Depression mediates the relationship of experiential avoidance and internet addiction: a cross-lagged mediation analysis

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Accepted: 7 March 2023

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Abstract

Previous research has identified the contemporaneous association between experiential avoidance, depression, and Internet addiction. However, the mechanisms underlying this association are not well acknowledged. The present study aimed to use cross-lagged panel modeling to examine whether depression mediates the relation between experiential avoidance and Internet addiction and whether gender plays a role in the relation. A total of 2731 participants (934 male, Mean_{ave}=18.03) were recruited from a university at the baseline study (December 2019). Data was collected at all 3 time points across one year (2019–2020), using 6-month intervals. Experiential avoidance, depression and Internet addiction were assessed using the Acceptance and Action Questionnaire-II (AAQ-II), the Beck Depression Inventory-II (BDI-II) questionnaire, and Young's Internet Addiction Test (IAT), respectively. Cross-lagged panel models were used to evaluate the longitudinal association and the mediating effect. Multigroup analyses were conducted to examine gender differences in the models. Cross-lagged models indicated that experiential avoidance significantly predicted subsequent depression, and depression significantly predicted subsequent Internet addiction. Furthermore, mediation analyses showed that depression has a mediating effect in the relation between experiential avoidance and Internet addiction ($\beta = 0.010, 95\%$ CI[0.003, 0.018], p > 0.001). Multigroup analyses demonstrated that the pattern of structural relations stayed consistent across gender. The findings indicated that experiential avoidance is indirectly related to Internet addiction through depression, suggesting that treatments targeted at reducing experiential avoidance could help relieve depression and thus decrease the risk of Internet addiction.

Keywords Experiential avoidance · Depression · Internet addiction · Cross-lagged mediation model

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Introduction

Over the past few decades, the Internet has developed into a practical platform for communication and pleasure. Despite the benefits it has brought to people, excessive and uncontrolled Internet use is linked to a psychiatric condition known as Internet addiction (IA). IA is also recognized as "compulsive Internet use", "Internet-related addictive behavior", "Internet-related problems", "problematic Internet use" and "pathological Internet use". We prefer to use the term "Internet addiction" since there are several notable parallels between IA and other behavioral addictions (Grant et al., 2013). IA refers to loss of control over Internet usage that would exerts negative impacts on daily life (Young, 1999). IA is particularly prevalent among university students in China. A meta-analysis revealed that the pooled overall prevalence of IA among Chinese university students was 11.3% (Li et al., 2018). Public health authorities have been concerned about the negative effects of IA, which include low quality of life, poor academic performance, poor sleep quality, and mental health problems (Fatehi et al., 2016; Karimy et al., 2020; Veisani et al., 2020). Therefore, it is important to investigate the factors associated with IA among university students.

Experiential avoidance (EA) has long been considered as a risk factor for IA (Chou et al., 2018; Faghani et al., 2020). Rooted in Acceptance and Commitment Therapy (ACT) theory, EA refers to a self-regulation strategy that entails efforts to control or avoid unpleasant or painful stimuli (such as body sensations, emotions, thoughts, and memories) (Hayes et al., 1996). This avoidance strategy may be temporarily adaptive, while it could be detrimental in the long term when it becomes a predominant strategy (Hayes et al., 1996). According to the Interaction of Person-Affect-Cognition-Execution (I-PACE) model, avoidance expectancies (e.g., to escape from reality) is considered as a cognitive bias that contributes to the development and maintenance of IA (Brand et al., 2019; Brand et al., 2016). Positive feedback will be received when a particular Internet application is frequently used and produces satisfying outcomes (e.g., escape from reality), which may increase the likelihood of using the application again (Brand et al., 2016, 2019). Besides, seeking relief from unpleasant or unwanted experiences is thought to be one of the most important aspects in the emergence and maintenance of addictive behaviors, as identified by the allostatic model of addiction (Baker et al., 2004; McCarthy et al., 2010). In addition, empirical research also recognized the critical role of EA in addictive behaviors, such as alcohol abuse (Levin et al., 2012), problematic gambling (Riley, 2014), substance use disorder (Elmquist et al., 2018), cannabis use (Buckner et al., 2014), and excessive use of video games (Kingston et al., 2010).

