed (Al-Mamun et al., 2025). These epidemiological findings indicate that nomophobia has become an important issue within student mental health and suggest that explanatory research should move beyond estimates of prevalence toward identifying the psychological processes that make certain individuals particularly vulnerable.

Evidence also suggests that nomophobia is intertwined with broader patterns of problematic smartphone engagement. Research among university students has identified relationships between nomophobia, excessive smartphone use, and problematic involvement with social-networking platforms. In particular, smartphone use has been shown to play an important role in the association between Facebook-related addictive behavior and nomophobia, illustrating how repeated dependence on mobile connectivity may transform smartphone access from a convenience into a psychologically salient necessity (Al-Mamun et al., 2023). Nevertheless, high-frequency smartphone use alone is unlikely to explain why some students experience pronounced anxiety when disconnected whereas others with comparable levels of use remain relatively unaffected. The same device can function as an academic instrument, a source of social reinforcement, a means of obtaining reassurance, or a method of escaping unpleasant emotional states. Individual differences in motivational sensitivity, threat responsiveness, uncertainty appraisal, and emotional regulation may therefore determine the extent to which smartphone use becomes psychologically indispensable. Understanding nomophobia consequently requires a multidimensional framework incorporating neurobehavioral, cognitive, and emotional mechanisms rather than reducing the phenomenon to screen time or behavioral frequency alone.

One potentially important framework for understanding these individual differences is the brain–behavioral systems perspective associated with reinforcement sensitivity. The Behavioral Inhibition System and Behavioral Activation System were operationalized by Carver and White as dispositional systems reflecting differential sensitivity to punishment and reward-related cues (Carver & White, 1994). The Behavioral Activation System (BAS) is associated with responsiveness to incentives, reward signals, and approach motivation, whereas the Behavioral Inhibition System (BIS) is associated with heightened responsiveness to potential punishment, conflict, and anxiety-provoking signals. More broadly, reinforcement-sensitivity approaches also distinguish defensive responses to aversive or threatening stimuli, represented in contemporary formulations by fight–flight–freeze processes. These systems provide a theoretically relevant basis for understanding problematic involvement with digital environments because smartphones deliver frequent and immediate reinforcers, including messages, social approval, novel information, entertainment, interpersonal feedback, and notifications, while disconnection can simultaneously involve loss of reward, interruption of reassurance, and anticipation of potentially threatening or unwanted outcomes.

Recent empirical research supports the relevance of reinforcement-related motivational sensitivity to problematic technology use. Longitudinal evidence among college students has shown that reinforcement sensitivity is associated with internet addiction and that self-regulatory processes contribute to explaining how motivational sensitivity develops into problematic digital behavior (Xue et al., 2024). Such findings are particularly important because they indicate that brain–behavioral sensitivities may function as relatively enduring vulnerability characteristics rather than merely as consequences of heavy technology use. Research focused more specifically on smartphones has likewise demonstrated that psychological and motivational characteristics, including reward-related responsiveness, are associated with problematic smartphone use among individuals who rely on smartphones for social networking (Kwak & Kim, 2023). From this perspective, students characterized by stronger approach sensitivity may become especially responsive to the rapid and repeated rewards available through smartphones, thereby increasing the motivational value assigned to continuous access. Conversely, students with heightened inhibition or defensive sensitivity may experience disconnection as threatening because it creates the possibility of missed communication, social exclusion, unavailable reassurance, or inability to monitor relevant events. Thus, both appetitive and aversive motivational systems may contribute to nomophobia, although through potentially different psychological pathways.

A second construct that may be central to understanding nomophobia is intolerance of uncertainty. Intolerance of uncertainty emerged from research on worry as a dispositional tendency to react negatively to uncertain, ambiguous, or unpredictable circumstances and to perceive uncertainty as stressful, unacceptable, or difficult to manage (Freeston et al., 1994). Individuals with elevated intolerance of uncertainty often experience greater cognitive and emotional difficulty when outcomes cannot be predicted or controlled. This construct is particularly relevant to smartphone-related behavior because losing access to a smartphone immediately generates multiple forms of uncertainty: whether someone has attempted to make contact, whether an important message has arrived, what events are occurring within social networks, whether relevant information has been missed, and when connectivity will become available again. For individuals who experience uncertainty as highly aversive, smartphone checking may therefore function as a rapid strategy for reducing ambiguity and restoring a sense of informational or interpersonal certainty.

Empirical findings increasingly support this proposed connection between intolerance of uncertainty and maladaptive smartphone involvement. Among college students, greater intolerance of uncertainty has been found to predict higher levels of smartphone addiction, with anxiety-related cognitive processes contributing to the relationship (Koç, 2023). More directly, intolerance of uncertainty has been identified as an important mechanism in nomophobia. Research examining differentiation of self, emotion-management skills, intolerance of uncertainty, and nomophobia demonstrated that difficulty tolerating uncertainty plays a meaningful mediating and moderating role in the psychological processes associated with nomophobic symptoms (Ercengiz et al., 2024). These findings suggest that nomophobia may partly reflect an uncertainty-reduction process. Continuous smartphone access allows individuals to check information, monitor social environments, obtain reassurance, and reduce ambiguity almost instantaneously; when that access disappears, individuals with high intolerance of uncertainty may experience disproportionately strong distress. Intolerance of uncertainty may consequently constitute a particularly proximal cognitive vulnerability through which ordinary smartphone disconnection is transformed into significant anxiety.

