



Factorial validity of the problematic social media use scale among Chinese adults

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ABSTRACT

The Problematic Social Media Use Scale (PSMUS) is a promising self-report measure assessing problematic use of social media among adolescents and adults. However, data concerning its psychometrics are still scant, and adaptation in Eastern cultures is missing.

This study aimed to test the factorial structure, internal consistency, and external validity of the Chinese version of the PSMUS in a sample of 672 adults (31% males) aged between 18 and 58.

A series of confirmatory factor analyses supported the bifactor structure of the PSMUS, including a general factor and five specific independent components, namely preference for online social interactions, mood regulation, cognitive preoccupation, compulsive use, and negative outcomes. Hierarchical Omega supported the presence of a general factor, and also ancillary indexes suggested that the questionnaire is not strictly unidimensional.

Subsequent structural equation modeling testing the incremental contribution of each PSMUS facet in predicting negative emotional states showed that, above and beyond the general factor, only one of the five dimensions (i.e., negative outcomes) significantly links to our criterion measure further support the use of an overall PSMU score. Moreover, results support the external validity of the questionnaire, given its positive association with depression, anxiety, and stress scores.

The Chinese version of the PSMUS is a psychometric sound instrument to assess the level of PSMU in adults. Future research may evaluate the cross-cultural validity of the bifactor model and its associations with other assessment methods.

1. Introduction

Social media is a general term referring to a wide range of online applications including text service (e.g., email, IM), forums (e.g., Quora, Reddit, Digg), social networking sites (e.g., Facebook, WhatsApp, Twitter, Instagram, QQ, WeChat), and other communities (e.g., target for travel, dating, business, enterprise, shopping, game, hobby; (Aichner et al., 2021; Kaplan & Haenlein, 2010). Social media use is normative but can become problematic if it impairs users' daily functioning (Marino et al., 2023). Problematic social media use (PSMU) can be broadly defined as a maladaptive pattern of cognitions and behaviors of individuals who prefer online social interactions rather than face-to-face ones (Marino et al., 2017). Moreover, PSMU includes the tendency of

individuals to use social media in order to regulate their mood and preoccupation to the extent to which they engage in compulsive use that results in negative outcomes for every-day life (Marino et al., 2017).

Over the last 20 years, a growing amount of research has highlighted the potential detrimental effect of PSMU from adolescence to adulthood. For example, empirical evidence has suggested that PSMU impairs adolescents' physical and mental health (Zhang et al., 2022). Similar findings have been reported for adult samples, in which compulsive social media use or PSMU was related to a series of negative outcomes such as sleep problems, depression, anxiety and stress (Chang et al., 2022; Marino et al., 2022; Tandon et al., 2020).

However, although the negative effects of PSMU have been extensively documented, the assessment of PSMU is still controversial as

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different instruments are based on different theoretical models and conceptualization of PSMU (Cataldo et al., 2022; Moretta, et al., 2022). The present study aims at showing the psychometric properties of the Problematic Social Media Use Scale (PSMUS) based on the Caplan's model (Caplan, 2010) in a sample of Chinese adults.

1.1. Available questionnaires based on the adaptation of addiction criteria to PSMU

Among the available self-report questionnaires, the Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016) and the Social Media Use Questionnaire (SMUQ; Xanidis & Brignell, 2016) are of the most widely used (Cataldo et al., 2022; Moretta, et al., 2022). The former is a multidimensional scale based on the component model of behavioral addictions proposed by Griffiths (2005) and has been adapted from the well-validated Bergen Facebook Addiction Scale (BFAS; Andreassen et al., 2012). The scale consists of 18 items rated on a 5-point Likert reflecting the common facets of addictive behaviors, i.e., salience, mood modification, tolerance, withdrawal, conflict, and relapse (Griffiths, 2005). Scores across items are summed to provide six different scores (one for each subscale). The scale reported good psychometric properties in terms of factorial structure, reliability, and external validity across several cultures and countries (Zarate et al., 2022). The latter, namely the SMUQ (Young, 1998), is a scale developed according to the Diagnostic and Statistical Manual-IV-TR criteria for gambling disorder (American Psychiatric Association, 2010) and adapted from the multidimensional Internet Addiction Test (IAT; Young, 1998). It consists of 9 items on a 5-point Likert scale assessing two facets of PSMU namely withdrawal and compulsion. Scores across items are summed to provide two different scores.

Another commonly used scale is the Social Media Disorder Scale (SMDS; van den Eijnden et al., 2016) which was developed based on the Diagnostic and Statistical Manual of Mental Disorders-5 for Internet gaming disorder. It is available in a long (27 items) and a short (9 items) version. Items follow a dichotomous (yes/no) response scale, and "yes" responses are summed to give a total score.

1.2. The adaptation of the Caplan's model to PSMU

Beyond the adaptation of the addiction criteria to problematic Internet use, the cognitive-behavioral model of Generalized Problematic Internet Use (GPIU) proposed by Caplan (2010) recognized the crucial role of the preference for online social interactions (POSI) as a central maladaptive cognition toward the Internet. The model posits that POSI, Internet use to regulate mood, and insufficient self-regulation (both in terms of preoccupation and compulsive Internet use), negative consequences for daily life, were positively correlated (Caplan, 2010). It is operationalized by the Generalized Problematic Internet Use Scale 2 (GPIUS-2), which comprises 15 items rated on an 8-point Likert scale (from 1 = "definitely disagree" to 8 = "definitely agree") and covers five dimensions: the preference for online social interactions (POSI), mood regulation (MR), cognitive preoccupation (CP), compulsive use (CU), and negative outcomes (NO; Caplan, 2010). Scores across items are summed to obtain five different scores (one for each dimension), as well as an overall score obtained summing the 15 items. Indeed, in terms of factor structure, Caplan (2010) reported a reasonably good fit of the second-order factor structure with five first-order dimensions (i.e., POSI, MR, CP, CU, NO) and its second-order dimension is named "deficient self-regulation (DSR)" loaded on two first-order dimensions of CU and CP. The validation study of the Italian version of the scale showed that the best-fit measurement model included four first-order factors (namely, POSI, MR, DSR, and NO; Fioravanti et al., 2013). A more recent study testing the original GPIUS-2 in Japanese adults ($N = 291$, median age = 25 years; range 22–43 years; 128 women) corroborated the five correlated factors (Yoshimura et al. 2022).