Studies also supported the association between EA and problematic Internet use (Faghani et al., 2020; Garcia-Oliva & Piqueras, 2016; Wetterneck et al., 2012). For example, Faghani and his colleague found that EA was strongly and positively related to IA in that the Internet may constitute an easy way to forget painful and unwanted feelings for individuals (Faghani et al., 2020). Taken together, it can be assumed that EA is a significant contributor of IA.

Another frequently researched variable related to IA is depression. Depression was considered as one of the main co-morbid conditions of Internet use disorders (Ho et al., 2014), and the I-PACE model also identified depression as an important underlying factor of IA (Brand et al., 2016, 2019). Bryant and Zillmann put forward the mood enhancement hypothesis (Brvant & Zillmann, 1984) and suggested that individuals who experience unpleasant emotions are more inclined to engage in leisure activities as a way to relieve stress, including surfing the Internet. In this case, individuals with depression seek to alleviate their emotional symptoms through Internet use, spending increasingly amount of time on entertainment and leisure activities such as video games and music. Besides, according to the problematic internet use theory (Caplan, 2003), individuals with psychosocial issues (e.g. depression) prefer online social engagement over face-to-face interaction because social networking would compensate for their social skill deficiencies. However, the preference for online social connection may result in compulsive engagement, which could eventually result in IA (Caplan, 2003). Increasing evidence also supported the essential role of depression in the development of IA (Ha et al., 2007; G. Li et al., 2019; Liang et al., 2016; Nie et al., 2017; Seki et al., 2019). For example, Li and his colleague revealed that depression increase the risk of IA in Chinese adolescent and suggested that adolescents were most likely to turn to the Internet to alleviate their internalizing problems such as depression (Li et al., 2019). The above literature suggested that depression may be a key risk factor leading to IA.

Regarding the relationship between the two risk factors of IA—EA and depression, preliminary evidence indicated that EA may contribute to depression. According to ACT theory, EA enables individuals to employ a variety of avoidant emotional regulation strategies (such as rumination and thought suppression) so that reducing the frequency, intensity, or duration of these unpleasant internal experiences (Hayes et al., 1996, 1999). Such an inflexible reaction to internal feelings maybe a harmful process (Zvolensky & Forsyth, 2002) and thus provoking more negative emotions and thoughts. In line with this perspective, previous findings demonstrated that emotional avoiders have a greater tendency to experience depression, especially when they were engaged in thought suppression (Wegner & Zanakos, 1994). As such, EA was suggested as a core vulnerability factor for emotional distress (Hayes et al., 1996). Positive associations between EA and depression were observed across a number of laboratory and correlational studies (Chawla, 2007; W. Mellick et al., 2017; W. H. Mellick et al., 2019). For example, Mellick found that EA could predict future depressive symptoms and this relationship may be unidirectional (Mellick et al., 2019). Evidence also revealed that ACT treatment, with the core goal of reducing EA levels, is beneficial in decreasing the depression level of participants (Bricker & Tollison, 2011). Furthermore, based on the self-medication hypothesis of addiction (Khantzian, 1997), individuals who struggle with addictive behaviors experience extreme emotional pain, and addictive behaviors may help relieve unpleasant feelings. Thus, it is reasonable to assume that individuals suffered from EA-induced depression may treat the Internet as a necessary tool for managing their stress and negative emotions. In other words, EA may contribute to IA through depression. Consistently, a cross-sectional study showed that mental health problems including depression mediate the relationship between EA and IA (Chou et al., 2017). In addition, several studies demonstrated that boys are relatively vulnerable to IA than girls (Fattore et al., 2014; Shan et al., 2021), indicating that the relationship between IA and depression may be affected by gender (Liang et al., 2016). Therefore, gender should also be considered as a potential factor influencing the association between EA, depression, and IA. In sum, these studies suggested depression to be an important mediator linking EA and IA, and gender may affect the relationship between them.

However, even though the association between EA, depression, and IA has been well documented in numerous cross-sectional studies, the interpretations regarding causal or mediational relationships between them are still unclear. Therefore, the controversial relationship and underlying mechanism of the relationship between EA, depression, and IA remains to be explored. Cross-lagged models allow for the exclusion of the autoregressive effects, and are often used to determine the causes and effects in investigation-based research (Schuurman et al., 2016). Thus, we aim to use cross-lagged panel models to explicate the mediating role of depression in the longitudinal relationships between EA and IA, and explore whether gender would change the relationship between them.