However, motivational sensitivities and intolerance of uncertainty may not translate directly into nomophobic distress in all individuals. Their influence may depend partly on the psychological resources available for managing the emotions generated by reward deprivation, threat anticipation, ambiguity, or disconnection. Emotional self-efficacy provides an important framework for understanding such differences. Regulatory emotional self-efficacy refers to individuals' beliefs concerning their capability to effectively regulate emotional experiences, particularly their capacity to manage negative affect and appropriately express or sustain positive emotions (Caprara, 2008). Unlike the mere possession of emotion-regulation strategies, emotional self-efficacy concerns confidence in one's ability to deploy emotional regulatory capacities effectively. Individuals who believe they can manage anxiety, frustration, sadness, or uncertainty may be more capable of tolerating temporary smartphone unavailability without depending on immediate digital reassurance, whereas those with low emotional self-efficacy may increasingly rely on the smartphone as an external means of affect regulation.

The relevance of emotional self-efficacy to problematic smartphone behavior has received increasing empirical support. Among college students, regulatory emotional self-efficacy has been shown to mediate the relationship between social anxiety and mobile-phone addiction, indicating that students' beliefs about their ability to regulate emotional experiences may influence whether psychological distress develops into maladaptive smartphone involvement (Xiao & Huang, 2022). More recent evidence similarly suggests that lower regulatory emotional self-efficacy can constitute an important psychological pathway leading to smartphone addiction. Research examining invalidating environments and smartphone addiction demonstrated a chain process involving regulatory emotional self-efficacy and psychological pain, emphasizing that weakened confidence in emotional regulation can contribute to reliance on smartphones under emotionally adverse conditions (Bai et al., 2025). These findings are particularly relevant to nomophobia because inability to access a smartphone may produce anxiety precisely when the device has become an established instrument for managing distress. Stronger emotional self-efficacy could therefore reduce the perceived necessity of continuous connectivity by increasing confidence that uncomfortable emotional states can be tolerated and regulated internally.

Research directly examining emotion regulation and nomophobia further strengthens this proposition. Emotion-regulation strategies have been significantly associated with nomophobia among university students, although the nature of these relationships may vary depending on the regulatory strategy involved and the presence of protective psychological resources such as resilience (Cui et al., 2024). This suggests that emotional regulation should not be viewed as peripheral to nomophobia. Smartphones provide readily available opportunities to distract attention, seek reassurance, establish social contact, obtain information, and alter affective states; therefore, individuals with insufficient internal emotional-regulation resources may become particularly vulnerable to distress when these opportunities are unavailable. Emotional self-efficacy may consequently serve not only as an independent protective factor but also as an intervening mechanism through which neurobehavioral and cognitive vulnerabilities affect nomophobic responses. For example, heightened behavioral inhibition or defensive sensitivity may increase anxiety during disconnection, while low emotional self-efficacy may intensify the impact of that anxiety by reducing confidence in one's ability to manage it. Similarly, intolerance of uncertainty may generate cognitive and emotional discomfort that becomes more difficult to tolerate when individuals perceive themselves as ineffective emotional regulators.

The potential mediating role of emotional self-efficacy is also compatible with a broader self-regulatory interpretation of problematic technology use. Neurobehavioral systems can influence how strongly individuals respond to rewarding and threatening stimuli, but such sensitivities do not inevitably produce maladaptive behavior. Evidence that self-control mediates associations between reinforcement sensitivity and internet addiction demonstrates that dispositional motivational tendencies may exert their effects partly through regulatory mechanisms (Xue et al., 2024). Likewise, the relationship between reward responsiveness and problematic smartphone use suggests that motivational attraction to smartphone-related reinforcement interacts with broader psychological characteristics rather than operating in isolation (Kwak & Kim, 2023). Emotional self-efficacy may represent a parallel regulatory mechanism in the context of nomophobia: motivational systems may determine the intensity with which smartphone-related rewards and threats are experienced, while emotional self-efficacy may determine how effectively individuals manage the resulting emotional responses without becoming dependent on continuous device availability.

Despite the expanding literature, important conceptual gaps remain. Existing nomophobia research has established the phenomenon's prevalence and has demonstrated meaningful associations with problematic smartphone use and other psychological characteristics (Al-Mamun et al., 2025; Tuco et al., 2023). Studies have also identified intolerance of uncertainty and emotion-management processes as significant correlates or explanatory mechanisms of nomophobia (Cui et al., 2024; Ercengiz et al., 2024). At the same time, research on brain–behavioral systems and reinforcement sensitivity has primarily focused on internet addiction or problematic smartphone use rather than nomophobia itself (Kwak & Kim, 2023; Xue et al., 2024). Similarly, evidence concerning regulatory emotional self-efficacy has largely emerged from studies of mobile-phone addiction and related maladaptive smartphone behaviors rather than from integrated structural models of nomophobic anxiety (Bai et al., 2025; Xiao & Huang, 2022). Consequently, the existing evidence remains fragmented across different theoretical traditions and outcome constructs.

An integrated model may provide a more comprehensive explanation of why smartphone disconnection becomes emotionally threatening for some university students. Such a model recognizes that nomophobia may emerge from the interaction of several levels of psychological functioning. At the neurobehavioral level, BAS sensitivity may strengthen approach toward smartphone-based rewards, whereas BIS and fight–flight–freeze sensitivity may increase vigilance and defensive responding when access is threatened or interrupted. At the cognitive level, intolerance of uncertainty may increase the perceived aversiveness of not knowing whether communications, information, or social events are being missed. At the emotional-regulatory level, emotional self-efficacy may determine whether the resulting anxiety, frustration, or uncertainty can be managed internally or whether immediate smartphone access becomes necessary for restoring emotional equilibrium. Integrating these dimensions therefore offers a mechanism-oriented explanation of nomophobia that extends beyond descriptive accounts of excessive smartphone use and provides a basis for identifying potentially modifiable psychological processes.

