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Breaking Face-to-Face Interactions: A Theoretical Path Between FoMO and Phubbing Via Problematic Social Media Use Among Preservice Teachers

Inés Mosquera-Bargiela

ines.mosquera.bargiela@usc.es

Universidade de Santiago de Compostela

Pablo César Muñoz-Carril

Universidade de Santiago de Compostela

María Lidia Platas-Ferreiro

Universidade de Santiago de Compostela

Oneida Cristina Barcelos Irigon

Instituto Federal de Goiás

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Abstract

Background

Smartphones are commonplace tools in higher education, but poorly self-regulated use may divert attention from face-to-face interactions. This study examined the psychological and behavioral associations between fear of missing out (FoMO), problematic social media use (PSMU), and communication disturbance, understood as the interpersonal dimension of *phubbing*, within an educational cohort.

Methods

This quantitative, non-experimental, cross-sectional study involved 1,068 Spanish university students enrolled in pre-service teacher education programmes. The *state-FoMO* subscale, the *Bergen Social Media Addiction Scale*, and the *Phubbing Scale* were administered. After examining measurement structures through confirmatory factor analyses, hypotheses were tested using structural equation modelling (SEM) with WLSMV estimation in Mplus 7. Results: FoMO was positively and significantly associated with PSMU and communication disturbance. PSMU retained a specific association with communication disturbance when FoMO was considered simultaneously, and a significant indirect association between FoMO and interpersonal communication disturbance via PSMU was identified. The structural model accounted for 64.5% of the variance in PSMU and 52.9% of the variance in communication disturbance. Complementary and sensitivity analyses successfully reproduced this primary pattern.

Conclusions

The findings are consistent with a partial indirect association and underscore a critical behavioral pathway. They highlight the urgent psychological and practical importance of addressing digital self-regulation and interpersonal attention within preservice teacher education.

1. Background

1.1. Smartphones in Higher Education: Educational Value and Self-Regulation of Attention

The increasing integration of digital technologies into everyday life has made communication, information, and social participation more immediate and accessible than ever before. Paradoxically, the same conditions that facilitate learning, collaboration, and interpersonal connectedness also create persistent pressures to remain continuously available and responsive, making digital engagement increasingly difficult to regulate for some individuals [1, 11, 21, 23]. Within higher education, where

students routinely move between learning management systems, instant messaging applications, social media platforms, and face-to-face interactions, these competing demands are particularly evident [15, 17]. Recent longitudinal evidence indicates that vulnerability is shaped less by technology use itself than by underlying psychological processes [16, 22, 35]. These include fear of missing out, self-regulation difficulties, social comparison, peer influences, and emotional functioning, all of which influence how individuals respond to permanent connectivity. Consequently, understanding these psychological mechanisms has become a central challenge for explaining why digital connectivity promotes adaptive behaviours in some students while contributing to maladaptive patterns of online engagement in others.

Within higher education, smartphones have become the principal gateway through which students access this digitally connected environment. They simultaneously support academic activities—including accessing virtual learning environments, searching for educational resources, collaborating with peers, and communicating with lecturers—while also providing uninterrupted access to social media platforms and instant messaging applications [1, 15]. Consequently, academic and social interactions increasingly coexist within the same digital ecosystem, requiring students to regulate attention, prioritise competing demands, and manage the boundaries between academic and social activities [10, 28]. Recent evidence suggests that problematic social media use is better understood as a maladaptive pattern of engagement sustained by underlying motivational and self-regulatory processes than as a simple consequence of time spent online [35, 57]. From an educational perspective, these processes are particularly relevant because successful participation in higher education increasingly depends on students' ability to regulate their learning, attention, and digital behaviour within technology-rich environments [18, 23].

Understanding individual differences in digital behaviour is especially relevant in the context of preservice teacher education [6, 42]. Future teachers are expected not only to develop digital competence but also to become self-regulated professionals capable of sustaining attention, engaging in reflective practice, and modelling responsible technology use in educational settings. Evidence from a recent systematic review indicates that self-regulated learning is a core component of initial teacher education because preservice teachers must first learn to regulate their own learning before they can effectively foster these competencies in their future students [18, 55]. This expectation is consistent with broader frameworks describing digital competence as a professional competence that integrates pedagogical, reflective, and responsible technology use [24, 43, 50]. Within this context, three constructs have emerged as particularly relevant for understanding individual differences in digital behaviour: FoMO, PSMU, and phubbing. Together, these constructs provide complementary lenses through which to understand the motivational, behavioural, and interpersonal dimensions of digital engagement in increasingly connected educational environments.

Among these constructs, FoMO has attracted growing attention as a motivational mechanism that may explain why some individuals experience persistent pressures to remain continuously connected to their online social environment.

1.2. Fear of Missing Out: The Cognitive and Motivational Basis of Persistent Digital Connectedness

FoMO refers to the pervasive concern that others may be having rewarding experiences from which one is absent, accompanied by a strong desire to remain continuously informed about others' activities and social interactions [41]. Originally conceptualised within Self-Determination Theory, FoMO reflects unmet psychological needs for relatedness and belonging, motivating individuals to seek reassurance through frequent monitoring of digital communication and social media platforms [41]. Rather than representing a consequence of social media use, FoMO is therefore understood as a motivational disposition that shapes how individuals engage with digitally connected environments. Within higher education, where students are increasingly expected to regulate their own learning while navigating permanently connected digital ecosystems, this motivational tendency may become particularly relevant for sustaining attention, balancing competing academic and social demands, and engaging effectively in self-regulated learning [18, 23, 38].

A growing body of evidence identifies FoMO as one of the most robust psychological predictors of maladaptive digital behaviour. Individuals with higher levels of FoMO are consistently more likely to engage in repetitive online checking, experience difficulties disengaging from social media platforms, and report more problematic patterns of social media use and smartphone-related behaviours [3, 17, 53]. Importantly, FoMO appears not merely to increase the frequency of online activity but to promote a persistent state of cognitive and emotional monitoring in which attention is repeatedly redirected towards online social information. In educational settings, these attentional demands may compete with cognitive engagement, sustained concentration, and self-regulated learning, all of which are recognised as fundamental for successful learning in higher education [18, 38].