In terms of external validity, a meaningful association has been

reported with a range of maladaptive outcomes including interference with daily life activities, self-esteem, measures of depression, anxiety, and impulsivity (Gámez-Guadix et al., 2012; Yoshimura et al. 2022).

The GPIU model has been gaining increasing acceptance by scholars and empirical evidence emerged about the adequacy of Caplan's cognitive-behavioral model to conceptualize also specific online behaviors beyond generalized use of the Internet, such as gaming (Haagsma et al., 2013) and social media use (e.g., Marino et al., 2017).

Compared to other theoretical frameworks, it has been argued that the GPIU model can be an excellent candidate to assess PSMU because of the crucial role given to POSI (e.g., Fioravanti et al., 2020). Indeed, the belief that one is safer, more efficacious and confident with online interactions with others rather than with face-to-face interpersonal communication (that is POSI) is a typical belief among social media users. Accordingly, there is an increasing number of studies suggesting that maladaptive cognitions are central to PSMU (e.g., Wang et al., 2021; Fioravanti et al., 2020; Moretta & Buodo, 2018) but more empirical evidence are needed (Moretta, et al., 2022; Varona, et al., 2022). Therefore, the assessment of PSMU should move the attention from sole addiction-like symptoms to cognitive and emotional processes that track the line from normal to severe use (Cataldo et al., 2022; Fernandes et al., 2019).

Following this line of reasoning, the GPIU model has been applied to PSMU and the GPIUS-2 has been adapted to the social media context. Previous studies replaced the word 'Internet' with 'social media', 'social networking sites', 'Facebook' or 'Instagram' (Gioia et al., 2020; Marino et al., 2017; Martínez-Pecino & García-Gavilán, 2019; Solem et al., 2021). Nevertheless, data supporting the validity of the GPIUS-2 as a measure of PSMU are still scarce, and inconsistent results have emerged regarding its factorial structure. This is surprising considering the recent call that rigorous measurement practices should be the foundation for generating knowledge from psychological science (Flake et al., 2022). Furthermore, the common practice of "adapting ad hoc" extant measures without testing their psychometric properties may lead to questioning the research results.

To our knowledge, four validated studies (Assunção & Matos, 2017; Marino et al., 2017; Moretta & Buodo, 2018; Sirota et al., 2018) showed mixed results depending on specific Facebook and social networks that were considered.

Marino et al. (2017) tested the factorial structure of the Facebook-adapted version of the GPIUS-2 in a sample of Italian adolescents and young adults ($N = 1460$, 49.2% boys, age range 14–29 years). Results showed a good fit, suggesting a five-correlated factor structure.

Assunção and Matos (2017) validated the factorial structure of GPIUS-2 in the context of Facebook in a sample of Portuguese adolescents ($N = 761$, 53.7% boys, age range 14–18 years). Results indicated that DSR is specified as a second-order factor, based on two first-order factors: CU and CP and the other factors are specified as first-order factors.

Moretta and Buodo (2018) found a validated theoretical model of Problematic Facebook Use based on GPIUS-2 in a sample of young Italian adults ($N = 815$, 49.8% girls, age range 18–30 years). Results supported the original model by Caplan (2010).

Sirota et al. (2018) presented the results of factorial structure of the social networks-adapted version of the GPIUS-2 among Russian-speaking users ($N = 900$, 74.4% women, age range 21–37 years). Results showed a good fit, suggesting a five-correlated factor structure.

1.3. The current study

The use of well-validated measures is paramount to better understanding how PSMU occurs and interacts with additional risk/protective factors. In turn, understanding such dynamics is crucial for further improving PSMU assessment and implementing effective intervention programs aimed at preventing the dark side of social media use.

Therefore, the aims of the current study were to test the

psychometric properties of the PSMUS by testing its factorial structure, internal consistency, and external validity. Particularly, based on the extant literature, we tested four models (i) a five correlated factor model including POSI, MR, CP, CU, and NO (Marino et al., 2017; Sirota et al., 2018); (ii) a hierarchical model with five first-order factors (POSI, MR, CP, CU, and NO) loading on a higher-order factor, namely PSMU, (iii) a partial hierarchical model with only two of the five first-order factors (i.e., CU and CP) loading on a higher-order factor of DSR (Assunção & Matos, 2017; Moretta & Buodo, 2018), and (iv) a bifactor model assuming a general factor (i.e. PSMU) while recognizing the multidimensionality of the construct (i.e., the five dimensions: POSI, MR, CP, CU, and NO). While the correlated factor model focuses on specific facets of PSMU, the hierarchical and bifactor models include both general and specific dimensions. However, regarding model estimates, there are relevant differences in how the commonality between items is treated. In the hierarchical model, the observed variables (items) serve as indicators of the first-level factors, and each mediates the relationship between the higher-level factor and the observed variables (there is no direct relationship between the higher-level general factor and the observed variables). In the bifactor model, each observed variable loads directly on the general and specific grouping factors. In other words, the bifactor models directly model the shared variance among the items. This confers higher theoretical importance to the general factor than the grouping factors in contrast to the higher order model, which most emphasizes the specific factors.