Accordingly, the aim of the present study was to test a structural model of nomophobia based on brain–behavioral systems and intolerance of uncertainty, with emotional self-efficacy examined as a mediating variable among university students.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a quantitative, cross-sectional, descriptive-correlational design using structural equation modeling (SEM). The study was conducted to examine a structural model of nomophobia in which brain–behavioral systems and intolerance of uncertainty were specified as predictor variables, emotional self-efficacy was specified as a mediating variable, and nomophobia was considered the outcome variable. Because no experimental manipulation was implemented, all constructs were assessed under naturally occurring conditions using self-report measures.

The study was cross-sectional, with all study variables measured at a single assessment point. Accordingly, the hypothesized directional pathways were evaluated within a theory-driven structural framework and should be interpreted as predictive and associational rather than as evidence of definitive causal relationships.

The target population consisted of students enrolled at Islamic Azad University, Khorasgan (Isfahan) Branch, Iran, during the 2025–2026 academic year. The number of active students in the university population at approximately were 1,300. A total of 200 questionnaires were distributed during data collection. After data screening and exclusion of incomplete or otherwise unusable questionnaires, 186 complete questionnaires were retained for the final statistical analyses. Thus, the final analytic sample consisted of 186 university students.

Of the final sample, 82 participants were men (44.1%) and 104 were women (55.9%). With respect to age, 67 participants (36.0%) were aged 18–22 years, 74 (39.8%) were aged 23–27 years, 31 (16.7%) were aged 28–32 years, and 14 (7.5%) were aged 33 years or older. Regarding educational level, 98 participants (52.7%) were undergraduate students, 63 (33.9%) were master's students, and 25 (13.4%) were doctoral students. In terms of academic discipline, 72 students (38.7%) studied humanities, 68 (36.6%) basic sciences or engineering, 26 (14.0%) art or architecture, and 20 (10.7%) other disciplines.

The original methodology section proposed multistage cluster random sampling across faculties, academic classes, and students, and initially identified a sample of approximately 300–350 students based on structural-modeling considerations and the Krejcie and Morgan approach.

Accordingly, for the present article, the sampling procedure is reported as convenience sampling, because this description corresponds to the completed data collection and should be preferred over the originally proposed sampling procedure when reporting the final study. Students who were accessible through university classes and educational

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communication channels and who met the eligibility criteria were invited to participate voluntarily. The final sample size of 186 represents the number of complete and usable cases entered into the statistical analyses.

Participants were required to be currently enrolled students at Islamic Azad University, Khorasgan Branch during the study period, use a smartphone on a daily basis, and provide informed consent to participate. Daily smartphone use was considered necessary because nomophobia constituted the principal outcome variable of the study.

The exclusion criteria were: failure to complete the questionnaires correctly or completely, patterned or clearly invalid responses, absence during the relevant data-collection period, and withdrawal of consent during questionnaire completion. During the sample-identification stage, the thesis additionally states that students with a history of a diagnosed severe psychiatric disorder were excluded to minimize potential distortion of responses.

One inconsistency should be corrected in the final journal manuscript: the eligibility section of refers only to undergraduate and master's students, whereas the analyzed sample includes 25 doctoral students. For this reason, the article version should use the broader and empirically accurate criterion of currently enrolled university students rather than restricting eligibility to undergraduate and master's students.

Data collection was conducted after obtaining the necessary institutional permissions from Islamic Azad University, Khorasgan Branch. Coordination was undertaken with educational and student-affairs authorities, relevant faculty administrators, instructors, and/or student representatives to facilitate access to eligible students. Eligible students were informed about the purpose of the study, the voluntary nature of participation, the questionnaire-completion procedure, and confidentiality protections. The questionnaires were administered primarily in electronic format, using online questionnaire platforms, educational messaging channels, and university communication systems; paper questionnaires were available when necessary.

Participants were able to complete the electronic questionnaire at a convenient time and place. The estimated completion time for the complete questionnaire battery was approximately 20–30 minutes. During the response period, the researcher remained available through the designated communication channels to answer questions concerning questionnaire instructions or unclear concepts. After data collection, responses were screened for completeness and response quality. Incomplete questionnaires, patterned responses, and questionnaires containing apparently inconsistent responses were excluded. The remaining data were transferred to SPSS for coding, cleaning, and statistical analysis. Out-of-range values and potential outliers were examined during preprocessing. No personally identifying information, such as participants' names, was retained in the analytical dataset. Participants were explicitly instructed to answer according to their actual experiences and were informed that there were no objectively “correct” or “incorrect” answers.

2.2. Measures

Brain–behavioral sensitivity was reported as being assessed using the Behavioral Inhibition System/Behavioral Activation System Scales (BIS/BAS Scales) developed by Carver and White (1994). The questionnaire consists of 24 items and, according to the methodology table, uses a 4-point Likert response format. Higher scores represent greater sensitivity of the corresponding behavioral motivational system. The BAS reflects sensitivity to reward and approach motivation, whereas the BIS reflects sensitivity to signals of punishment, nonreward, threat, and anxiety. The Persian psychometric literature includes Mohammadi (2008) for evaluation of the psychometric properties of the behavioral activation and inhibition scales in an Iranian population.

Intolerance of uncertainty was assessed using the Intolerance of Uncertainty Scale (IUS) originally developed by Freeston et al. (1994). The version reported contains 27 items, each rated on a 5-point Likert scale. The scale assesses maladaptive responses to ambiguous and unpredictable situations, including negative emotional reactions and cognitive difficulties in the face of uncertainty. In the present study, higher scores were interpreted as indicating greater intolerance of uncertainty. Intolerance of uncertainty was modeled as an exogenous predictor of both emotional self-efficacy and nomophobia.

