The relationships between smartphone distraction, problematic smartphone use

and mental health issues amongst a Chinese sample

Abstract

Smartphone distraction (SD) has been reported as an important factor associated with problematic smartphone use (PSU). The present study explored the relationship between SD, PSU, and mental health problems using the newly developed Smartphone distraction Scale (SDS). A total of three hundred and twenty smartphone users (M_{age} = 20.34, SD = 2.58) completed a questionnaire that comprised psychometric scales for the aforementioned variables. Results showed that SD was significantly correlated with PSU, anxiety, depression and stress. PSU fully mediated the relationships from SD to anxiety and depression. PSU partially mediated the relationship between SD and stress. The four-factor SDS was reliable and obtained good model fit in confirmatory factor analysis. This study suggests that being distracted by smartphone use can be associated with mental health issues while the level of PSU might be the bridge of this link. The present study is one of very few studies to examine SD in China, which aimed to investigate the relationships between SD, PSU and mental health issues (stress, anxiety and depression), and adopt the newly developed SDS in the Chinese context. Further studies are needed to explore the complex mechanism between SD and mental health.

Key words: smartphone distraction, problematic smartphone use, mental health, smartphone distraction scale

Introduction

Smartphones are now a necessity in daily life and have become a popular research focus in the field of behavioural addiction. Recent studies have investigated and discussed topics such as problematic smartphone use (PSU, Busch & McCarthy, 2021; Eichenberg et al., 2021) and smartphone addiction (Sun et al., 2019), With researchers using different terms to describe this problematic behavior. PSU has been defined as the urge to use a smartphone recurrently and uncontrollably, leading to functional impairment (Busch & McCarthy, 2021). An addictive pattern of smartphone use is seen as one pathway to PSU (Billieux et al., 2015). PSU has been largely reported to be closely associated with mental health issues such as anxiety and depression (Elhai et al., 2017; Busch and McCarthy, 2021).

More recently, smartphone distraction, one of the pathways to PSU (Throuvala et al., 2021), has raised concerns (Oraison et al., 2019; Chu et al., 2021; Huang et al., 2021; Yang et al., 2021). For instance, smartphone distraction (SD) was reported to be linked with lower psychological well-being (Chu et al., 2021). However, the validity of the various approaches used for testing SD remain doubtful. These studies used single-item scale (Huang et al., 2021), reversed scores for the mindfulness scale (Oraison et al., 2019), or subscale obtained from earlier problematic internet use scales (Chu et al., 2021) to test SD. The measurements for PSU appear to be more established (Elhai et al., 2017; Busch & McCarthy, 2021) but the screening tool for SD was scarce (Throuvala et al., 2021). In order to measure smartphone distraction, Throuvala et al., (2021) recently developed and validated the Smartphone Distraction Scale (SDS),

which includes four dimensions: attention impulsiveness, online vigilance, multitasking and emotion regulation. To the best of the authors' knowledge, the SDS is the first validated measurement to test smartphone distraction. It is important to explore whether the four-factor model of the SDS could be approved in different research contexts or cultural backgrounds. Although studies into PSU frequently mention the issue of distraction, very few studies have explored SD and its consequences using validated screening tools. It is necessary to test the relationship between SD, mental health, and PSU using the newly validated SDS in different contexts and contribute to the limited SD literature. Therefore, the present study aims to adopt the SDS in another context (i.e., China), test the four-factor model of the SDS, and test the relationships between SD, PSU and mental health issues.

Literature review

Problematic smartphone use

Problematic smartphone use (PSU) has been widely investigated for more than fifteen years following the stream of Internet addiction studies. The definition of PSU remains debatable and still needs more clarification (Starcevic et al., 2021). PSU has been interchangeably described as smartphone addiction (e.g. Nahas et al., 2018; Sun, et al., 2019) and believed to be a potential behavioural addiction (e.g. Bianchi & Phillips, 2005). While in the pathways model, Billieux et al., (2015) argue that problematic mobile phone use (i.e. PSU) could be a more complex concept which includes three types of problematic use (addictive, antisocial, and risky patterns) led by three pathways