After identifying the best model, we tested the reliability of the PSMUS and its external validity by examining the associations between the PSMUS and depression, anxiety, and stress assessed by the Depression, Anxiety and Stress Scale – 21 (DASS-21). These variables were selected because they have previously been used to test the external validity of PSMU tools (e.g., Huang et al., 2021; Pontes et al., 2016; Sirota et al., 2018) and/or they have often been used in studies aimed at understanding PSMU and related outcomes (Di Blasi et al., 2022; Huang et al., 2023). Therefore, based on the extant literature (e.g., Lopes et al., 2022), in the current study, we expected to replicate a positive association between the PSMUS and anxiety, depression, and stress as evidence of the external validity of the tool.

2. Methods

2.1. Participants

The initial sample included 717 participants. However, 45 respondents who did not meet the inclusion criteria (age 18 or older) were excluded from the analyses. Thus, the final sample included a total of 672 Chinese adults (69% female; mean age = 26.87 years, $SD = 6.62$). One participant did not report gender information. In terms of age distribution, 49% were emerging adults aged between 18 and 25 years (79% female; mean age = 22.3 years, $SD = 2.13$), and 51% were adults aged between 26 and 58 years (59% females; mean age = 31.23 years, $SD = 6.55$). Of the participants, 42.7% were students, 40.8% were employees, and the rest self-reported as freelance, housewife/husband, others, or no job. As for education experiences, 54% of participants had achieved a bachelor's degree or higher vocational college degree, and 35.7% were graduate degree holders. Furthermore, 70.1% of participants were unmarried, 23.8% were married, and 1.3% were separated.

2.2. Procedure

The Human Subjects Ethics Subcommittee of Jiangnan University approved the ethical compliance of this study.

Participants were recruited by snowball sampling from diversified areas of China between February and March 2022. All participants were invited to select the “agree” button for the informed consent. The data were collected via an online survey by distributing mainly on WeChat, which is a popular multifunctional social media platform in China.

2.3. Measures

Problematic social media use. The PSMUS was adapted from the GPIUS-2. The scale was translated into Chinese using a back-translation process. In addition, the word “Internet” of the original version was replaced with “social media” in the Chinese version. It is a 15-item scale that covers five distinct dimensions: POSI (i.e., “I prefer communicating with people online rather than face-to-face”), MR (i.e., “I have used social media to talk with others when I was feeling isolated”), CP (i.e., “I would feel lost if I was unable to go on social media”), CU (i.e., “I find it difficult to control my social media use”), and NO (i.e., “My social media use has made it difficult for me to manage my life”). Moreover, in the original GPIUS-2, CP and CU consisted of a higher-order factor “deficient self-regulation” (Caplan, 2010). Each item is rated on an 8-point scale from 1 (definitely disagree) to 8 (definitely agree). Items are summed to provide five scores (one related to each dimension made up of three items each), ranging from 3 to 24, and a total score, ranging from 15 to 120. Higher total scores indicate higher levels of PSMU.

Depression, anxiety, and stress. The Depression, Anxiety and Stress Scale – 21 Items (DASS-21) was developed by Lovibond and Lovibond (1995) and validated among Chinese by Wang et al. (2016) to assess negative emotional states. It included 21 items equally shared across three dimensions, namely with depression, anxiety, and stress. Each item is rated on a 4-point scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much). Scores across items are summed to obtain three separate scores (one for each emotion-related aspect) and a total score. Higher scores indicate higher levels of the corresponding negative emotional state. The alpha was 0.85 for the stress subscale, 0.84 for the anxiety subscale, and 0.86 for the depression subscale in the current study.

2.4. Statistical analysis

All analyses were performed using R (R Development Core team, version 4.1.3, 2022). All models (CFAs and SEM) were developed using the lavaan package (Rosseel, 2012).

Descriptive analysis. At the descriptive level, item response distributions and the main descriptive statistics (i.e., mean, standard deviation, range, and skewness) of the 15 items, as well as of the relevant PSMUS-related factors were explored.

Factorial structure. To test the factorial structure of the PSMUS, a series of CFAs were performed. Particularly, the following were tested: (a) a five-factor model (M1) in which each item was loaded on one of the five theoretical dimensions (Marino et al., 2017); (b) a hierarchical model (M2) in which items are constrained to load on one out of the five subscales modeled as first-order factors, which in turn were forced to load on a second-order factor, namely the PSMUS (Roberto & Marta, 2019; Solem et al., 2021); (c) a partial hierarchical model (M3) in which only two of the five dimensions (i.e., CU and CP) were forced to load on a second-order factor (DSR; Assunção & Matos, 2017; Caplan, 2010); and (d) a bifactor model (M4; Reise, 2012), in which items are constrained to load on a general factor and on one out of the five specific orthogonal factors.

Model estimation and evaluation. All models were tested using the robust maximum likelihood estimation method (MLR). A series of goodness of fit indices were computed, including the chi-squared (χ^2/df), the Tucker-Lewis index (TLI) and the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Values of $\chi^2/df < 4$ and 3, as well as CFI and TLI > 0.95 and > 0.97 , were considered acceptable and good fit, respectively. For RMSEA and SRMR, values ranging from 0.05 and 0.08 were considered adequate fit, and values of < 0.05 were considered good fit (Schermelleh-Engel et al., 2003). The most plausible model was selected using (a) a qualitative evaluation of the fit indices of each model; (b) the χ^2 difference test among models (where no differences between the two competing models subsist if the associated p -

value is greater than 0.05; Satorra & Bentler, 2001); and (c) a model comparison approach considering the Akaike information criterion (AIC) and Bayesian information criterion (BIC; where lower values of BIC and AIC indicate a better fit [(Raftery, 1995)]).