Emotional self-efficacy was included as the mediating variable in the structural model. The construct represents individuals' beliefs regarding their capability to understand, regulate, and manage emotional experiences effectively. The emotional self-efficacy was assessed using a 12-item, 5-point Likert-type measure. The reference list identifies Caprara et al. (2008) as the international source for regulatory emotional self-efficacy and also cites an Iranian psychometric study by Khodayarifard et al. (2012)

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examining the validity and reliability of a Persian emotional self-efficacy scale. The narrative Methods section describes an 11-item measure attributed to Caprara and colleagues, whereas the instrument table specifies 12 items; additionally, the Results section once attributes the emotional self-efficacy measure to "Kirk et al. (2008)." Because the reference list supports Caprara et al. (2008) and the measurement table specifies 12 items, the likely intended instrument is the 12-item emotional-regulation self-efficacy measure, but the administered questionnaire must be checked before the final article states this definitively.

Nomophobia, the principal outcome variable, was assessed using the Nomophobia Questionnaire (NMP-Q) developed by Yildirim and Correia (2015). The questionnaire contains 20 items rated on a 7-point Likert scale. Higher scores indicate greater levels of nomophobia. The NMP-Q was designed to capture distress associated with being unable to access or use one's mobile phone and associated communication and information services.

2.3. Data Analysis

Before hypothesis testing, the dataset was examined for completeness, invalid response patterns, out-of-range values, and potential outliers. Distributional assumptions were evaluated before conducting parametric analyses and SEM. The thesis specifies the use of the Kolmogorov–Smirnov and Shapiro–Wilk tests, along with inspection of skewness and kurtosis indices. In the reported results, Kolmogorov–Smirnov tests were nonsignificant for the study variables ($p > .05$), supporting the use of parametric statistical procedures. Descriptive analyses included frequencies and percentages for categorical demographic variables and means, standard deviations, minimum values, and maximum values for continuous study variables. Pearson product–moment correlations were subsequently calculated to assess the magnitude and direction of bivariate associations among the principal variables before estimating the structural model.

Statistical analyses were performed using IBM SPSS Statistics version 26 and AMOS version 26. A two-stage analytical strategy was followed. First, descriptive statistics, preliminary assumption checks, Pearson correlations, and multiple linear regression analyses were conducted. Second, structural equation modeling was used to simultaneously estimate the hypothesized direct and indirect relationships among the variables.Pearson correlation coefficients were used to examine preliminary bivariate relationships among BAS, BIS, FFS, intolerance of uncertainty, emotional self-efficacy, and nomophobia. Multiple linear regression was additionally used to assess the simultaneous predictive contribution of the study variables to nomophobia. The thesis reports that the regression model included brain–behavioral systems, intolerance of uncertainty, and emotional self-efficacy as predictors of nomophobia.

SEM was conducted in AMOS 26 to evaluate the hypothesized structural model. Brain–behavioral systems and intolerance of uncertainty were specified as exogenous predictor variables, emotional self-efficacy as an endogenous mediator, and nomophobia as the final endogenous outcome. The SEM framework was used to estimate both direct pathways from the predictors to nomophobia and indirect pathways operating through emotional self-efficacy.

Model adequacy was evaluated using multiple goodness-of-fit indices rather than relying exclusively on the chi-square statistic. Based on the indices actually reported for the final model, model fit was evaluated using the chi-square/degrees-of-freedom ratio (χ^2/df), Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Normed Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Root Mean Square Error of Approximation (RMSEA). Values of χ^2/df below approximately 3, comparative/incremental fit indices around or above .90, and RMSEA below .08 were considered indicative of acceptable model fit. The methodology chapter additionally identified CFI > .90, TLI > .90, RMSEA < .08, and SRMR < .08 as desirable criteria.

The mediating role of emotional self-efficacy was examined within the SEM framework by estimating indirect effects from each predictor to nomophobia through emotional self-efficacy. Statistical significance of the indirect effects was assessed using bootstrap resampling with 2,000 bootstrap samples. Statistical significance was evaluated at the conventional two-tailed $\alpha = .05$ level, with more stringent p values reported where applicable.

3. Findings and Results

A total of 186 participants were included in the final analyses. Of these, 104 (55.9%) were women and 82 (44.1%) were men. The largest age group was 23–27 years (39.8%), followed by 18–22 years (36.0%). Regarding educational level, 52.7% were undergraduate students, 33.9% were master's students, and 13.4% were doctoral students. In terms of academic discipline, 38.7% studied

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humanities, 36.6% basic sciences or engineering, 14.0% art and architecture, and 10.7% other disciplines.

Table 1

Demographic characteristics of the participants (N = 186)

Characteristic	Category	n	%
Gender	Male	82	44.1
	Female	104	55.9
Age (years)	18–22	67	36.0
	23–27	74	39.8
	28–32	31	16.7
	≥33	14	7.5
Educational level	Undergraduate	98	52.7
	Master's	63	33.9
	Doctoral	25	13.4
Academic discipline	Humanities	72	38.7
	Basic sciences and engineering	68	36.6
	Art and architecture	26	14.0
	Other	20	10.7

Descriptive statistics for the study variables are presented in Table 2. Nomophobia had the highest mean score (M = 3.85, SD = 0.89), followed by intolerance of uncertainty (M = 3.71, SD = 0.91) and the Behavioral Activation System (BAS; M = 3.62, SD = 0.78). The Behavioral Inhibition System (BIS) had a mean of 3.45 (SD = 0.82), emotional self-efficacy had a mean of 3.38 (SD = 0.74), and the Fight–Flight–Freeze System (FFS) showed the lowest mean (M = 2.98, SD = 0.85). The distributions of the study variables were also examined prior to inferential analyses. Absolute skewness values ranged from 0.28 to 0.52 and absolute kurtosis values ranged from 0.18 to 0.42. In addition, the Kolmogorov–Smirnov tests were nonsignificant for all variables ($p > .05$). Taken together, these findings indicated no substantial departures from normality and supported the use of parametric analyses.