including excessive reassurance pathway, impulsive pathway and extraversion pathway. More specifically, this model argues that PSU could be predicted by excessive reassurance needs (e.g. consistent needs for checking notifications), poor control of impulsivity and risk taking personalities such as extraversion. The symptoms of PSU include addictive smartphone use (e.g., regarding smartphone usage as the most important activity in life, i.e., salience), antisocial use (e.g., cyberbullying), risky use (e.g., phone using while driving) (Billieux et al., 2015). It thus seems not suitable to simplify the concept of PSU as smartphone addiction, theoretical evidence suggests that smartphone addiction appears to be one pathway to PSU (Billieux et al., 2015). Given the various contexts and purposes of smartphone usage, it is important to specify the antecedents and consequences of PSU, and distinguish non-problematic from problematic use when defining PSU. Daily use or "non-problematic" use of smartphones (e.g. information seeking, online learning, and entertainment) could not be described as overuse or PSU, while negative consequences such as functional impairment might be the sign of PSU (Billieux et al., 2015). Therefore, some research defines PSU as the uncontrollable consistent craving for smartphone use which leads to impaired functions (Horwood & Anglim, 2018; Busch & McCarthy, 2021).

Self-control and mental health problems appear to be the most investigated factors that are known to be associated with PSU. A recent systematic review of PSU including 293 studies from 2008 to 2019 concluded that control (i.e., self-control) is one of the main antecedents for PSU (Busch & McCarthy, 2021). According to Busch & McCarthy (2021), control appears to be the central antecedent for PSU among the other

antecedents such as emotional health, physical health and personal backgrounds. Similarly, Huang et al., (2021) found that loss of control and continued excessive use were the core symptoms of adolescents' PSU. Other studies also proved the relationship between poor self-regulation (as a predictor) and PSU (e.g. Van Deursen et al., 2015; Yang et al., 2019, 2021).

Mental health problems (e.g., anxiety and depression) were the most reported consequences and the antecedents of PSU (Billieux, 2012; Elhai et al, 2017; Busch and McCarthy, 2021). PSU was found to be associated with increased depression (medium effect sizes), anxiety (small effect sizes) and stress (small to medium effect sizes) in a systematic review that included 23 empirical studies (Elhai et al., 2017). Many empirical studies have identified the relationships between PSU and mental health problems such as anxiety, depression, stress, and loneliness (e.g., Guo et al., 2020; Chen, Pakpour, et al., 2020; Eichenberg et al., 2021; Kim et al., 2015; Kim, 2018). Furthermore, several longitudinal studies suggest that there could be a bi-directional relationship between PSU and increased mental health issues (psychopathology) (Jun, 2016; Kim, 2017; Lapierre et al., 2019). For example, in a three-year follow-up survey of Korean adolescents, Jun (2016) found individuals' mobile phone addiction exacerbated their depressive symptoms, while increased depression also raised the level of mobile phone addiction. Although the link between PSU and mental health issues was found to be bi-directional, the whole map behind this relationship remains unclear. Taking the path from PSU to mental health for example, it remains unclear whether mental health problems were predicted by PSU or other variables mediated by PSU,

this is an area that needs investigating further.

In sum, as shown in empirical studies, it appears that self-control acts as an important antecedent for PSU, while mental health problems could be one of the most concerning consequences of PSU. However, for the problematic users, it is necessary to know what exactly is out of control, not just the poor levels of self-control. In other words, it seems important to investigate whether PSU comes from poor control over some specific factors such as individual's impulsivity or responding to social networking notifications. Furthermore, given that PSU appears to be predicted by self-control (the main central antecedent for PSU [Busch & McCarthy, 2021]), it is necessary to know whether mental health problems are predicted by PSU directly or a set of factors (including or bridged by PSU).

Smartphone Distraction

Smartphone distraction (SD) is defined as "the prevention of giving full attention to the nearest surroundings" (because of smartphone use) (Chu et al., 2021, p. 2), which can be caused by external triggers (e.g. notifications), internal thoughts of checking smartphones (e.g. fear of missing out), or the conflict between the two (Throuvala et al., 2021). Theoretical frameworks consistently suggest the possible relationship between distraction and problematic internet or smartphone use (Davis, 2001; Billieux et al., 2015; Brand et al., 2019). The Cognitive-Behavioral Model of Pathological Internet Use proposes that pathological internet use could be reinforced and maintained by individuals' conditional reactions to internet-related cues (Davis, 2001). SD, as a typical reaction to internet cues such as notifications (Throuvala et al., 2021), could be