Recent conceptual and empirical evidence further suggests that FoMO should be understood as a dynamic and self-reinforcing process rather than as a stable individual characteristic. Concerns about missing socially relevant information encourage repeated monitoring of digital platforms, providing temporary reassurance while simultaneously strengthening expectations that important social experiences may occur at any moment [35]. Over time, these recurrent monitoring behaviours may become increasingly habitual, reinforcing psychological dependence on continuous social connectivity and making disengagement progressively more difficult, a developmental pattern supported by longitudinal evidence [39, 51]. These self-regulatory challenges may be particularly significant in preservice teacher education, where future teachers are expected to develop self-regulated learning competencies not only for their own academic success but also as a foundation for fostering these competencies in their future students [18]. This expectation is consistent with broader conceptions of teacher professionalism that emphasise reflective practice, responsible technology use, and pedagogically informed digital competence [43, 50].

Although FoMO has been associated with a wide range of psychological and behavioural outcomes, its relationship with PSMU appears particularly robust across systematic reviews and meta-analyses [3, 17,

53]. Social media platforms provides immediate access to interpersonal information, social feedback, and opportunities for reassurance, making them particularly effective in satisfying and, simultaneously, reinforcing the motivational concerns underlying FoMO [35, 41]. Accordingly, FoMO is increasingly conceptualised as a key motivational antecedent of problematic social media use within contemporary theoretical models of digital behaviour [10, 28, 39]. Understanding this mechanism is especially relevant for preservice teachers, who are expected not only to become competent and self-regulated professionals but also to model responsible technology use and foster healthy digital and self-regulatory practices in future educational settings [18, 43, 50].

If FoMO represents the motivational drive to remain continuously connected, the next question is how this motivation develops into persistent and maladaptive patterns of social media engagement. This transition is commonly conceptualised through the framework of PSMU.

1.3. Problematic Social Media Use: From Motivational Vulnerability to Maladaptive Digital Behaviour

PSMU refers to a maladaptive pattern of engagement with social media platforms characterised by diminished control over use, excessive preoccupation with online interactions, and continued engagement despite negative academic, psychological, or social consequences [2, 33]. Unlike measures based solely on frequency or duration of use, PSMU conceptualises digital behaviour as a problem of self-regulation rather than exposure, recognising that intensive social media use is not inherently maladaptive unless it interferes with everyday functioning [57]. This distinction is particularly relevant within higher education, where digital technologies simultaneously facilitate learning, collaboration, and communication while also creating continuous opportunities for distraction, requiring students to regulate attention and balance competing academic and social demands.

Contemporary theoretical models conceptualise PSMU as the behavioural expression of underlying motivational and self-regulatory vulnerabilities rather than as an isolated behavioural phenomenon. The Interaction of Person–Affect–Cognition–Execution (I-PACE) model proposes that personal predispositions, including motivational factors such as FoMO, interact with affective and cognitive responses to shape maladaptive technology use over time [10]. Likewise, the Compensatory Internet Use Theory argues that excessive engagement with digital platforms may represent an attempt to cope with unmet psychological needs or negative emotional states rather than reflecting addiction to technology itself [28]. Together, these frameworks explain why persistent motivational concerns gradually develop into habitual patterns of dysregulated social media use.

Empirical evidence consistently identifies FoMO and self-regulation deficits as the strongest predictors of PSMU over time [3, 39, 53]. Longitudinal research demonstrates that recurrent monitoring behaviours progressively weaken self-regulatory control, facilitating maladaptive engagement patterns [51]. This developmental process is self-reinforcing, as anxieties about missing rewarding social experiences encourage continuous monitoring for temporary reassurance [35]. Consequently, FoMO and PSMU represent successive stages where motivational concerns evolve into habitual, dysregulated

engagement, which impacts educational outcomes more through these problematic patterns than the actual time spent online [57].

These mechanisms are highly relevant in preservice teacher education, where professional preparation requires developing self-regulation, professional identity, and the digital competences needed to integrate technology into future teaching [43, 50]. This digital competence develops through the interaction of psychological, motivational, curricular, and institutional factors [56], whilst also depending on reflective practice and the capacity to regulate behaviour within digital environments [50]. Therefore, difficulties regulating social media use not only affect academic achievement but also limit opportunities to cultivate and model the responsible, self-regulated patterns of technology use expected in educational settings.

However, although PSMU explains why individuals experience increasing difficulty regulating their online behaviour, it does not fully explain how this dysregulation manifests during face-to-face interactions. One of the most visible interpersonal consequences of problematic digital engagement is phubbing, whereby attention is redirected from ongoing social interactions to smartphone use. This behavioural expression represents the next step in understanding how motivational and self-regulatory vulnerabilities may ultimately affect interpersonal relationships in educational contexts.

1.4. Phubbing: Behavioral Manifestation and Disrupted Face-to-Face Interactions

Phubbing -the act of ignoring or interrupting face-to-face interactions by attending to one's smartphone- has emerged as one of the most visible interpersonal consequences of excessive digital engagement [44]. Although often perceived as a relatively minor social behaviour, phubbing reflects the repeated redirection of attentional resources away from the immediate social environment towards digitally mediated interactions. Rather than representing an isolated habit, it is increasingly conceptualised as the behavioural manifestation of underlying motivational and self-regulatory processes that prioritise online over offline social engagement [13].

A growing body of research indicates that phubbing is closely associated with both FoMO and PSMU. Individuals who experience persistent concerns about missing online social experiences are more likely to monitor their smartphones during face-to-face interactions [13], while problematic social media use further reinforces these behaviours through habitual checking and diminished behavioural control [48]. Consequently, phubbing may represent the interpersonal manifestation of the broader self-reinforcing process described in the previous sections, whereby motivational vulnerability (FoMO) progressively develops into dysregulated social media use (PSMU) and ultimately manifests in disrupted face-to-face interactions. This perspective shifts the focus from viewing phubbing as a simple smartphone distraction to understanding it as the observable behavioural outcome of broader psychological mechanisms.

Within higher education, phubbing has implications that extend beyond interpersonal etiquette. Frequent attentional shifts towards smartphones have been associated with reduced classroom engagement, lower-quality peer interactions, diminished communication, and poorer academic functioning [1, 11]. Because collaborative learning, classroom discussion, and peer interaction constitute essential components of university education, students must continuously regulate competing online and offline demands to participate effectively in these learning environments.