The objective of this three-wave longitudinal study was to determine the prospective association between IA, depression, and EA in Chinese university students. Based on the literature and the previous discussion, we hypothesized that EA influences IA through its effect on depression over time. Specifically, it is expected that EA would predict future depression, which would further predict future IA, and depression would mediate the relationship between EA and IA. Furthermore, gender may influence the association between variables. Identifying the mediating role of depression between EA and IA would provide guidance for early detection and prevention strategies of IA.

Method

Participants and procedure

Participants in the present study were recruited from a university in Hunan province, China. In the academic year 2019-2020, freshmen were invited to participate in the baseline survey (December 2019). All participants were informed of the study purpose and procedure, and provided informed consent. A total of 2731 Chinese students (934 male, Mean_{age}=18.03, Standard Deviation_{age}=0.751) agreed to participate and provided fully completed questionnaires at the first wave (Time 1, T1). The students participated in assessments at three-time points across one year (2019-2020), with six-month assessment intervals. A number of 1992 students (72.9% retention rate) completed the second wave (Time 2, T2) of data collection in June 2020, and 1296 students (65.1% retention rate) completed the third wave (Time 3, T3) of data collection in December 2020. Self-report questionnaires including items related to demographics, EA, depression, and IA were distributed to the students during a class break at Time 1 and Time 3 and were sent using a website at Time 2 since the students suspended classes due to the COVID-19 epidemic. The final sample included 1296 participants who completed assessments in all three waves, which comprised 31.1% male participants and 68.9% female participants, with age ranging from 16 to 22 years old (Mage=19.14, SDage=0.716) and education ranging from 11 to 15 years ($M_{education years} = 12.37$, $SD_{education vears} = 0.552 (1 missing data)). 42.8\%$ of the final participants was grown up in urban areas before the age of 12 and 57.2% of the final participants was grown up in rural areas before the age of 12 (62 missing data).

Measures

Internet addiction

IA was measured using Young's Internet Addiction Test (Young, 1998). The IAT contains 20 items (e.g., 'Do you think the time spent on the Internet is longer than you expected'), rated on a 5-point Likert scale ranging from 1 (rarely) to 5 (always). Higher total scores indicate a higher level of IA. The internal consistencies, measured by Cronbach's alpha (α), were 0.919 for T1, 0.953 for T2, and 0.945

for T3. Confirmatory factor analyses were performed to confirm the construct validity of the IAT. In addition to the one-factor model, a six-factor model proposed by Widyanto and his colleague (Widyanto & McMurran, 2004) was also evaluated. The models fit well at all time points, as indicated in Supplementary Tables 1, suggesting strong construct validity.

Experiential avoidance

Experiential avoidance was measured using the Acceptance and Action Questionnaire II (AAQ-II) (Bond et al., 2011; Zhang et al., 2014). The AAQ-II consists of 7 items (e.g., 'I am afraid of my feelings'), rated on a 7-point Likert scale ranging from 1 (never true) to 7 (always true), with higher scores indicating greater experiential avoidance. The AAQ-II has demonstrated adequate internal consistency and convergent and divergent validity (Bond et al., 2011). The internal consistencies, measured by Cronbach's alpha (α), were 0.904 for T1, 0.942 for T2, and 0.935 for T3. Confirmatory factor analysis was performed to confirm the construct validity of the AAQ-II. The one-factor model was evaluated (Cao et al., 2013), and the models fit well at all time points, as indicated in Supplementary Tables 1, suggesting strong construct validity.

Depression

Depression level was assessed using the Beck Depression Inventory-II (BDI-II) questionnaire (Beck et al., 1996; Yang et al., 2014). The BDI-II comprised 21 items, rated on a 4-point Likert scale, from 0 ("no symptoms") to 3 ("severe symptoms, can barely endure it"), with higher scores indicating a greater level of depression. The internal consistencies, measured by Cronbach's alpha (α), were 0.907 for T1, 0.928 for T2, and 0.932 for T3. Confirmatory factor analyses were performed to confirm the construct validity of the BDI-II. In addition to the one-factor model, a two-factor model was also evaluated (W. h. Yang et al., 2012). The models fit well at all time points, as indicated in Supplementary Tables 1, suggesting strong construct validity.