a potential predictor of PSU based on Davis' (2001) theory. The pathway model of PSU argues that individuals' PSU could be predicted through excessive reassurance needs (e.g. maintaining online relationship and fear of missing out from online comments or feedbacks) and impulse control (Billieux et al., 2015). Considering the above definition of SD, excessive reassurance needs and impulse control are clearly the components of SD, which can predict PSU. Furthermore, the I-PACE model for specific internet use disorders suggests that distraction could be a predictor of addictive internet use (Brand et al., 2019). Addictive behaviours such as internet use disorders can be reinforced by individuals' uncontrolled craving for specific behaviours (e.g. craving for checking smartphone notifications), while the purpose of specific behaviours is compensation rather than gaining gratification (Brand et al., 2019). Altogether, theoretical frameworks indicate that SD could act as a potential predictor of PSU and reveal the complex associations between these factors. Research investigating PSU and SD is very much warranted.

Recent studies have identified the relationship between distraction and PSU or problematic social media use (Oraison et al., 2019; Yang et al., 2021; Huang et al., 2021; Throuvala et al., 2021). Distraction was reported as one of the major factors that related to PSU in a qualitative study among British college students (Yang et al., 2021). While unexpectedly, Oraison et al., (2019) reported that smartphone addiction was negatively correlated with distraction. However, it is noteworthy that they measured participants' distraction using the reversed scores of a scale for mindfulness rather than validated scales for SD. In a large-scale network analysis with 26,950 grade 4 students and 11,687

grade 8 students, SD (measured by a single item) was found to be directly or indirectly connected to excessive smartphone use (Huang et al., 2021). Similarly, using the validated Smartphone Distraction Scale (SDS), Throuvala et al., (2021) found that SD was significantly and positively correlated with problematic social media use.

In line with the pathways model (Billieux et al., 2015), SD was reported to have negative or dangerous impact (e.g. David et al., 2015; Cho and Lee, 2016). Cho and Lee (2016) explored nursing students' smartphone use and distraction during clinical practice, 24.7% of the participants reported that they sometimes get distracted by their smartphones which might lead to detrimental effects on patients' safety. Moreover, SD could have a negative impact on other activities such as learning and driving (David et al., 2015; Oviedo-Trespalacios et al., 2016). Some studies have reported that SD was associated with mental health problems. In one study, mobile phone distraction, measured by a subscale of the Online Cognition Scale (Davis et al., 2002), positively predicted psychological well-being among Chinese university students, partially mediated by cognitive emotional preoccupation (obsessive thought patterns involving technology use) (Chu et al., 2021). Similarly, SD significantly and positively predicted higher levels of anxiety, stress, and depression (Oraison et al., 2019).

In order to measure SD, Throuvala et al., (2021) developed and validated an English version of 16-item Smartphone Distraction Scale (SDS) which includes four dimensions: attention impulsivity, online vigilance, multitasking and emotion regulation. The initial 33-item SDS was developed based on four psychological dimensions of SD as above. Then, Exploratory Factor Analysis (EFA) and

Confirmatory Factor Analysis (CFA) were conducted and 16 items (four in each dimension) were retained as the final version of the SDS, which obtained a good model fit (*CFI* = .940, *RMSEA* = .053). The Cronbach alpha value for the whole SDS was .87 and all the sub-scales showed good internal consistency with all alpha values above .74 (Throuvala et al., 2021). They found that the SDS scores were significantly and positively correlated with daily recreational smartphone use, social media addiction, deficient self-regulation and stress. Altogether, previous studies have shown that SD is associated with PSU and some mental health variables. However, further research that makes use of the SDS is needed to better understand the role of SD and associations with PSU.

Research aims

Given the close relationship between PSU and mental health issues such as anxiety, depression, and stress, and the link between PSU and SD identified in recent studies, it seems necessary to investigate whether SD predicts mental health issues (e.g., depression, anxiety, and stress) and whether PSU bridges this potential relationship. Knowledge concerning the above mentioned variables is important for understanding the etiology of PSU and for the development of PSU treatment programs. Based on existing empirical and theoretical evidence, the present study proposes several hypotheses as below:

H_1: smartphone distraction positively predicts problematic smartphone use

H_{2a}: problematic smartphone use positively predicts stress.

H_{2b}: problematic smartphone use positively predicts anxiety.

H$_{2c}$: problematic smartphone use positively predicts depression.