These challenges may be especially relevant in preservice teacher education, where professional preparation extends beyond acquiring disciplinary knowledge to developing communication skills, sustained attention, reflective practice, pedagogical reasoning, teacher identity, and the digital competencies required to integrate technology meaningfully into future teaching [43]. Recent systematic evidence further indicates that preservice teachers' digital competence develops through the interaction of psychological, motivational, curricular, and institutional factors [56], highlighting the importance of self-regulated and responsible technology use throughout teacher preparation. Consequently, persistent phubbing behaviours may reflect patterns of digital engagement that are inconsistent with the professional competencies expected of future educators, who are expected to model purposeful, respectful, and pedagogically appropriate technology use in educational settings.

Taken together, the literature suggests that FoMO, PSMU, and phubbing should not be viewed as isolated phenomena but as interconnected expressions of a broader process of digital self-regulation. Examining these constructs simultaneously may therefore provide a more comprehensive understanding of digital behaviour among preservice teachers than studying each construct independently, thereby providing the rationale for the integrative model proposed in the present study.

1.5. From Digital Self-Regulation to Behavior: Problematic Social Media Use as the Link Between FoMO and Phubbing

Although FoMO, PSMU, and phubbing have frequently been examined as distinct constructs, growing evidence suggests that they represent interconnected manifestations of a broader process of digital self-regulation [3, 4]. FoMO has consistently been associated with persistent monitoring of social media platforms to remain informed about others' activities [35, 41], whereas PSMU reflects increasing difficulties in regulating these behaviours over time [10, 28, 39]. As these self-regulatory difficulties become more pronounced, smartphone checking may progressively extend to face-to-face situations, disrupting ongoing interpersonal interactions [26, 51]. Beyond this indirect pathway, FoMO may also contribute directly to communication disturbance through more immediate cognitive and attentional processes, including heightened expectations of social updates, perceived urgency to respond, and habitual checking behaviours that are not fully captured by general measures of problematic social media use [20, 32].

Despite these advances, important gaps remain. Although the multidimensional nature of phubbing has been recognised since the development of the original Phubbing Scale [27] and confirmed in subsequent validation studies [8], comparatively little research has examined whether its different dimensions show

distinct relationships with motivational and self-regulatory factors. In particular, communication disturbance—the dimension that directly reflects smartphone-related disruption of face-to-face interactions—has received comparatively less attention than global measures of phubbing, despite its particular relevance for understanding interpersonal functioning [27, 7]. This issue is especially important among preservice teachers, whose future professional practice depends on effective communication, sustained attention, and the development of healthy digital habits in technology-rich educational environments [43, 56]. Examining communication disturbance as a distinct outcome may therefore provide a more nuanced understanding of how motivational and self-regulatory vulnerabilities translate into disruptions of interpersonal communication.

1.6. Research model and hypotheses

Against this background, the present study investigates the relationships among FoMO, PSMU, and communication disturbance in a large sample of preservice teachers. Specifically, it is proposed that FoMO will be positively associated with PSMU, that PSMU will be positively associated with communication disturbance, and that FoMO will also maintain a direct positive association with communication disturbance beyond its indirect effect through PSMU.

On this basis, Fig. 1 presents the research model and the above predictions are formalised in the the four hypotheses formulated.

H1. Prospective teachers' fear of missing out on relevant experiences (FoMO) will be positively and significantly associated with their problematic social media use (PSMU).

H2. Preservice teachers' problematic social media use (PSMU) will be positively and significantly associated with the 'communication disruption' dimension of *phubbing* when the direct association between FoMO and this dimension is simultaneously estimated.

H3. Prospective teachers' fear of missing out (FoMO) will maintain a positive and significant direct association with the 'communication disruption' dimension of *phubbing*.

H4. The fear of missing out on relevant experiences (FoMO) will show a positive and significant indirect association with the 'communication disruptions' dimension of *phubbing* mediated by problematic social media use (PSMU).

2. Methods

2.1. Design, context and participants

A quantitative, non-experimental, cross-sectional study was conducted using a self-administered questionnaire. The target population consisted of students on initial teacher training degrees enrolled at two faculties, located on different campuses of the same public university in (blinded for review). Fieldwork was carried out in stages: data were collected at one of the campuses between April and May

2025, and at the other campus between December 2025 and April 2026. The same questionnaire and administration procedure were used in both phases.

Non-probabilistic convenience sampling was used. All students enrolled on the Bachelor's degree programmes in Early Childhood Education (four years), Primary Education (four years) and the Joint Bachelor's degree in Early Childhood and Primary Education (five years) were invited to participate. Participation required students to be enrolled on one of these degree programmes, to be based at the campus included in each phase, and to provide informed consent; complete and valid responses were required for the analytical sample.

The sample comprised 1,068 students, with a mean age of 20.12 years (SD = 2.34; range = 17–47). Of these, 870 participants identified as women (81.5%), 191 as men (17.9%) and 7 as having another gender identity (0.7%). In terms of degree programmes, 538 students were studying for a Bachelor's degree in Primary Education (50.4%), 403 for a Bachelor's degree in Early Childhood Education (37.7%) and 127 for a combined Bachelor's degree in Early Childhood and Primary Education (11.9%). The distribution by gender, degree programme and academic year is presented in Table 1.

Table 1
Characteristics Of The Participants

Variable	**Category**	***n***	**%**
Gender	Female	870	81.4
	Men	191	17.9
	Other identity	7	0.7
Qualification	Primary Education	538	50.4
	Early Years Education	403	37.7
	Joint Degree	127	11.9
Year	First	405	37.9
	Second	314	29.5
	Third	197	18.4
	Fourth	137	12.8
	Fifth	15	1.4

2.2. Instruments

Three measures, administered in Spanish, were used to assess the constructs of interest. Table 2 sets out the items, the codes used in the analyses and the descriptive statistics for the items.

Specifically, to assess FoMO, the *state-FoMO* subscale proposed by [52] was used, comprising seven items that assess the need to remain connected and the concern about missing out on relevant online content, conversations or experiences. Participants responded using a five-point scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The items were identified using the codes Fo1–Fo7.

With regard to PSMU, the Spanish version of the *Bergen Social Media Addiction Scale* (BSMAS) [2, 5, 9, 47] was administered. The scale contains six items relating to salience, tolerance, mood modification, relapse, withdrawal and conflict over the previous 12 months. Response options ranged from 1 (*never*) to 5 (*very frequently*). The term PSMU was used, rather than social media addiction, to avoid attributing diagnostic significance to a brief self-report measure. The items were identified using the codes SN1–SN6.