Internal consistency was evaluated via Cronbach’s alpha and McDonald’s omega. If the bifactor model was supported the hierarchical omega (ω_{Htot} ; Reise et al., 2013) would be computed. This index is recommended for testing the reliability of the bifactor model and reflects the proportion of variance attributable to a single general factor and the extent to which subscale scores provide reliable variance after accounting for the general factor (Rodriguez et al., 2016; Reise et al., 2013). Furthermore, following the recommendations of the extant literature (see, Bonifay et al., 2015; Rodriguez et al., 2016) an in-depth diagnosis of the bifactor model was made by examining several ancillary indexes including: (a) the percentage of uncontaminated correlations (PUCs), which can be defined as the percentage of correlations that reflect general factor variance (Bonifay et al., 2015; Reise et al., 2013); and (b) the explained common variance (ECV), which represents the percent of common variance attributable to the general factor in the bifactor model (Reise et al., 2010). A ω_{Htot} higher than 0.70, a PUC greater than 0.80, and ECV values greater than 0.60 suggest the presence

of a general factor (Reise et al., 2013).

To further test the validity of the bifactor model and the incremental utility of each PSMUS factor over and above the general factor, a structural equation modeling (SEM) approach was used (Olatunji et al., 2015). In particular, this study examined to what extent the PSMUS subscales are associated with depression-, anxiety-, and stress-related negative emotions while controlling for the general factor. A latent factor defined by anxiety, depression, and stress was considered a dependent variable (i.e., an endogenous variable), and group factors and a general factor of the PSMUS were simultaneously considered predictors (i.e., exogenous variables; see Fig. 1).

External validity. Based on the selected model, the external validity of the PSMUS was evaluated via Pearson’s bivariate correlations with anxiety, depression, and stress as assessed by the DASS-21 related dimensions. Associations among variables were evaluated in terms of significance and effect size. Following Cohen’s guidelines (1988), values of 0.1, 0.3, and 0.5 reflect a small, medium, and large effect size, respectively.

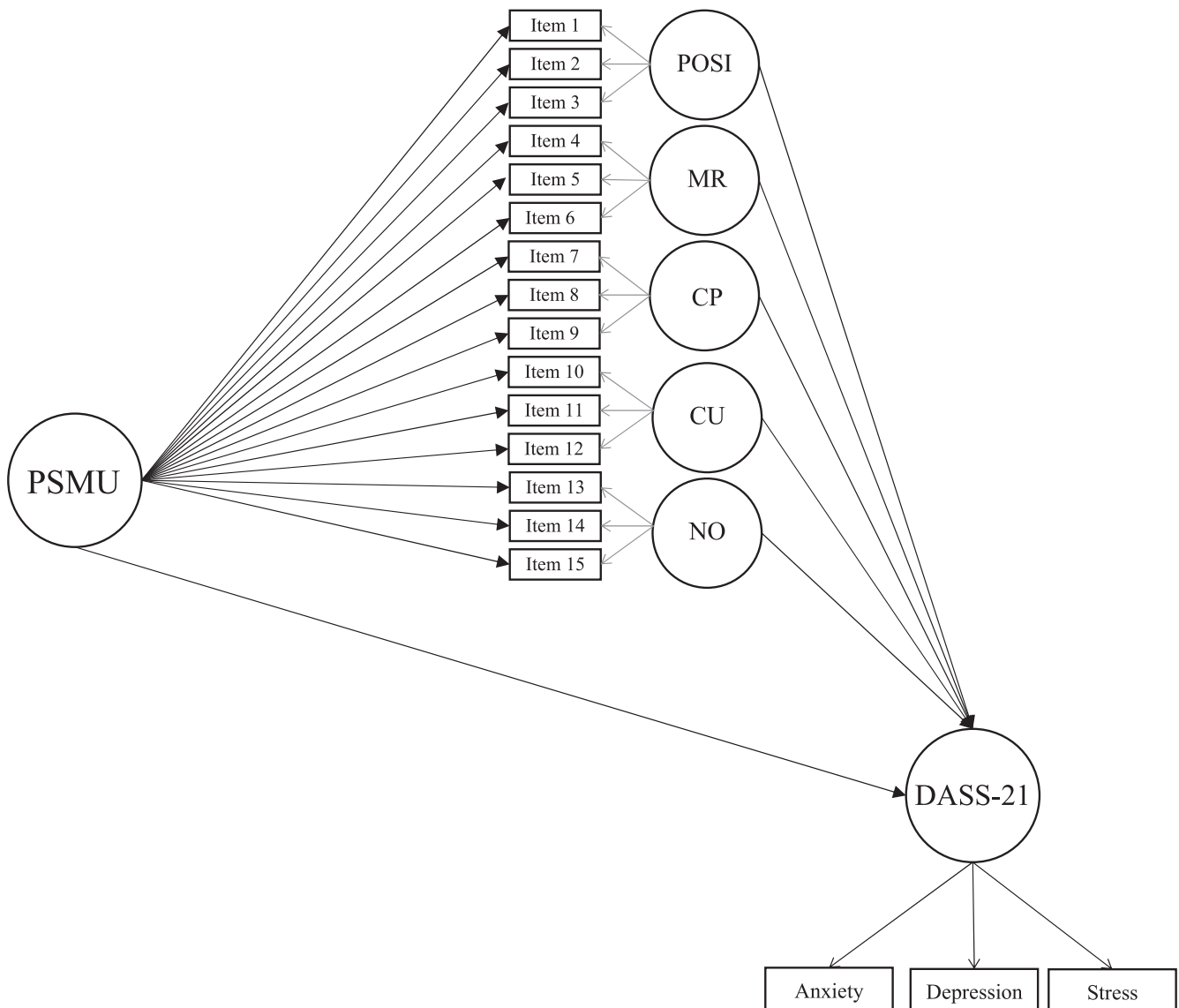


Fig. 1. Structural equation model predicting the DASS-21 ($N = 579$). DASS-21 = Depression, Anxiety, Stress Scale-21 items, PSMU = problematic social media use, POSI = preference online social interaction, MR = mood regulation, CP = cognitive preoccupation, CU = compulsive use, NO = negative outcomes.