H$_{3a}$: smartphone distraction positively predicts stress

H$_{3b}$: smartphone distraction positively predicts anxiety

H$_{3c}$: smartphone distraction positively predicts depression

H$_4$: problematic smartphone use mediates the relationship between smartphone distraction and stress

H$_5$: problematic smartphone use mediates the relationship between smartphone distraction and anxiety

H$_6$: problematic smartphone use mediates the relationship between smartphone distraction and depression

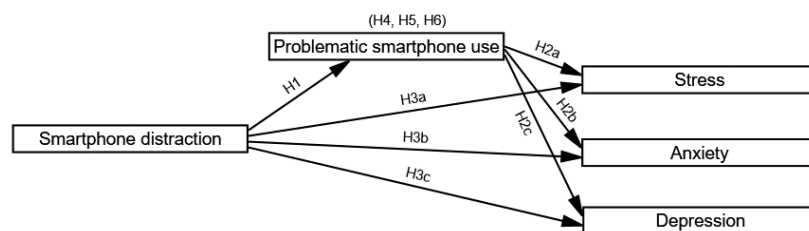A hypothesized model containing these hypotheses is shown in Figure 1:

Figure 1. The hypothesized model

Thus, this study has several aims as follows: (1) to adopt the SDS in Chinese context and test the validity of the Chinese version of the SDS; (2) to investigate the relationships between SD, PSU and mental health issues (anxiety, stress, and depression).

Methods

Participants

The present study comprised 320 university students recruited from two universities in South China using random sampling, convenience sampling and snowball sampling. There were 201 females and 118 males, and one participant did not provide gender information. The participants were aged between 17 and 30 (M=20.30, SD=1.67) and five participants did not provide their age.

Design and Measures

A cross-sectional survey design was utilized in the present study. The survey consisted of several measurement instruments which are described below.

Smartphone Distraction Scale

Smartphone distraction was measured by the Smartphone Distraction Scale (SDS) developed by Throuvala et al., (2021). The SDS is a 16-item measure consisting of four subscales (attention impulsiveness, online vigilance, multitasking, and emotion regulation). Respondents rate the extent to which each item applied to them on a 5-point Likert scale from 1 (*almost never*) to 5 (*almost always*). An example item is "I get distracted by my phone notifications". The sum of the items within each subscale was calculated with higher mean scores indicating higher levels of smartphone distraction. The Cronbach's alpha value for the whole SDS was 0.92 in the present study. The four subscales had good internal consistency with acceptable Cronbach's alpha values: 0.87 (attention impulsiveness), 0.80 (online vigilance), 0.74 (multitasking), 0.92 (emotion regulation). The SDS was translated into simplified Chinese and validated

through a standardized back-translation process (Beaton et al., 2000).

Smartphone Application-Based Addiction Scale

PSU was measured using the Smartphone Application-Based Addiction Scale (SABAS) developed by Csibi et al., (2018). In the present study, the Chinese version of the SABAS was utilized (Chen, et al., 2020). The SABAS is a 6-item measure based on the components model of behavioural addiction (Griffiths, 2005). Items are rated on a 6-point Likert scale ranging from 1 (*Strongly disagree*) to 6 (*Strongly agree*). An example item is: "My smartphone is the most important thing in my life". Scores were summed, higher scores indicated higher PSU severity. The Cronbach's alpha was 0.84 in this study.

Depression, Anxiety, and Stress Scale

The 21-item short form Depression Anxiety Stress Scale (DASS-21) developed by Lovibond and Lovibond (1995) and validated in Chinese by Gong et al., (2010) was used to assess the symptoms of anxiety, depression, and stress. The DASS-21 comprises three 7-item subscales covering the three symptoms that are rated on a 4-point Likert scale ranging from 0 (*Did not apply to me*) to 3 (*Applied to me very much, or most of the time*). Example items for the DASS-21 are: "I found it hard to wind down" (stress); "I felt scared without any good reason" (anxiety); "I felt that life was meaningless" (depression). Scores were summed with higher scores indicating higher severity of depression, anxiety, and stress. The Cronbach's alpha values for stress, anxiety, and depression subscales were .85, .84 and .87 respectively.