Furthermore, the ten items of the *Phubbing Scale* developed by [27] and adapted into Spanish by [8] were administered. Responses were recorded on a scale from 1 (*never*) to 5 (*always*). Using the three-dimensional structure identified by (blinded for review) as a reference, this study employed confirmatory factor analysis to test a solution comprising the dimensions of mobile phone attachment, communication disruptions and smartphone obsession. Communication disruptions constituted the main outcome variable, as its items directly describe mobile phone use whilst in the company of others. Mobile phone attachment and smartphone obsession were analysed in a complementary manner, as they capture aspects related to *phubbing* (reactions from those around the user and concern about the device), but represent its interpersonal component less directly. Item Phu6 (*'My mobile phone is within reach'*) was included in the administration and initial evaluation of the scale, although it was not retained in the final factor solution. The items were identified by the codes Fhu1–Fhu10.

Table 2
Scale Items And Descriptive Statistics

Construct or dimension	Code	Item	*KM*	*DT*
FoMO	Fo1	I'm constantly online so I don't miss a thing	2.26	1.09
	Fo2	It's important that I engage with current topics on my social media (videos, images, posts, etc.)	1.99	1.06
	Fo3	I'm worried about not keeping up to date on my social media	1.86	0.99
	Fo4	I constantly check my mobile so I don't miss anything	2.26	1.12
	Fo5	When I'm having a good time, it's important for me to share it online (e.g. by updating my status)	1.71	1.00
	Fo6	It's important that I understand the internet slang my friends use	2.23	1.17
	Fo7	When I'm on holiday, I still keep an eye on what my friends are up to	2.50	1.18
PSMU	SN1	Do you spend a lot of time thinking about social media or planning how to use it?	2.85	1.09
	SN2	Do you feel a growing need to use social media more and more?	2.60	1.05
	SN3	Do you use social media to take your mind off personal problems?	2.49	1.10
	SN4	Have you tried to cut down on your social media use, but haven't been able to?	2.52	1.13
	SN5	Do you feel restless or annoyed if you can't use social media?	2.29	0.96
	SN6	Have you used social media so much that it has had a negative impact on your work, studies or relationships?	2.21	1.10
Phubbing- communication problems	Phu1	I find myself checking my mobile phone when I'm with other people	2.26	1.12
	Phu2	I'm busy on my mobile phone when I'm with my friends	1.58	0.86
	Phu4	I'm busy on my mobile when I'm with my family	1.63	0.93
Phubbing- attachment to mobile phones	Phu3	Other people complain about my mobile phone use	1.39	0.82

Construct or dimension	Code	Item	*KM*	*DT*
	Phu5	My partner, friends and/or family are annoyed that I'm busy on my mobile	1.52	0.95
Phubbing- item not retained	Phu6	My mobile phone is within reach	4.11	1.14
Phubbing- smartphone obsession	Phu7	The first thing I do when I wake up is check my messages on my mobile	3.57	1.43
	Phu8	I feel empty without my mobile	1.95	1.12
	Phu9	My mobile phone use is increasing every day	1.70	0.98
	Phu10	The time I spend on social, personal or professional activities is reduced by the time I spend on my mobile phone	1.86	1.22

2.3. Procedure and ethical considerations

The questionnaire was administered mainly during regular class sessions, with prior authorisation from the relevant faculty heads and teaching staff. Members of the research team provided access to Microsoft Forms via a URL and a QR code, and addressed any queries whilst students were completing the questionnaire on their mobile devices. To enable those who did not attend the session to participate, the link was also shared via the course's virtual classroom.

Before accessing the questionnaire items, participants were provided with information on the general purpose of the study, the voluntary nature of participation, the anonymity and confidential treatment of responses, as well as their right to opt out or withdraw from the questionnaire without any consequences. Access to the questionnaire was granted only after informed consent had been given. The dataset used for the analyses did not contain any direct personal identifiers.

The protocol was approved by the University Ethics Committee of the University of Santiago de Compostela (approval No. 115/2025). The research was conducted in accordance with the ethical principles applicable to studies involving human participants, specifically following the Declaration of Helsinki, and ensured the privacy, confidentiality and anonymous processing of the information.

2.4. Data Analysis

The integrity of the dataset, response ranges and missing data were checked, and records were reviewed to detect possible duplicates or invalid response patterns. Frequencies, means, standard deviations, skewness, kurtosis and correlations between the observed scores were calculated.

The measurement model was evaluated in stages. After estimating FoMO and PSMU separately, three structures of the *Phubbing Scale* were compared: a two-factor model with ten items, a two-factor model excluding item Phu6, and a three-factor correlated model excluding Phu6. A joint five-factor model (FoMO, PSMU and the three dimensions of *phubbing*) was then estimated, along with the main model

restricted to FoMO, PSMU and communication disturbances. Composite reliability and the average extracted variance (AVE) were calculated using STDYX loadings and residual variances. Discriminant validity was examined using latent correlations, the Fornell–Larcker criterion [19] and the HTMT calculated on polychoric correlations [25]. The five-factor model was also compared with another model that included PSMU and smartphone obsession.

The models were estimated in Mplus 7 [37] using *weighted least squares mean- and variance-adjusted* (WLSMV) estimation, theta parameterisation, and the items as ordered categorical variables. Model fit was assessed jointly using χ^2, CFI, TLI and RMSEA with their 90% confidence intervals, whilst also considering factor loadings, the absence of spurious solutions, parsimony and substantive coherence, without applying cut-off points mechanically [29, 30, 54]. Nested models were compared using DIFFTEST.

Where the initial fit was insufficient, residual dependencies were sequentially released only if a high modification index coincided with a semantic justification; as they were identified and evaluated within the same sample, they were considered data-informed respecifications. The structural model included the relationships FoMO → PSMU, PSMU → communication difficulties and FoMO → communication difficulties, as well as the corresponding indirect association. STDYX coefficients, robust standard errors, 95% confidence intervals, direct, indirect and total associations, and R^2 were reported. The contribution of the direct relationship was examined by comparing, using DIFFTEST, the full model with another model in which it was set to zero.

The supplementary analysis incorporated the three dimensions of *phubbing* as correlated outcome variables. In the sensitivity analysis, the estimation was repeated without SN6 (*'Have you used social media so much that it has had a negative impact on your work, studies or relationships?*'), as its content relating to functional interference might overlap with Phu10. Both analyses were secondary and exploratory; no correction for multiple comparisons was applied. α was set at .05.

3. Results

3.1. Data quality and descriptive statistics

The indicators showed no missing data or outliers. The means for the constructs ranged from 1.46 to 2.49 on scales of 1 to 5, with mobile phone attachment showing the greatest positive skewness (Table 3).