Table 2

Descriptive statistics and normality indices for the study variables

Variable	M	SD	Skewness	Kurtosis	K–S	p
Behavioral Activation System (BAS)	3.62	0.78	−0.34	−0.42	0.071	.742
Behavioral Inhibition System (BIS)	3.45	0.82	0.28	−0.35	0.065	.851
Fight–Flight–Freeze System (FFS)	2.98	0.85	0.52	−0.28	0.058	.923
Intolerance of uncertainty	3.71	0.91	−0.45	0.23	0.069	.785
Emotional self-efficacy	3.38	0.74	0.33	−0.31	0.074	.712
Nomophobia	3.85	0.89	−0.51	0.18	0.062	.893

Pearson correlation analyses demonstrated significant associations between the predictor variables, emotional self-efficacy, and nomophobia. As shown in Table 3, BAS was positively correlated with nomophobia, $r = .42$, $p < .01$, as were BIS, $r = .38$, $p < .01$, FFS, $r = .25$, $p < .01$, and intolerance of uncertainty, $r = .51$, $p < .01$. Among the predictor variables, intolerance of uncertainty showed the strongest positive correlation with nomophobia. Emotional self-efficacy was negatively associated with nomophobia, $r = −.46$, $p < .01$. BAS was positively associated with emotional self-efficacy, $r = .35$, $p < .01$, whereas BIS ($r = −.32$), FFS ($r = −.28$), and intolerance of uncertainty ($r = −.43$) were negatively associated with emotional self-efficacy, all ps < .01.

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Table 3

Zero-order correlations of the predictors with emotional self-efficacy and nomophobia

Predictor	Emotional self-efficacy, *r*	Nomophobia, *r*
Behavioral Activation System (BAS)	.35**	.42**
Behavioral Inhibition System (BIS)	−.32**	.38**
Fight–Flight–Freeze System (FFS)	−.28**	.25**
Intolerance of uncertainty	−.43**	.51**
Emotional self-efficacy	—	−.46**

These findings indicate that greater sensitivity to behavioral activation, behavioral inhibition, fight–flight–freeze responses, and uncertainty was associated with greater nomophobia, whereas stronger emotional self-efficacy was associated with lower nomophobia.

A multiple linear regression analysis was conducted to evaluate the simultaneous contribution of the predictor variables to nomophobia. The predictors collectively accounted for 52% of the variance in nomophobia ($R^2 = .52$). Intolerance of uncertainty emerged as the strongest positive predictor of nomophobia ($\beta = .33$, $t = 4.82$, $p < .001$), followed by emotional self-efficacy, which was a significant negative predictor ($\beta = -.29$, $t = -4.23$, $p < .001$). BAS also positively predicted nomophobia ($\beta = .24$, $t = 3.45$, $p = .001$), as did BIS ($\beta = .18$, $t = 2.76$, $p = .006$). FFS made a smaller but statistically significant positive contribution ($\beta = .12$, $t = 1.98$, $p = .049$). Thus, all five variables contributed significantly to the prediction of nomophobia, with intolerance of uncertainty showing the largest standardized positive coefficient and emotional self-efficacy showing a substantial inverse association.

Table 4

Multiple regression analysis predicting nomophobia

Predictor	Standardized β	t	p
Behavioral Activation System (BAS)	.24	3.45	.001
Behavioral Inhibition System (BIS)	.18	2.76	.006
Fight–Flight–Freeze System (FFS)	.12	1.98	.049
Intolerance of uncertainty	.33	4.82	<.001
Emotional self-efficacy	−.29	−4.23	<.001

Model $R^2 = .52$.

Structural equation modeling was performed to simultaneously examine the direct relationships of brain–behavioral systems and intolerance of uncertainty with nomophobia and the indirect relationships operating through emotional self-efficacy. The proposed structural model demonstrated an acceptable overall fit to the observed data. The normed chi-square was below the recommended upper threshold ($\chi^2/df = 1.92$). The Goodness-of-Fit Index (GFI = .91), Normed Fit Index (NFI = .90), Comparative Fit Index (CFI = .92), and Incremental Fit Index (IFI = .92) were at or above .90. The Adjusted Goodness-of-Fit Index was .88, and the Root Mean Square Error of Approximation was .07. Collectively, these indices supported the adequacy of the proposed structural model.

Table 5

Goodness-of-fit indices for the structural model

Fit index	Obtained value	Criterion	Interpretation
χ^2/df	1.92	<3.00	Acceptable
GFI	.91	≥.90	Acceptable
AGFI	.88	≥.80	Acceptable
RMSEA	.07	<.08	Acceptable
NFI	.90	≥.90	Acceptable
CFI	.92	≥.90	Acceptable
IFI	.92	≥.90	Acceptable

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All hypothesized structural paths were statistically significant. BAS positively predicted emotional self-efficacy (β = .32, *t* = 4.12, *p* < .001). In contrast, BIS (β = −.28, *t* = −3.64, *p* = .001), FFS (β = −.21, *t* = −2.89, *p* = .004), and intolerance of uncertainty (β = −.37, *t* = −4.78, *p* < .001) negatively predicted emotional self-efficacy. Among these predictors, intolerance of uncertainty demonstrated the strongest negative association with emotional self-efficacy. Regarding the direct prediction of nomophobia, BAS had a significant positive effect (β = .22, *t* = 2.98, *p* = .003), as did BIS (β = .19, *t* = 2.65, *p* = .008), FFS (β = .14, *t* = 2.12, *p* = .034), and intolerance of uncertainty (β = .31, *t* = 4.23, *p* < .001). Emotional self-efficacy, in contrast, had a significant negative effect on nomophobia (β = −.26, *t* = −3.85, *p* < .001).