3. Results

Descriptive analyses. A few items showed a slightly right-skewed distribution (see Table 1 and Fig. 2) but without an appreciable distortion (not greater than 1; Muthén, & Kaplan, 1985). This aspect was more evident for the three items of NO (i.e., items #13, #14, #15) and one item of CP item (i.e., item #9). Also, the overall score of the general and specific factors showed a slightly skewed distribution, again without considerable bias, with mean scores ranging from 3.21 (NO subscale) to 4.81 (MR) (see Table E2).

Model estimation and evaluation. The five-factor model (M1) showed acceptable CFI, TLI, and SRMR values, but the χ^2/df barely exceeded the cutoff value of acceptability fit (Schermelleh-Engel et al., 2003). When testing the hierarchical model with five first-order factors (M2), all of the considered fit indices worsened. Similar results emerged for the hierarchical model in which only two dimensions (i.e., CP and CU) were modeled to load on a second-order factor (M3). The bifactor model yielded good and better fit indices compared to the competitive models (see Table 2 and Fig. 3). The factor loadings were large and statistically significant (all $p < .001$) on both the general factor and the specific factor (except for item 12, which loaded non-significantly on CU, $p = .072$). The χ^2 difference test between the five-factor and the bifactor model suggested that the latter had a significantly better fit than the other competitive models (χ^2 [DIFF] = 83.1, $df = 5$, $p < 0.001$), also manifested in lower AIC and BIC values (see Table 2). All χ^2 difference tests among models are provided within the online supplementary material section (see Table E1).

All subscales and the general PSMU factors showed high alpha and omega reliability indices (Table 3).

However, ω H coefficients of CP, CU, and NO factors were substantially inadequate after accounting for the general factor of PSMU in the bifactor model. On the contrary, POSI and MR showed high values of ω H coefficients (see Table 3). The ω H_{tot} for the general factor was high (0.81), as well as the PUC (0.86), supporting the presence of a general factor. In contrast, the ECV (0.53) did not reach the recommended cutoff value (0.60) to consider PSMUS as strictly unidimensional.

Finally, structural equation models were used to examine the degree to which the PSMU subscales are significantly associated with negative states while controlling for the general factor of the bifactor model. A negative variance of one CU item was fixed to 0 (Chen et al., 2006). The results showed good fit indices ($\chi^2/df = 2.31$, CFI = 0.97, TLI = 0.96, RMSEA = 0.048 [90% CI: 0.041-0.054]). The general PSMU factor significantly predicted this study's criterion measure ($\beta = 0.40$, $SE = 0.065$, $p < .001$), and only one of the five dimensions (i.e., NO) significantly linked with the DASS-21 score ($\beta = 0.27$, $SE = 0.063$, $p < .001$).

Table 1

Descriptive statistics and item response distributions of the Problematic Social Media Use Scale (PSMUS) items.

Item	N	Mean	SD	Min-Max	Skew	Frequency (%)							
						1	2	3	4	5	6	7	8
Item1	672	4.14	2.27	1.00	0.20	0.17	0.11	0.13	0.15	0.14	0.12	0.05	0.12
Item2	672	4.31	2.17	1.00	0.12	0.12	0.12	0.15	0.14	0.16	0.14	0.06	0.11
Item3	672	4.03	2.13	1.00	0.29	0.14	0.16	0.15	0.14	0.16	0.12	0.05	0.09
Item4	672	4.52	2.18	1.00	-0.05	0.12	0.11	0.11	0.14	0.17	0.15	0.08	0.12
Item5	672	4.94	2.01	1.00	-0.34	0.07	0.08	0.10	0.12	0.19	0.21	0.12	0.11
Item6	672	4.99	2.03	1.00	-0.35	0.07	0.07	0.11	0.12	0.17	0.20	0.14	0.11
Item7	672	4.13	2.18	1.00	0.18	0.15	0.12	0.15	0.14	0.15	0.11	0.09	0.09
Item8	672	3.93	2.10	1.00	0.29	0.16	0.13	0.17	0.14	0.15	0.12	0.05	0.08
Item9	672	3.21	1.98	1.00	0.67	0.26	0.17	0.17	0.13	0.12	0.08	0.03	0.04
Item10	672	4.05	2.12	1.00	0.23	0.15	0.14	0.15	0.14	0.15	0.14	0.05	0.08
Item11	672	4.00	2.16	1.00	0.28	0.15	0.14	0.18	0.12	0.13	0.12	0.06	0.08
Item12	672	3.68	2.07	1.00	0.43	0.18	0.16	0.18	0.14	0.13	0.11	0.04	0.06
Item13	672	3.20	1.98	1.00	0.74	0.25	0.20	0.18	0.11	0.11	0.08	0.03	0.04
Item14	672	3.32	2.01	1.00	0.64	0.23	0.18	0.18	0.12	0.12	0.08	0.04	0.04
Item15	672	3.11	1.94	1.00	0.80	0.26	0.22	0.15	0.14	0.10	0.07	0.02	0.04

Note. Items 1–3: preference for online social interaction-related items (POSI); Items 4–6: mood regulation (MR)-related items; Items 7–9: cognitive preoccupation (CP)-related items; Items 10–12: compulsive use (CU)-related items; Items 13–15: negative outcomes (NO)-related items.