Procedure

Participants were recruited through both online and paper-based questionnaires. Advertisements containing the QR code for the online survey were posted on campus and distributed in social media groups among the students. Convenience sampling was used when the authors distributed the questionnaire in their class breaks. Snowball sampling was also adopted when participants introduced their friends or classmates to take the survey. There were 216 valid online responses obtained through the QR codes distributed on campus and social media groups through random sampling and snowball sampling, 120 paper-based questionnaires were distributed through convenience sampling in the researcher's classes and 104 responses were collected back. The present study was completely voluntary and anonymous. Participants were able to withdraw from the study before and after participation. All the participants read the information at the beginning of the survey and gave their consent to participate by filling in the questionnaires. All participants were assured that their data would remain anonymous and confidential. A debriefing statement at the end of the survey reiterated the purpose of the study and informed participants of their right to withdraw from the study.

Ethics

The study was approved by the ethics committee of the research team's university. The study was carried out in accordance with the Declaration of Helsinki. All participants were informed about the study and all provided informed consent.

Data analysis

Descriptive statistics for the scales (mean scores, standard deviations, Cronbach's alpha) and Pearson's correlation coefficients were calculated using IBM SPSS version

26. Confirmatory factor analysis and path analysis were conducted using structural equation modelling in AMOS version 26. As complete data is required in AMOS, the four missing values were replaced using regression imputation in SPSS.

Results

Descriptive statistics and correlations

Descriptive statistics and Pearson's product-moment correlational coefficients are shown in Table 1. The average score for the SDS was 50.34 ($SD = 10.87$) out of 80. The average score for the SABAS was 21.95 ($SD = 5.70$) out of 36. Smartphone distraction was positively and significantly correlated with PSU ($r = .68$, $p < .01$), stress ($r = .36$, $p < .01$), anxiety ($r = .31$, $p < .01$) and depression ($r = .26$, $p < .01$). PSU was positively and significantly correlated with the four dimensions of smartphone distraction (r ranges from .48 to .58, $p < .01$), stress ($r = .41$, $p < .01$), anxiety ($r = .38$, $p < .01$) and depression ($r = .36$, $p < .01$).

Table 1. Descriptive statistics and correlations N=320

Scales	Mean	SD	1	2	3	4	5	6	7	8	9
1.SDS	50.34	10.87									
2.SDS-AI	13.03	3.41	.84**								
3.SDS-OV	10.89	3.52	.84**	.66**							
4.SDS-MT	12.44	2.98	.80**	.54**	.56**						
5.SDS-ER	13.98	3.45	.78**	.51**	.48**	.53**					
6.SABAS	21.95	5.70	.68**	.57**	.57**	.48**	.58**				
7.Stress	5.44	4.13	.36**	.34**	.27**	.25**	.31**	.41**			
8.Anxiety	4.12	3.74	.31**	.25**	.28**	.24**	.24**	.38**	.84**		
9.Depression	4.25	4.00	.26**	.22**	.19**	.22**	.22**	.36**	.81**	.80**	