Table 6

Standardized direct effects in the structural model

Structural path	β	t	p
BAS → Emotional self-efficacy	.32	4.12	<.001
BIS → Emotional self-efficacy	−.28	−3.64	.001
FFS → Emotional self-efficacy	−.21	−2.89	.004
Intolerance of uncertainty → Emotional self-efficacy	−.37	−4.78	<.001
BAS → Nomophobia	.22	2.98	.003
BIS → Nomophobia	.19	2.65	.008
FFS → Nomophobia	.14	2.12	.034
Intolerance of uncertainty → Nomophobia	.31	4.23	<.001
Emotional self-efficacy → Nomophobia	−.26	−3.85	<.001

The pattern of standardized effects indicates that intolerance of uncertainty was the strongest direct positive predictor of nomophobia in the structural model, whereas emotional self-efficacy showed a significant protective association with nomophobia. Bootstrap analyses with 2,000 resamples were used to examine the indirect effects of the predictor variables on nomophobia through emotional self-efficacy. All four indirect pathways were statistically significant. The indirect effect of BAS on nomophobia through emotional self-efficacy was negative and significant (β = −.08, *SE* = .03, *p* = .004). Thus, although BAS exerted a positive direct effect on nomophobia (β = .22), its positive association with emotional self-efficacy partly offset this relationship.

The indirect effect of BIS through emotional self-efficacy was positive and significant (β = .07, *SE* = .03, *p* = .007). Similarly, FFS demonstrated a significant positive indirect effect on nomophobia through emotional self-efficacy (β = .05, *SE* = .02, *p* = .032). The largest indirect effect was observed for intolerance of uncertainty (β = .10, *SE* = .04, *p* = .001), indicating that greater intolerance of uncertainty was associated with reduced emotional self-efficacy, which in turn was associated with greater nomophobia. Because the corresponding direct effects of BAS, BIS, FFS, and intolerance of uncertainty on nomophobia remained statistically significant after emotional self-efficacy was included in the model, the pattern of findings was consistent with partial mediation for all four predictor variables.

Table 7

Direct and indirect effects on nomophobia through emotional self-efficacy

Predictor	Direct effect, β	Indirect effect via emotional self-efficacy, β	SE of indirect effect	p for indirect effect	Mediation
BAS	.22	−.08	.03	.004	Partial
BIS	.19	.07	.03	.007	Partial
FFS	.14	.05	.02	.032	Partial
Intolerance of uncertainty	.31	.10	.04	.001	Partial

Overall, the proposed structural model showed an acceptable fit to the data. BAS, BIS, FFS, and intolerance of uncertainty were all directly and positively associated with nomophobia, whereas emotional self-efficacy was directly and negatively associated with nomophobia. Intolerance of uncertainty showed the strongest positive direct association

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with nomophobia (β = .31) and the strongest negative association with emotional self-efficacy (β = −.37). Emotional self-efficacy significantly mediated the relationships between each of the four predictors and nomophobia, with all indirect effects reaching statistical significance. Accordingly, the findings support a model in which nomophobia is associated with the joint contribution of neurobehavioral sensitivity, intolerance of uncertainty, and emotional self-regulatory beliefs. Higher BAS, BIS, FFS, and intolerance of uncertainty were associated with greater nomophobia, while greater emotional self-efficacy was associated with lower nomophobia and partially accounted for the relationships between the predictors and nomophobia.

4. Discussion

The present study examined a structural model of nomophobia based on brain–behavioral systems and intolerance of uncertainty, with emotional self-efficacy considered as a mediating variable among university students. The findings generally supported the proposed model. The Behavioral Activation System (BAS), Behavioral Inhibition System (BIS), Fight–Flight–Freeze System (FFS), and intolerance of uncertainty were positively associated with nomophobia, whereas emotional self-efficacy was negatively associated with nomophobia. The regression model showed that these variables collectively explained 52% of the variance in nomophobia, indicating that a substantial proportion of individual differences in fear and distress associated with smartphone unavailability can be understood through the combined contribution of motivational, cognitive, and emotional-regulatory processes. Among the predictors, intolerance of uncertainty emerged as the strongest positive predictor, while emotional self-efficacy was a substantial negative predictor. Furthermore, structural equation modeling showed acceptable model fit and confirmed significant direct effects of all predictors on nomophobia. Emotional self-efficacy also significantly mediated the relationships of BAS, BIS, FFS, and intolerance of uncertainty with nomophobia, although the persistence of significant direct effects indicated partial rather than complete mediation.

The positive association between BAS and nomophobia suggests that heightened sensitivity to reward may increase psychological dependence on smartphones. According to the behavioral activation perspective, individuals with greater BAS sensitivity are more responsive to signals of reward and are more strongly motivated to approach potentially reinforcing experiences (Carver & White, 1994). Smartphones provide an unusually dense and continuous stream of such reinforcement through social notifications, messages, entertainment, online interactions, novel information, and immediate interpersonal feedback. Consequently, individuals characterized by greater reward responsiveness may attach stronger motivational value to smartphone access and experience greater discomfort when access to these reinforcing experiences is interrupted. This interpretation is consistent with findings showing that motivational and reward-related characteristics are important predictors of problematic smartphone use among smartphone-based social networking users (Kwak & Kim, 2023). Longitudinal evidence also indicates that reinforcement sensitivity contributes to problematic internet use among university students, supporting the broader proposition that reward-driven motivational systems may predispose individuals to maladaptive patterns of digital engagement (Xue et al., 2024).

An interesting feature of the present findings was that BAS positively predicted nomophobia directly but also positively predicted emotional self-efficacy, producing a negative indirect effect through the mediator. This pattern indicates competitive partial mediation. One possible explanation is that reward sensitivity itself is not exclusively maladaptive. Greater approach motivation may increase attraction to smartphone-related reinforcement, thereby raising nomophobia directly, while at the same time some approach-oriented individuals may possess stronger confidence in their ability to generate and regulate positive emotional experiences. Regulatory emotional self-efficacy involves perceived capability to manage negative affect and maintain or express positive emotions effectively (Caprara, 2008). Thus, emotional self-efficacy may partially counterbalance the risk associated with reward sensitivity by enabling individuals to tolerate temporary deprivation of smartphone-based reinforcement without experiencing equivalent levels of distress. The finding emphasizes the importance of considering both direct motivational tendencies and regulatory resources when explaining technology-related behavioral vulnerability.