All of the parameters estimated are provided within the supplementary section (see Table E3).

External validity. The results showed a positive association with a medium effect size between PSMUS and the DASS-21-related dimensions (stress: $\beta = 0.33$, $p < .001$; anxiety: $\beta = 0.33$, $p < .001$; depression: $\beta = 0.36$, $p < .001$). The associations between the PSMUS factors and the DASS-21 dimensions were also significant, with an effect size ranging from low to medium (see Table E3 in the supplementary material section).

4. Discussion

The aim of the present study was to test the psychometric properties of the PSMUS in a sample of Chinese adults by testing its factorial structure, reliability and external validity. This study is in response to a call for better research on how this construct is framed (Cataldo et al., 2022) and, in turn, the development of valid and reliable instruments, and it expands the current literature on instruments referred to a specific social media (i.e., Facebook) that limited their application in a broad social media context and cross-cultural population (Assunção & Matos, 2017; Marino et al., 2017; Sirota et al., 2018). Facing the endless emergence of new social media platforms, the availability of a valid and reliable comprehensive tool that adopts general criteria may be highly fruitful in avoiding confusion across studies (Cataldo et al., 2022).

In terms of factorial structure, results from CFAs showed that the bifactor model was the best model and included a general factor (i.e., PSMU) and five specific orthogonal factors (i.e., POSI, MR, CP, CU, NO). The high hierarchical omega and PUC values also suggested the presence of a relative strong general factor. However, the relatively low ECV suggested that the scale may have a structure at least in part multidimensional. To sum up, the scale can be used in multiple ways. Firstly, a general factor could be computed. From a theoretical perspective, the existence of a common dimension of PSMU is reasonable following the original cognitive-behavioral model of generalized problematic Internet use (Caplan, 2010) in which poor general mental functioning and cognitive skills can lead to problematic use of technology. Our results suggest that POSI, MR, CP, CU and NO are specific components of PSMUS, reflecting a general PSMU, and emphasize the prominent role of the general factor over the specific factors: the PSMU factor may correspond to an underlying vulnerability factor that predisposes individuals to POSI, MR, CP, CU and NO. Thus, secondly, the multidimensionality of the scale should be observed with particular attention to POSI and MR. Indeed, results provide a useful insight regarding which subscales may contribute most to the multidimensionality of the PSMUS. Specifically, by examining the hierarchical omega values it could be