Confirmatory factor analysis for the SDS

Confirmatory factor analysis showed that the four-factor model of the 16-item SDS was acceptable among the Chinese sample. The model represented the data well with acceptable model fit indices, χ^2=267.82, *df* =97, χ^2/*df* = 2.76, *CFI* = .939, *TLI* = .925, *SRMR* = .052, *RMSEA* = .074. The factor loadings were all above .50 and significant (p<.001), as shown in Figure 2.
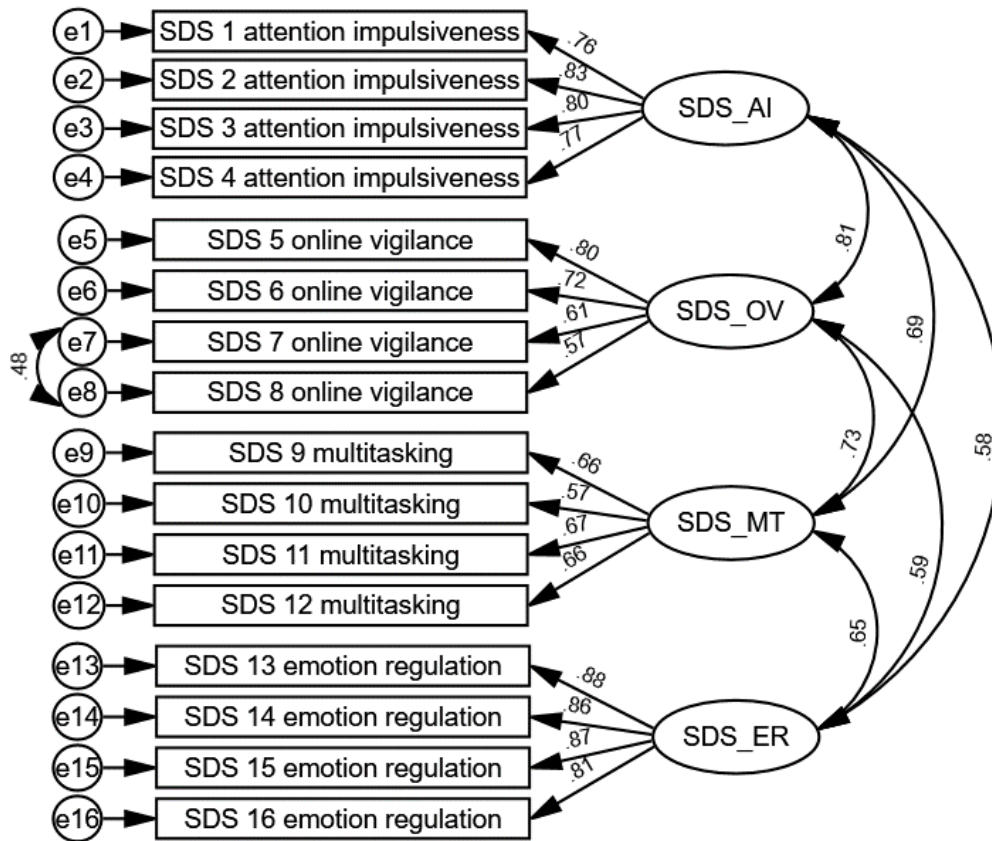
Figure 2. Confirmatory factor analysis for the SDS (*N*=320).

Path analysis

Path analysis was used to test the study hypotheses. As shown in Figure 3, the path

model fitted the data well with acceptable model fit indices, χ^2=19.61, *df*=12, p = .075,

χ^2/*df* =1.63, *CFI* =.995, *TLI* =.988, *SRMR* =.014, *RMSEA* =.045. In the model, SD

positively and significantly predicted PSU (γ=.71, *p*<.001) and stress (γ=.17, *p*<.05).

PSU positively and significantly predicted stress (γ=.28, p<.001), anxiety (γ=.30,

p<.001) and depression (γ=.33, p<.001). Several partial or full mediation relationships

were identified in the model. PSU partially mediated the relationship between SD and

stress with a significant indirect effect of .20 (*p*=.001). PSU fully mediated the

relationships between SD and anxiety (indirect effect = .21, *p*=.001) and depression
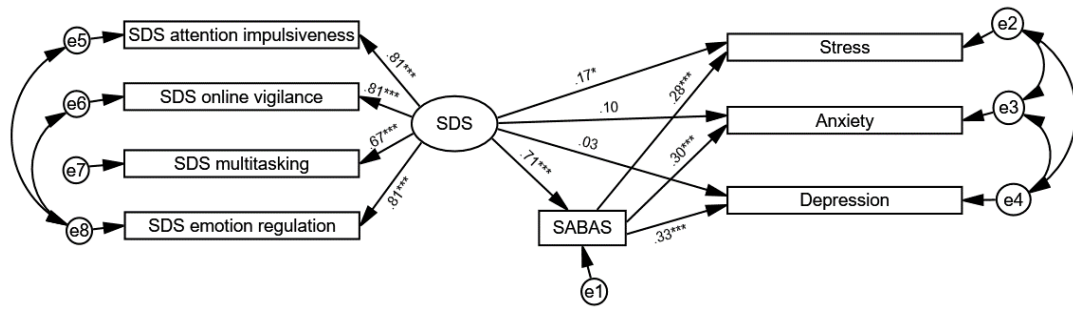
(indirect effect = .24, *p*=.001) respectively.

Figure 3. The path model for smartphone distraction, problematic smartphone use, stress, anxiety, and depression (*N*=320).