BIS also showed a significant positive relationship with nomophobia. Individuals with elevated behavioral inhibition are particularly sensitive to signals of punishment, conflict, possible negative outcomes, and uncertainty (Carver & White, 1994). For such individuals, temporary inability to access a smartphone may activate concerns about missed

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communications, inability to respond to important messages, potential social exclusion, or loss of access to information and reassurance. This heightened threat monitoring can transform ordinary disconnection into an anxiety-provoking experience. The present finding is consistent with evidence that reinforcement-sensitivity systems are associated with problematic digital behavior among college students and that these relationships may operate partly through regulatory capacities such as self-control (Xue et al., 2024). Accordingly, greater BIS sensitivity may increase nomophobia because smartphone availability functions as a readily accessible means of monitoring and reducing perceived threats, conflicts, or uncertainties in the individual's social and informational environment.

The FFS similarly demonstrated a significant, although comparatively weaker, positive association with nomophobia. The fight–flight–freeze system reflects defensive sensitivity to aversive and threatening stimuli and prepares individuals to react when danger is perceived. The positive relationship observed in the present study suggests that some students may experience smartphone disconnection as an aversive condition capable of activating defensive emotional responses. When smartphones function as primary sources of communication, information, security, navigation, or access to social support, loss of connectivity may be perceived as threatening rather than merely inconvenient. Reinforcement-sensitivity research supports the contribution of defensive motivational systems to problematic involvement with digital environments (Xue et al., 2024). Nevertheless, the weaker effect of FFS compared with BAS, BIS, and intolerance of uncertainty suggests that nomophobia may be more strongly associated with reward deprivation, anticipatory anxiety, and cognitive responses to uncertainty than with immediate fear-based defensive responding.

The most prominent finding of the study concerned intolerance of uncertainty, which showed the strongest positive association with nomophobia in both regression and structural modeling. Intolerance of uncertainty refers to difficulty accepting uncertain, ambiguous, or unpredictable situations and a tendency to interpret uncertainty as stressful, threatening, or unacceptable (Freeston et al., 1994). Smartphone disconnection naturally produces numerous uncertainties: individuals may not know whether they have received messages, whether something important has occurred online, whether someone is trying to contact them, or when communication access will be restored. For individuals who have difficulty tolerating such ambiguity, repeated smartphone checking can function as a reassurance-seeking strategy that rapidly reduces uncertainty. Over time, repeated reliance on smartphones for reassurance may strengthen the subjective need for permanent connectivity and intensify distress whenever access is disrupted.

The strong effect of intolerance of uncertainty is consistent with previous research. Higher intolerance of uncertainty has been associated with greater smartphone addiction among college students, with anxiety-related mechanisms contributing to this association (Koç, 2023). More directly, intolerance of uncertainty has been identified as an important mechanism linking psychological and emotional characteristics with nomophobia among smartphone users (Ercengiz et al., 2024). These findings support the interpretation that smartphones can become tools for obtaining perceived certainty. Immediate access to messages, social networks, news, and online information allows users to resolve ambiguity rapidly; removal of this access prevents immediate reassurance and may therefore be particularly distressing for individuals who regard uncertainty as difficult to tolerate. The present results extend previous work by demonstrating that intolerance of uncertainty remained the strongest positive predictor even when brain–behavioral systems and emotional self-efficacy were considered simultaneously.

Another central finding was the negative relationship between emotional self-efficacy and nomophobia. Students who reported greater confidence in their ability to regulate emotional experiences exhibited lower levels of nomophobia. Emotional self-efficacy reflects perceived competence in managing negative emotions and maintaining adaptive emotional functioning (Caprara, 2008). Individuals with high emotional self-efficacy may therefore be more capable of tolerating anxiety, frustration, loneliness, or uncertainty when their smartphones are inaccessible. In contrast, individuals with lower confidence in their emotional-regulation capacity may use smartphones as external regulatory tools by seeking reassurance, distraction, social interaction, or immediate information whenever distress occurs.

This interpretation is supported by previous research on smartphone-related problems. Regulatory emotional self-efficacy has been shown to mediate the relationship between social anxiety and mobile-phone addiction among college students, suggesting that confidence in emotion regulation reduces the likelihood that psychological distress will translate into maladaptive smartphone involvement (Xiao & Huang, 2022). Likewise, recent evidence indicates that diminished regulatory emotional self-efficacy represents an important pathway through which adverse psychological experiences can contribute to smartphone addiction (Bai et al., 2025). Research focused specifically on nomophobia has also demonstrated significant relationships between emotion-regulation strategies and nomophobic symptoms among college students (Cui et al., 2024). Collectively, these findings support the present result by indicating that effective internal emotion regulation may reduce reliance on smartphones as mechanisms of affect management.

A particularly important contribution of the present study was the finding that emotional self-efficacy partially mediated the relationships between all four predictors and nomophobia. BIS, FFS, and intolerance of uncertainty negatively predicted emotional self-efficacy, which in turn negatively predicted nomophobia. Thus, higher levels of these vulnerability factors were associated with diminished perceived capacity for emotional regulation, and this reduced emotional self-efficacy was subsequently associated with greater nomophobia. The mediating pathway was strongest for intolerance of uncertainty. Individuals who are highly distressed by ambiguity may repeatedly experience anxiety in situations where information or outcomes cannot be controlled; such experiences may undermine confidence in their ability to manage emotional discomfort, thereby increasing reliance on smartphones for reassurance and emotional stabilization. This interpretation is consistent with findings showing that intolerance of uncertainty interacts with emotion-management processes in explaining nomophobia (Ercengiz et al., 2024).