All correlations were positive ($p < .001$). In the main model, FoMO was associated with PSMU ($r = .652$) and with communication disturbances ($r = .590$), and PSMU was associated with the latter ($r = .506$). The highest supplementary correlation was between PSMU and smartphone obsession ($r = .662$). The hypotheses were subsequently tested using latent variables.

Table 3
Descriptive Statistics and Observed Correlations

Variable	*M*	*SD*	*As*	*Cu*	1	2	3	4	5
1. FoMO	2.12	0.84	0.72	0.03	—				
2. PSMU	2.49	0.79	0.23	−0.21	.652	—			
3. Attachment to mobile phones	1.46	0.79	1.90	3.20	.418	.384	—		
4. Communication difficulties	1.82	0.82	1.10	0.85	.590	.506	.573	—	
5. Smartphone obsession	2.27	0.85	0.61	−0.05	.631	.662	.406	.561	—

Note. PSMU = problematic social media use. The scores correspond to item means on scales of 1 to 5. All off-diagonal correlations were significant, p < .001.

3.2. Measurement models for FoMO, PSMU and phubbing

The strict unidimensional models for FoMO and PSMU showed poor fit (Table 4). For FoMO, residual dependencies Fo1–Fo4, Fo5–Fo6 and Fo6–Fo7 were permitted, justified by the proximity of the content. The model yielded $\chi^2(11) = 54.04$, CFI = .996, TLI = .993 and RMSEA = .061, 90% CI [.045, .077], with loadings ranging from .627 to .902. The two-factor alternative fit the data less well and exhibited an interfactor correlation of .935. In PSMU, the SN1–SN2 and SN4–SN6 sub-scales produced a favourable fit, $\chi^2(7) = 11.40$, p = .122, CFI = .999, TLI = .998 and RMSEA = .024, 90% CI [.000, .049], with loadings ranging from .597 to .841. In both cases, a general factor was retained.

On the *Phubbing Scale*, the two-factor solutions with ten and nine items showed an insufficient fit. Phu6 (‘*My mobile phone is within reach*’) had a loading of .379, but its exclusion did not resolve the misfit. The solution comprising three correlated factors and nine items was the most appropriate: $\chi^2(24) = 161.13$, CFI = .981, TLI = .971 and RMSEA = .073, 90% CI [.063, .084]. The loadings ranged from .831 to .921 for attachment, .771 to .898 for communication difficulties, and .514 to .772 for obsession. Phu6 was excluded and the three-dimensional structure was retained.

Table 4
Fit of the evaluated measurement models

Model	χ^2	*df*	CFI	TLI	RMSEA [90% CI]
FoMO · a strict factor	194.18	14	.984	.976	.110 [.096, .124]
FoMO · a factor + 3 local dependencies	54.04	11	.996	.993	.061 [.045, .077]
FoMO · two factors	165.05	13	.986	.978	.105 [.091, .119]
PSMU · a strict factor	221.67	9	.959	.931	.149 [.132, .166]
PSMU · one factor + 2 local dependencies	11.40	7	.999	.998	.024 [.000, .049]
Phubbing · two factors, 10 items	471.92	34	.941	.922	.110 [.101, .119]
Phubbing · two factors, 9 items	287.66	26	.964	.949	.097 [.087, .107]
Phubbing · three factors, 9 items	161.13	24	,981	.971	.073 [.063, .084]
Joint model · five factors	695.83	193	.981	.977	.049 [.045, .053]
Alternative model · four factors	771.90	197	.978	.975	.052 [.048, .056]
Main measurement model	360.84	96	.987	.984	.051 [.045, .056]

Note. The retained local dependencies were Fo1–Fo4, Fo5–Fo6 and Fo6–Fo7 for FoMO; SN1–SN2 and SN4–SN6 for PSMU; and SN6–Phu10 in the joint model. SN6 corresponds to the item 'Have you used social media so much that it has had a negative impact on your work, studies or relationships?' Improvements between nested models were compared using DIFFTEST.

3.3. Joint measurement model and construct validity

The five-factor combined model achieved a favourable fit after incorporating a residual relationship between SN6 (*'Have you used social media so much that it has had a negative impact on your work, studies or relationships?*') and Phu10 (*'The time I devote to social, personal or professional activities is reduced by the time I spend on my mobile* phone'), both of which relate to functional interference (r_ε = .318, $p < .001$). The model yielded $\chi^2(193) = 695.83$, CFI = .981, TLI = .977 and RMSEA = .049, 90% CI [.045, .053]. All loadings were significant; composite reliability ranged from .780 to .914; and AVE exceeded .50, except for PSMU (.490) and *smartphone* obsession (.476) (Table 5).

Discriminant validity was adequate for most pairs. The exception was *PSMU–smartphone* obsession, with a latent correlation of .899 and HTMT = .897, which also failed to meet the Fornell–Larcker criterion. Nevertheless, the five-factor model fitted better than the model incorporating both constructs, $\Delta\chi^2(4) = 51.27$, $p < .001$. They were retained as distinct factors, whilst the analyses of obsession were maintained on a complementary level.

The principal-component model showed a favourable fit, $\chi^2(96) = 360.84$, CFI = .987, TLI = .984 and RMSEA = .051, 90% CI [.045, .056]. The HTMT values were .773 for FoMO–PSMU, .704 for FoMO–

disturbances and .642 for PSMU–disturbances, which supported the differentiation of the three constructs prior to estimating the structural model.

Table 5
Factor loadings and measurement quality in the combined model

Construct or dimension	Item	λ STDYX	FC	AVE
FoMO	Fo1	.865	.914	.606
	Fo2	.810		
	Fo3	.874		
	Fo4	.853		
	Fo5	.682		
	Fo6	.621		
	Fo7	.704		
PSMU	SN1	.695	.850	.490
	SN2	.782		
	SN3	.659		
	SN4	.603		
	SN5	.845		
	SN6	.580		
Phubbing · attachment to mobile phones	Phu3	.929	.870	.770
	Phu5	.823		
Phubbing · communication issues	Phu1	.810	.875	.699
	Phu2	.881		
	Phu4	.816		
Phubbing · smartphone obsession	Phu7	.521	.780	.476
	Phu8	.773		
	Phu9	.768		
	Phu10	.667		

Note. All loadings were significant, $p < .001$. CR = composite reliability; AVE = average variance extracted. SN6 corresponds to the item *'Have you used social media so much that it has had a negative impact on your work, studies or relationships?'* The coefficients are taken from the five-factor combined model.