Note. * *p*<.05, *** *p*<.001

Discussion

Summary of the findings

The present study is one of very few studies to examine SD in China, which aimed to investigate the relationships between SD, PSU and mental health issues (stress, anxiety, and depression), and adopt the newly developed SDS in a Chinese context. This study results showed that SD was positively and significantly correlated with PSU, stress, anxiety, and depression. The path analysis model showed that SD significantly predicted PSU and stress, which support hypotheses 1 and 3a. PSU predicted stress, anxiety, and depression, which support hypotheses 2a, 2b, and 2c. SD did not significantly predict anxiety and depression in the model, which reject hypotheses 3b and 3c. PSU partially mediated the relationship between SD and stress, and fully mediated the relationships between SD and anxiety, and depression. Thus, the mediation hypotheses (4, 5 and 6) were supported. The four-factor measurement model of the translated Chinese version of the 16-item SDS was supported in the present study with good model fit in CFA.

Theoretical and practical implications

In line with previous studies (Oraison et al., 2019; Chu et al., 2021), the present study confirmed that SD was significantly correlated with self-reported mental health problems (i.e., stress, anxiety, and depression). However, in the path analysis model, SD only significantly predicted stress but not anxiety or depression. PSU fully mediated the paths from SD to anxiety and depression. The mediation effects indicate that individuals distracted by smartphones might be at higher risk of anxiety or depression

only when they become problematic users of smartphones or show addiction-like symptoms (as measured by the SABAS in the present study). In other words, SD does not necessarily predict mental health problems, unless individuals get involved in the smartphone distractions problematically or addictively.

The I-PACE model indicates that in the early stages of addictive behaviours, external and internal triggers can lead to gratification and positive effects, while in later stages compensatory effects become stronger than gratification and individuals are more likely to experience negative effects in life (Brand et al., 2019). In line with this, as the mediation effects identified in the current study, SD (the triggers) only predicted negative consequences when behaviours become addictive or problematic, namely in later stages as suggested by the I-PACE model. Therefore, the relationship between SD and mental health is influenced by the individual situation of smartphone users, whether in early stages or later stages of addictive behaviours, and whether they experience more gratifying or compensatory effects. It seems necessary for future studies to explore other variables (e.g., self-control or personality as discussed in the I-PACE model) which could mediate or moderate the relationship between SD and mental health issues.

Similar to Throuvala et al., (2021), the present study identified that the four-factor model of the SDS was acceptable and fitted the data well. In the Chinese context of the current study, SD also includes four dimensions including attention impulsiveness, online vigilance, multitasking and emotion regulation. It shows that the four-dimension 16-item SDS, which was developed based on robust theoretical frameworks (Throuvala

et al., 2021), is a reliable instrument for measuring smartphone distraction when adopted for use in a different culture. Given the importance of the construct of distraction in PSU studies (Yang et al., 2021), more studies are needed to test if the four-factor model of the SDS can be reliably used in different cultures.

Limitations and recommendations for future studies

There are several limitations of the present study. This study used self-reported questionnaires and only collected quantitative data. It is possible that the participants gave socially desirable answers and underestimated their levels of SD, PSU or mental health problems, though the reliability of the scales were good. However, it is important to note that self-report data is an important source when dealing with maladaptive behaviour of an individual (Montag et al., 2015). It is possible that the numbers of socially desirable answers from online and paper-based questionnaires were different though the participants' response were completely anonymous. More investigation and discussions are needed around the methodological issue associated with online and offline data collection. The present study only analysed the self-perceived scores which might be a limitation. Participants' narrative perceptions or comments on SD were not collected. It is therefore necessary for future studies to collect both quantitative and qualitative data to investigate SD from different perspectives. Interviews and diaries are the possible methods for further qualitative studies. The study sample consisted of college students, it is necessary for future studies to include individuals from different age groups or social backgrounds. Furthermore, future studies might also explore SD using experimental, longitudinal or cross-cultural designs. Since the present study only

proved the path from PSU to mental health issues in our model with good fit, more studies are needed to test the bi-directional relationship between PSU and mental health using longitudinal designs. Furthermore, for the educational policy makers in schools and universities, the present study indicates the risk of overpathologising PSU simply based on distractive behaviours on smartphones. SD does not necessarily mean mental health issues since the present study found that PSU fully mediated the pathways from SD to anxiety and depression. The present study findings contribute to the increasing smartphone research literature by revealing the role of SD and associations with PSU, and mental health issues. The findings will be of benefit to clinicians and mental health professionals involved in the development of PSU health programmes. For example, interventions on PSU or mental health issues could focus on dealing with the components of SD such as attention impulsiveness and emotion regulation.

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