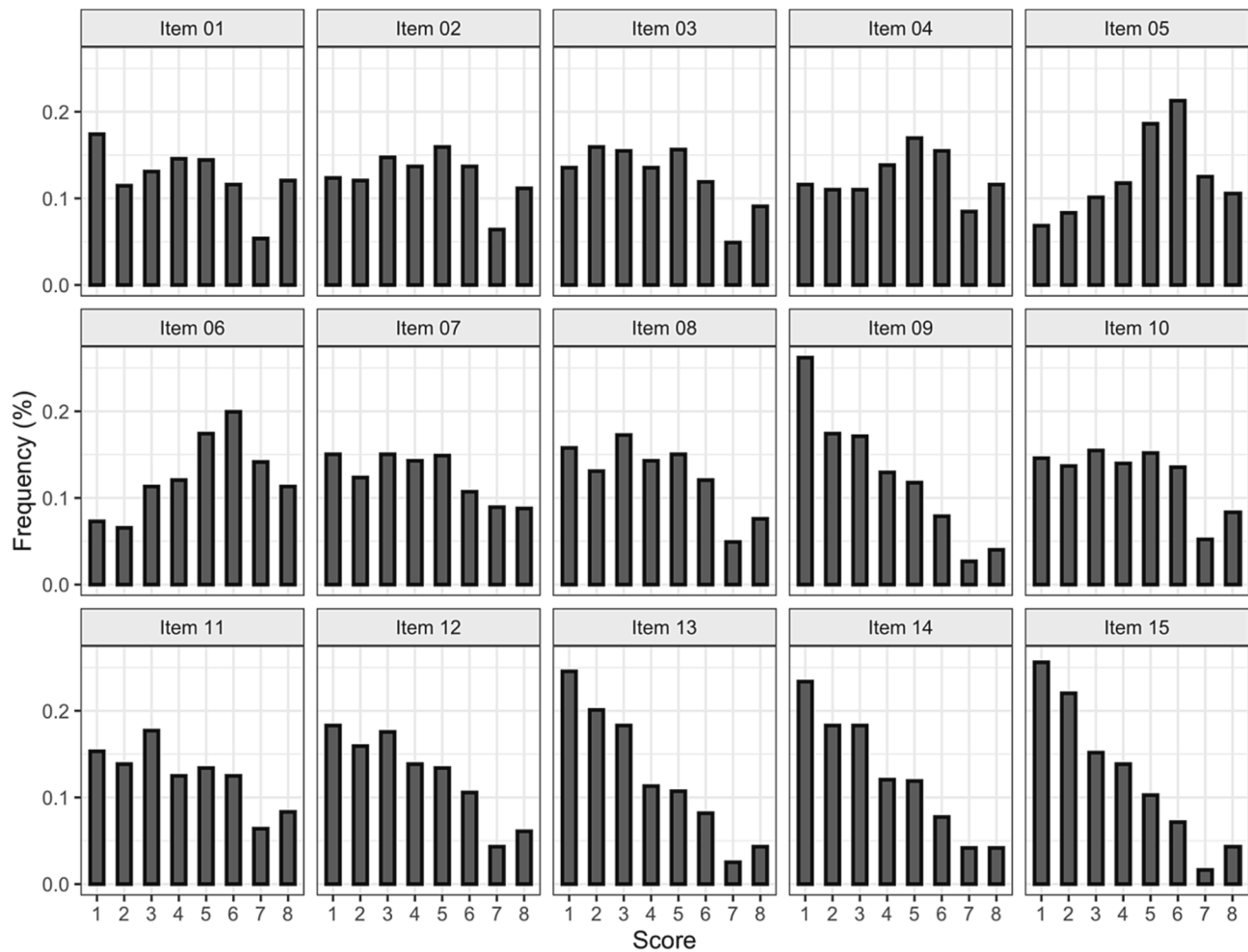


Fig. 2. Graphical representation of the Problematic Social Media Use Scale (PSMUS) item response distributions.

Table 2
Fit indices for the confirmatory factorial of the Problematic Social Media Use Scale (PSMUS).

	χ^2	df	χ^2/df	CFI	TLI	RMSEA [90% CI]	SRMR	AIC	BIC
M1	330.06	80.00	4.13	0.94	0.93	0.07 [0.06-0.07]	0.05	36473.48	36653.89
M2	405.17	85.00	4.77	0.93	0.91	0.07 [0.07-0.08]	0.07	36557.17	36715.03
M3	369.72	82.00	4.51	0.94	0.92	0.07 [0.07-0.08]	0.06	36518.48	36689.87
M4	213.77	75.00	2.85	0.97	0.96	0.05 [0.05-0.06]	0.07	36306.91	36509.87

Note. $N = 672$. All indices are scaled. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square of approximation; SRMR = standardized root mean square residual; AIC = Akaike information criterion; BIC = Bayesian information criterion. M1 = five-factor model; M2 = hierarchical model with five subscales as first-order factors, all of which are loaded on the high-order factor; M3 = hierarchical model in which only two of the five dimensions (i.e., compulsive use and cognitive preoccupation) are loaded on a high-order factor; M4 = bifactor model assuming a single general factor and five specific dimensions.

observed that, while the reliability of the CP, CU, and NO subscales was substantially inadequate after accounting for the general factor of PSMU in the bifactor model, the POSI and MR dimensions displayed high values suggesting that the multidimensionality of the PSMUS may be likely attributed to these two subscales. With regards to POSI, it represents the crucial “social interaction” function of social media, and results support the idea that POSI could be considered a very important “symptom” implicated in the definition of PSMU (Marino et al., 2017). Most of the studies focused on measuring general addiction-like symptoms and ignored the key components of social media-induced maladaptive symptoms (Griffiths, 2005; van den Eijnden et al., 2016; Young, 1998). In the future, POSI should be considered as important when studying PSMU. As regard MR, it emerged, along with POSI, a crucial factor that should be taken into account as it can be considered as

a common reason to engage in social media especially for problematic users with lack of offline social support and social hopelessness (Caplan 2010; Davis, 2001; Fioravanti et al., 2020). Moreover, from recovery perspective, psychological detachment from negative moods via cyber-related leisure has been hypothesized and, therefore, MR could be thought a significant dimension of PSMU (Liu et al., 2021).

Subsequent SEM testing the incremental value of each scale over and above the general factor in predicting negative states as assessed by DASS-21 showed that the general factor significantly predicted psychological distress and that only the NO dimension was significantly linked to our criterion measure, suggesting that all the symptoms taken together and the negative consequences due to maladaptive social media use are the ones that really matter in terms of potential distress experienced by social media users (e.g., Arrivillaga et al., 2022; Huang et al.,