Table 6
Latent correlations and HTMT

Construct	FoMO	PSMU	Attachment	Disturbances	Obsession
FoMO	—	.803/.773	.580/.580	.713/.704	.821/.816
PSMU		—	.602/.588	.661/.642	.899/.897
Attachment			—	.808/.792	.669/.658
Disorders				—	.755/.763
Obsession					—

Note. Each cell shows latent correlation/HTMT. All latent correlations were significant, $p < .001$. Attachment, disturbances and obsession correspond to the dimensions of mobile phone attachment, communication disturbances and smartphone obsession.

3.4. Main structural model and hypothesis testing

The results supported H1–H3 (Table 7; Fig. 2). FoMO was associated with PSMU (β = .803, SE = .015, 95% CI [.773, .833]), PSMU with communication disturbances when FoMO was simultaneously controlled for (β = .246, SE = .060, 95% CI [.129, .363]), and FoMO maintained a direct association with these impairments (β = .515, EE = .057, 95% CI [.403, .627]); all relationships had p < .001.

The indirect association FoMO → PSMU → alterations in interpersonal communication was significant (β = .198, EE = .048, 95% CI [.103, .292], p < .001), supporting H4. The total association was β = .713 (EE = .021, 95% CI [.671, .754]), and the model explained 64.5% of the variance in PSMU and 52.9% of the disturbances. Setting the direct effect to zero worsened the fit, $\Delta\chi^2(1) = 56.28$, p < .001. The co-existence of direct and indirect associations was consistent with a partial indirect pathway.

Table 7
Standardised effects of the main structural model

Effect	β	*EE*	95% CI	*p*
FoMO → PSMU	.803	.015	[.773, .833]	< .001
PSMU → Communication impairments	.246	.060	[.129, .363]	< .001
FoMO → Communication difficulties (direct)	.515	.057	[.403, .627]	< .001
FoMO → PSMU → Communication difficulties (indirect)	.198	.048	[.103, .292]	< .001
FoMO → Communication difficulties (total)	.713	.021	[.671, .754]	< .001

Note. PSMU = problematic social media use. R^2 for PSMU = .645; R^2 for communication difficulties = .529. Intervals were calculated using robust WLSMV standard errors.

Note

The dotted line represents the indirect association formulated in H4. All coefficients are standardised and were estimated simultaneously.

3.5. Supplementary and sensitivity analyses

In the supplementary model, PSMU was associated with attachment, communication difficulties and obsession (β = .384, .249 and .675, respectively); the direct associations for FoMO were β = .271, .513 and .278, and the indirect associations were β = .309, .200 and .542 (all, $p < .001$). The model explained 38.8%, 53.0% and 83.5% of the variance in these dimensions. Owing to their secondary nature and the absence of correction for multiple comparisons, the results were interpreted as exploratory (Table 8).

The exclusion of SN6 maintained the fit, direction and significance of the relationships. In the supplementary model, the indirect association corresponding to communication difficulties changed from β = .200 to .182 and its R^2 from .530 to .525; the other two dimensions retained the same pattern. The main result did not, therefore, depend on the inclusion of SN6.

Table 8
Supplementary results and sensitivity analysis with and without SN6

***Phubbing* dimension**	**Model**	**PSMU → *Y***	**FoMO → *Y***	**Indirect β [95% CI]**	***R²***
Mobile phone attachment	Full model	.384	.271	.309 [.184, .433]	.388
	Without SN6	.303	.334	.245 [.118, .372]	.367
Communication impairments	Complete model	.249	.513	.200 [.105, .295]	.530
	Without SN6	.225	.531	.182 [.083, .281]	.525
Smartphone obsession	Full model	.675	.278	.542 [.454, .630]	.835
	Without SN6	.686	.265	.556 [.461, .651]	.836

Note. Note. Secondary and exploratory analyses, without correction for multiple comparisons; all estimates, $p < .001$. SN6 = sixth item of the PSMU (functional interference); *Y* = *phubbing* dimension used as the outcome variable.

4. Discussion

The present study examined the relationships among FoMO, PSMU, and communication disturbance in a large sample of preservice teachers. Overall, the findings support the proposed conceptual model by showing that FoMO was positively associated with both PSMU and communication disturbance, while

PSMU was independently associated with communication disturbance. Furthermore, PSMU partially accounted for the association between FoMO and communication disturbance, although a substantial direct association remained. Taken together, these findings suggest that difficulties in digital self-regulation explain part—but not all—of the relationship between motivational vulnerability and smartphone-related disruption of face-to-face interactions. Rather than supporting a single explanatory mechanism, the results are consistent with the view that communication disturbance emerges through multiple interconnected motivational, behavioural, and interpersonal processes.

The strong association between FoMO and PSMU is consistent with theoretical perspectives that conceptualise FoMO as a motivational vulnerability underlying persistent online monitoring behaviours rather than simply reflecting frequent social media use [10, 41]. Individuals concerned about missing socially relevant experiences may repeatedly monitor digital platforms in an attempt to reduce uncertainty, gradually making these behaviours increasingly difficult to regulate. This interpretation aligns with the I-PACE framework, which proposes that vulnerabilities contribute to problematic technology use through interactions with cognitive and affective processes [10], and is compatible with Self-Determination Theory, according to which FoMO may emerge when psychological needs remain insufficiently satisfied, increasing the motivation to seek connection through digital environments [41].

Crucially, the present study extends these frameworks by interpreting communication disturbance as the interpersonal consequence of these self-regulatory processes. From this perspective, PSMU represents the behavioral mechanism through which the internal, motivational concerns of FoMO (fearing missing experiences elsewhere) translate into the observable disengagement from people physically present. However, the finding that PSMU only partially accounted for this association suggests that broader difficulties regulating social media use do not fully explain why individuals break face-to-face interactions. More immediate cognitive and attentional processes—including habitual monitoring, perceived urgency to respond, or expectations of social updates—may also contribute to communication disturbance independently of general patterns of problematic social media use [20, 32]. Although the cross-sectional design precludes causal conclusions, these findings collectively support interpreting FoMO, PSMU, and communication disturbance as complementary, levels-based manifestations (motivational, behavioural, and interpersonal) of the same broader process of digital self-regulation.