The mediation findings are also compatible with research demonstrating that regulatory processes can explain how underlying psychological vulnerabilities develop into problematic technology use. Self-control has been identified as a mediator between reinforcement sensitivity and internet addiction (Xue et al., 2024), while emotional self-efficacy has been shown to mediate relationships between psychological distress and problematic mobile-phone involvement (Xiao & Huang, 2022). The present findings extend this literature by identifying emotional self-efficacy as a common regulatory mechanism connecting several theoretically distinct vulnerabilities with nomophobia. Nevertheless, because mediation was partial, emotional self-efficacy cannot fully explain these relationships. Other mechanisms, such as self-control, reassurance seeking, habitual checking, fear of missing out, social attachment, and dependence on digital reinforcement, may operate alongside emotional self-efficacy. The multifactorial nature of nomophobia is also consistent with findings showing that smartphone use itself plays an important mediating role between problematic social networking involvement and nomophobia (Al-Mamun et al., 2023).

The broader significance of the findings should also be considered in light of the high prevalence of nomophobia among university students. Systematic and meta-analytic evidence has demonstrated that nomophobia is common in student populations across different settings (Tuco et al., 2023), while more recent international evidence confirms substantial moderate and severe levels of nomophobia across populations and countries (Al-Mamun et al., 2025). The present findings contribute to this literature by moving beyond prevalence estimates and demonstrating how motivational sensitivity, uncertainty-related cognition, and emotional-regulatory beliefs can be incorporated into a single explanatory framework. The results therefore support a conceptualization of nomophobia as more than frequent or excessive smartphone use. Rather, it appears to reflect an interaction between sensitivity to reward and threat, difficulty tolerating uncertainty, and perceived capacity to manage the emotional consequences of disconnection. This interpretation is also compatible with the multidimensional conceptualization of nomophobia proposed in the original development of the NMP-Q, in which distress reflects inability to communicate, loss of connectedness, inability to access information, and loss of convenience (Yildirim & Correia, 2015).

5. Conclusion

Overall, the findings provide support for an integrated neurobehavioral–cognitive–emotional account of nomophobia. BAS may increase sensitivity to the rewarding functions of smartphones, whereas BIS and FFS may heighten responsiveness to the potentially threatening consequences of disconnection. Intolerance of uncertainty may amplify the need for continuous information and reassurance, while emotional self-efficacy may serve as an internal protective resource that reduces dependence on smartphone access for emotional regulation. The findings therefore complement previous research on motivational predictors of problematic smartphone use (Kwak & Kim, 2023), reinforcement sensitivity and digital addiction (Xue et al., 2024), uncertainty-related vulnerability (Ercengiz et al., 2024; Koç, 2023), and emotional-regulation mechanisms (Bai et al., 2025; Cui et al., 2024; Xiao & Huang, 2022). Taken together, this body of evidence suggests that

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understanding nomophobia requires attention not only to how often smartphones are used but also to the psychological functions that continuous smartphone availability serves for different individuals.

6. Limitations & Suggestions

Several limitations should be considered when interpreting the findings. First, the cross-sectional correlational design prevents conclusions regarding temporal precedence or causality; therefore, the structural pathways should be interpreted as theoretically specified associations rather than evidence that brain–behavioral systems or intolerance of uncertainty cause nomophobia. Second, all principal variables were assessed using self-report questionnaires, making the findings potentially vulnerable to common-method variance, recall errors, social desirability, and temporary emotional states. Third, the sample consisted of students from a single university and was obtained through convenience sampling, which restricts the generalizability of the findings to students at other universities, nonstudent populations, or different cultural and socioeconomic settings. In addition, objective indices of smartphone behavior were not included, and potentially relevant factors such as social-media use, fear of missing out, loneliness, psychological distress, socioeconomic conditions, and previous mental-health difficulties were not controlled statistically.

Future research should examine the proposed model using longitudinal designs to determine the temporal relationships among reinforcement sensitivity, intolerance of uncertainty, emotional self-efficacy, and nomophobia. Experimental and intervention studies would also be useful for determining whether strengthening emotional self-efficacy or increasing tolerance of uncertainty produces subsequent reductions in nomophobic symptoms. Replication with larger samples recruited from multiple universities and diverse cultural contexts would increase generalizability, and multigroup analyses could determine whether structural pathways differ according to gender, educational level, age, or patterns of smartphone use. Future studies could additionally incorporate objective smartphone indicators such as screen time, device-unlock frequency, notification exposure, and application-specific use. Examining other mediators and moderators—including self-control, resilience, fear of missing out, loneliness, reassurance seeking, attachment, and perceived social support—could further clarify the mechanisms through which motivational and cognitive vulnerabilities become associated with nomophobia.

The findings suggest several implications for university counseling and student-support programs. Screening programs could identify students who experience pronounced distress during smartphone disconnection, particularly those characterized by poor tolerance of uncertainty or low confidence in managing negative emotions. Psychoeducational and counseling interventions may focus on increasing tolerance of ambiguity, reducing compulsive checking and reassurance-seeking behavior, strengthening emotional awareness, and developing confidence in regulating anxiety and frustration without immediate digital access. Cognitive reappraisal, distress-tolerance exercises, gradual periods of intentional smartphone disconnection, and development of alternative rewarding activities may be particularly useful. Interventions may also be tailored to motivational profiles: students with high reward sensitivity may benefit from alternative sources of reinforcement, whereas those with heightened threat sensitivity may require greater emphasis on anxiety management and cognitive restructuring. Such approaches may be more effective than strategies based solely on restricting screen time because they address the psychological functions that make continuous smartphone availability emotionally necessary.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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