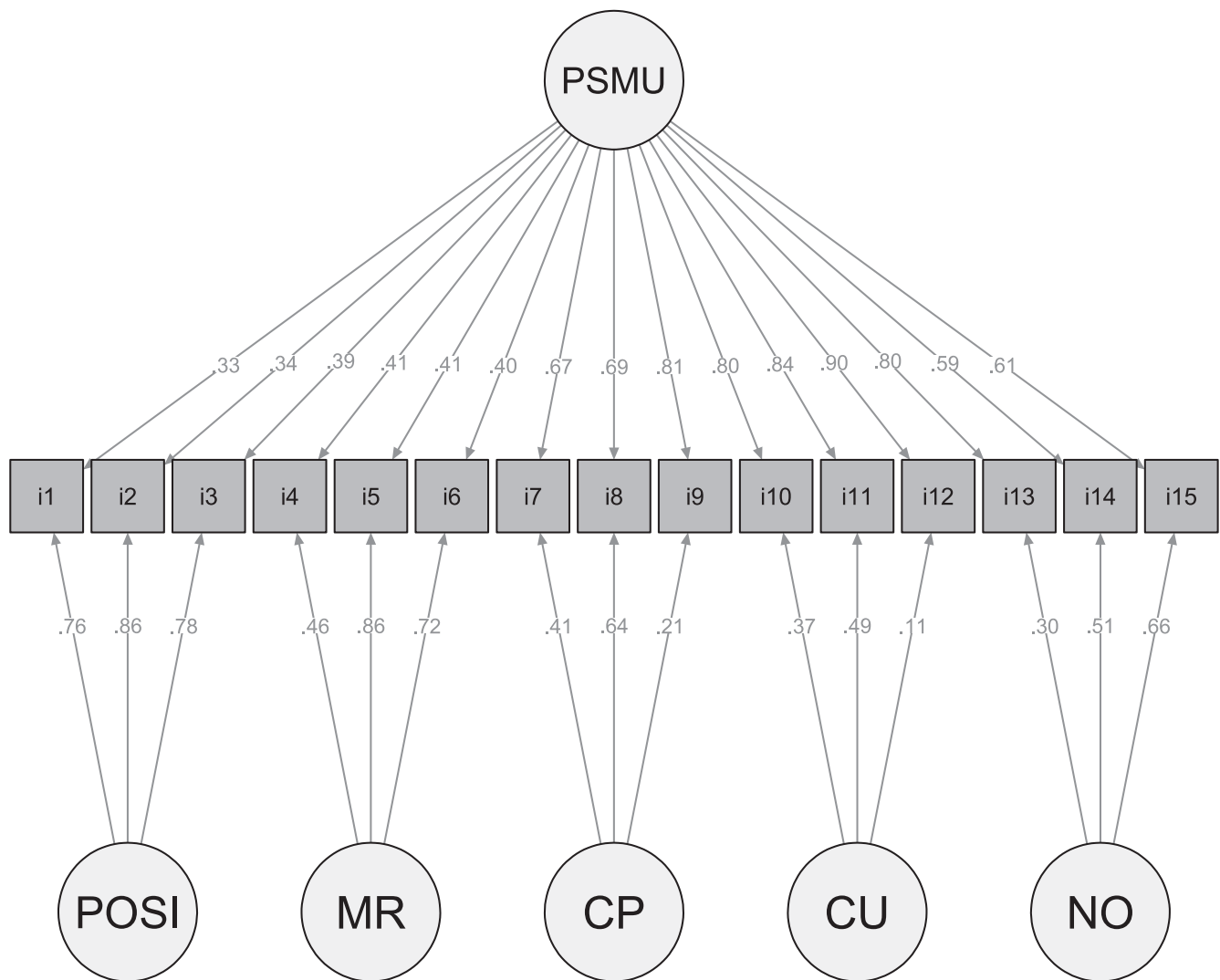


Fig. 3. Confirmatory factor model of the bifactor model of the Problematic Social Media Use Scale (PSMUS).

Table 3
Cronbach's alpha, McDonald's omega and Omega hierarchical (ω_H).

	Alpha	Omega	ω_H
g	0.92	0.96	0.81
POSI	0.90	0.91	0.76
MR	0.83	0.85	0.62
CP	0.87	0.89	0.22
CU	0.92	0.94	0.12
NO	0.86	0.88	0.31

Note. $N = 672$. g = general factor; POSI = preference online social interaction; MR = mood regulation; CP = cognitive preoccupation; CU = compulsive use; NO = negative outcomes.

2021). One potential explanation of the role of NO may be that it likely to be strongly related to the generation of negative emotions (Lopes et al., 2022). Contrariwise, no association emerged between POSI, MR, CP, CU, and the external measure of the DASS-21, suggesting a limited utility of these factors in predicting psychological distress above and beyond the general PSMU factor. Thus, further studies may explore the association between the other dimensions of PSMU with other relevant indicators of distress (such as, negative metacognitions and repetitive thinking styles, e.g., Casale et al., 2021) in order to ascertain the potential negative role of each specific PSMU factor.

Overall, our findings pointed out a new way to assess PSMU among

Chinese adults, which expanded the adaptation of the PSMUS to different language samples (Assunção & Matos, 2017; Caplan, 2010; Marino et al., 2017; Sirota et al., 2018). In other words, the new theoretical pattern of the bifactor model provides empirical support for the use of an overall score while recognizing the multidimensionality of the scale. From the implication perspective, the PSMUS could be empirically used as a flexible detection in finding and improving specific maladaptive cognitions and behavioral habits related to PSMU (Fernandes et al., 2019). However, examining the PSMU subscale in some clinical contexts may be beneficial (Kuss et al., 2014; Wadswley & Ihssen, 2023).

Several of the study's limitations must be acknowledged. A first limitation is the exclusive reliance on DASS-21 to test the external validity of the instrument. Future research may include other theoretically related constructs (e.g., problematic Internet use, maladaptive metacognitions) and measurement tools of PSMU in order to obtain a more comprehensive picture of the contribution of the specific factors beyond the general factor, as well as greater confidence in the external validity of the PSMUS. Second, our findings, mainly concerning the factor structure and external validity, were based on Chinese adults thus replication studies involving other cultures are needed to provide greater confidence about the generalizability of the current findings. Third, given the cross-sectional nature of this study, test-retest reliability should be considered in future research to further determine the stability of the scale. Fourth, invariance measurements were not

reported due to the insufficient gender and age subgroup sample sizes in the current study. Further studies should address these issues to allow comparison of scores across age and gender. Lastly, we recruited the participants using snowball sampling. Future research should improve the sampling methods.

5. Conclusion

Despite these shortcomings, these findings provide evidence that the PSMUS is a promising tool to assess PSMU in Chinese adults. From an implication perspective, our results provide empirical support both for the use of the total score of PSMU and the assessment of specific factors that may be relevant especially in a clinical context.

CRedit authorship contribution statement

Jiewen Zhang: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Tatiana Marci:** Writing – review & editing. **Claudia Marino:** Conceptualization, Supervision, Writing – review & editing. **Natale Canale:** Conceptualization, Writing – review & editing. **Alessio Vieno:** Conceptualization, Supervision, Writing – review & editing. **Jinyuan Wang:** Investigation, Data curation. **Xiaoxi Chen:** Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.addbeh.2023.107855>.

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