This interpretation also highlights a paradox of digital connectedness. Individuals motivated to avoid missing socially relevant experiences online may unintentionally become less available for the interactions unfolding in front of them. In other words, the effort to remain continuously connected to potential online experiences may come at the cost of reduced engagement with the present interpersonal context. Rather than simply competing for time, digital technologies compete for attentional resources, and the allocation of those resources ultimately shapes the quality of face-to-face communication. This perspective extends previous research by emphasising that the consequences of FoMO are not confined to the digital environment but may also influence the quality of interpersonal relationships through everyday patterns of attentional allocation.

The present study also contributes to the phubbing literature by shifting attention from phubbing as a global construct to communication disturbance as its most directly interpersonal expression. Although the multidimensional nature of phubbing has long been recognised [8, 27] comparatively little attention has been devoted to examining whether its different dimensions show distinct relationships with motivational and self-regulatory factors. Focusing specifically on communication disturbance provides greater conceptual precision because it captures the behavioural manifestation of smartphone-related interference during ongoing face-to-face interactions, whereas smartphone attachment and smartphone obsession reflect related but conceptually different aspects of digital behaviour. Examining these dimensions separately therefore contributes to a more nuanced understanding of how motivational vulnerabilities become translated into interpersonal outcomes.

These findings also have important implications for preservice teacher education. Contemporary frameworks of teachers' digital competence increasingly emphasise technological, pedagogical, ethical, and professional dimensions of technology use [50, 56]. The present findings suggest that digital self-regulation deserves greater attention within this broader competence framework. Future teachers are expected not only to integrate digital technologies effectively into teaching and learning but also to regulate their own attention while interacting with students and colleagues. From this perspective, digital competence extends beyond technological proficiency to include the capacity to remain psychologically available during interpersonal interactions despite the constant availability of digital information. Preparing preservice teachers to critically reflect on when digital connectivity supports learning—and when it interferes with attention and communication—may therefore represent an important objective of teacher education programmes.

The present study has several strengths, including a large sample of preservice teachers, the use of latent-variable modelling with ordinal indicators, the explicit differentiation between dimensions of phubbing, and complementary sensitivity analyses that supported the robustness of the findings. Nevertheless, several limitations should be acknowledged. First, the cross-sectional design prevents conclusions regarding temporal ordering or causal mediation, making longitudinal and experimental research necessary to examine these relationships over time. Second, the use of a non-probability sample from a single university limits the generalisability of the findings to other educational contexts. Third, all constructs were assessed using self-report measures, which may be influenced by common method variance and social desirability. Future research should therefore combine self-report data with behavioural indicators of smartphone use, ecological momentary assessment, observational approaches, and reports from interaction partners. It would also be valuable to examine whether communication disturbance predicts educational outcomes such as classroom engagement, collaborative learning, interpersonal relationships, and professional readiness in future teachers.

5. Conclusions

The present study contributes to a more integrated understanding of how motivational vulnerability, digital self-regulation, and interpersonal communication become interconnected in the context of

everyday technology use among preservice teachers. The findings suggest that communication disturbance is shaped both directly by FoMO and indirectly through PSMU, indicating that motivational vulnerability and digital self-regulation jointly contribute to disruptions in face-to-face communication. Rather than representing isolated constructs, these variables may be understood as complementary manifestations of the same broader process operating across motivational, behavioural, and interpersonal levels.

By focusing specifically on communication disturbance rather than phubbing as a global construct, this study also provides greater conceptual precision regarding the interpersonal consequences of digital engagement. The findings suggest that the impact of smartphones extends beyond patterns of technology use themselves, influencing how attentional resources are allocated during everyday social interactions. From this perspective, the challenge posed by digital technologies is not merely how frequently they are used, but how effectively individuals regulate their attention while engaging with the people around them.

These findings have particular relevance for teacher education as digital technologies become increasingly embedded in educational settings. Preparing future educators requires looking beyond traditional technological and pedagogical competencies; it demands fostering the capacity to regulate digital engagement, sustain attention during interpersonal interactions, and make intentional choices about when digital connectivity supports learning rather than interfering with it. Specifically, these implications apply to initial teacher training in two ways. First, they enable preservice teachers to recognize and manage how mobile devices disrupt attention and communication during their own academic interactions. Second, they prepare them to make informed decisions regarding device usage in their future teaching practice. Ultimately, digital competence must encompass more than tool integration —it requires assessing the purpose, timing, and conditions of technology use, while establishing classroom agreements that safeguard face-to-face attention. Digital self-regulation should therefore be recognized as a critical, yet often overlooked, component of professional competence in technology-rich educational environments.

Although longitudinal, experimental, and multi-method research is needed to clarify the temporal dynamics underlying these relationships, the present findings offer a theoretically grounded framework for understanding how motivational vulnerability can translate into behavioural dysregulation and, ultimately, into disruptions of face-to-face communication. Ultimately, in an era of permanent connectivity, digital well-being depends not only on remaining connected to online environments, but also on preserving the capacity to remain fully present in the interactions that occur offline.

Abbreviations

AVE: Average Varience Extracted

BSMAS: Bergen Social Media Addiction Scale

CFI: Comparative Fit Index

DIFFTEST: Difference Test

FoMo: Fear of Missing Out.

HTMT: Heterotrait-Monotrait ratio of correlations.

I-PACE: Interaction of Person–Affect–Cognition–Execution

PSMU: Problematic of Smartphone Use.

RMSEA: Root Mean Square Error of Approximation

SEM: Structural equation modelling

STDYX: Standardized factor loadings

TLI: Tucker–Lewis Index

WLSMV: Weighted least squares mean- and variance-adjusted

Declarations

Ethical approval and consent to participate:

The study protocol was reviewed and approved by the Ethics Committee of University of the Santiago de Compostela, approval No.115/2025. Informed consent was obtained from all participants prior to their inclusion in the study. The study was conducted in accordance with the Declaration of Helsinki.

Consent for Publication:

Informed consent for publication was obtained from all individual participants included in the study.

Competing interests:

The authors have no relevant financial or non-financial interests to disclose.

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Author Contribution

IM-B and PCM-C developed the conceptualization and investigation of the study. IM-B supervised the process, wrote the original draft, and conducted the writing, review, and editing. PCM-C was responsible for the methodology, formal analysis, and data curation, as well as writing the original draft. MLP-F contributed to the conceptualization, investigation, supervision, original draft writing, and subsequent review and editing. OCGBI performed the validation and visualization of the data, and contributed to the writing and review of the manuscript. All authors read and approved the final manuscript.

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Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

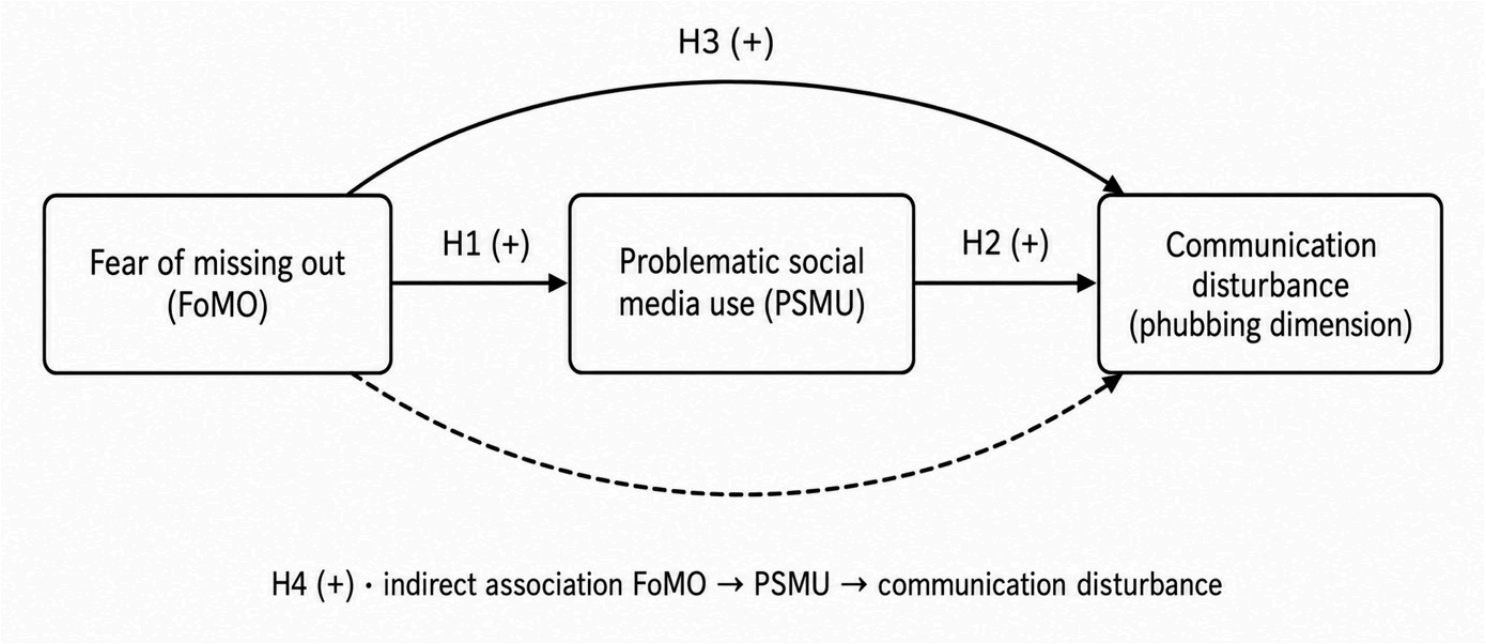


Figure 1

Research model and hypothesised trajectories

Note. The dotted line represents the indirect association formulated in H4, which combines the trajectories H1 and H2.

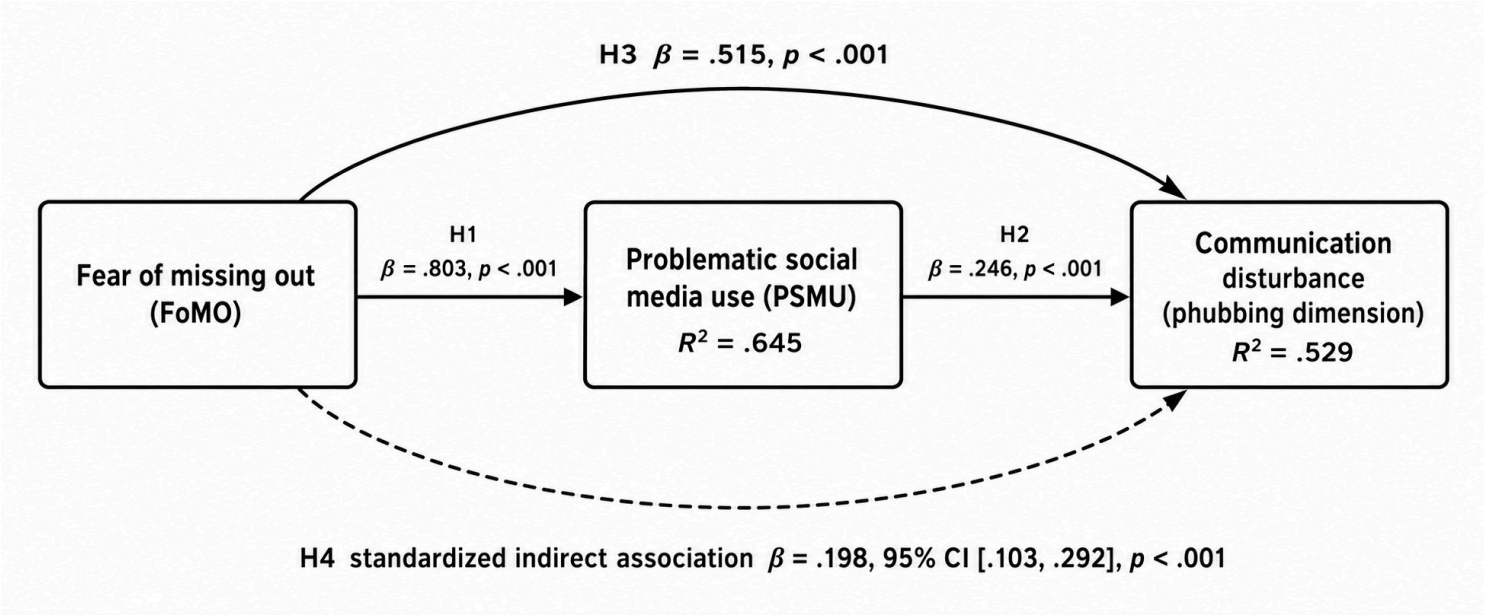


Figure 2

Main structural model with standardised coefficients

Note: The dotted line represents the indirect association formulated in H4. All coefficients are standardised and were estimated simultaneously.