Statistical analysis

Descriptive statistics including means and standard deviations for continuous variables. The difference tests and correlation analyses of the main variables were performed using SPSS 26.0 software. A three-wave cross-lagged panel model design was employed for longitudinal mediation analysis (Cole & Maxwell, 2003; Little, 2013). Structural equation modeling was performed using Mplus 8.1 (Muthén & Muthén, 2017) with maximum likelihood estimation (ML). EA, depression, and IA were modeled as latent factors with their respective items serving as observed indicators. The significance level was set to 0.05 for all tests. Model fit was examined based on the Chi-Square Test (χ 2), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). CFI and TLI values of 0.90 or higher, and RMSEA and SRMR values of 0.08 or lower were considered an acceptable fit (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003).

As the first step of the longitudinal analysis, measurement invariance tests were conducted by assessing the configural, weak, and strong invariance to ensure that the same constructs were measured across time. The residuals of the corresponding indicators were correlated across waves. At least a partial strong invariance is needed to continue to the mediation test (Little et al., 2007). In the loading invariance test, changes (Δ) of < 0.010 in CFI and TLI, a change of < 0.015 in RMSEA, and a change of < 0.030 in SRMR indicate the invariance; in the intercept invariance test, changes (Δ) of < 0.010 in CFI and TLI, a change of < 0.015 in RMSEA, and a change of < 0.010 in SRMR indicate the invariance (Chen, 2007; Cheung & Rensvold, 2002). Next, the structural model was tested. The need for mediational paths or any other paths (e.g., reversed mediation paths, direct paths, and reversed direct paths) above and beyond the mediation was tested by evaluating whether the model fit was improved after adding the paths to the model (Little, 2013). The autoregressive paths and cross-lagged paths were constrained equally across waves in all models respectively. To begin the modeling process, a null model (Model 0) was set up that included only autoregressive paths and covariances between constructs within each wave. And the subsequent models are as follows, all of which contain the paths from Model 0, with additional paths: (i) a causal-mediation model (Model 1) where the hypothesized mediational crosslagged paths were entered into Model 0; (ii) a full-mediation model (Model 2) including the causal mediational paths and the reversed mediational cross-lagged paths; (iii) a directeffects model (Model 3) generated by adding the direct effects paths to the previous model; (iv) a reversed-directeffects model (Model 4) generated by adding the reversed effects path to Model 3. All models were presented in Fig. 1. If the difference in fit between these models is not significant, then a more parsimonious model would be favored. The bias-corrected (BC) bootstrapping with 5000 resamples was used to examine the mediation, and the bias-corrected 95% confidence intervals (CI) excluding zero indicate significant indirect effects (Preacher & Hayes, 2008).

Multigroup analyses were conducted to examine gender differences in the models. The fit of a model in which each path of interest was constrained to be equal between males



Fig. 1 Longitudinal mediation models of experiential avoidance (EA), depression (DEP) and Internet addiction (IA) across three time points *Note:* Model 0: stability model. Model 1: causal-mediation model.

Model 2: full-mediation model. Model 3: direct-effects model. Model 4: reversed-direct-effects model

and females was compared with the fit of an unconstrained model, in which these paths were freely estimated. A nonsignificant difference in the fit between the constrained and unconstrained models suggests that the path is variant across gender. Considering the city residence may have an effect on Internet addiction (Kuss et al., 2014), we also examined whether the models differed between the groups of residence before 12-age-old.

Results

Descriptive statistics

Independent samples *t*-tests showed gender differences in EA scores at all time points (p < 0.001). Depression level at T1 (p = 0.007), and IA level at T2 and T3 (T2: p = 0.037; T3:

p=0.01) indicated that gender should be taken into account in the next analyses. Table 1 presents the means, standard deviations, and correlations of the measures used. Regarding the main variables, EA, depression, and IA were significantly positively correlated with each other (*r* ranging from 0.221 to 0.638). This suggested that it was appropriate to perform the subsequent cross-lagged analysis.

Longitudinal measurement invariance tests

Firstly, measurement invariance tests were conducted. Goodness-of-fit statistics for measurement invariance model analyses are reported in Supplementary Table 2. The configural model for EA provided an adequate fit to the data, supporting the configural invariance over time. The weak invariance model (Δ CFI<0.010; Δ TLI<0.010; Δ RMSEA<0.015; Δ SRMR<0.030) and the partial

The set of												
Variables	М	SD	1	2	3	4	5	6	7	8		
1.Experiantial avoidance(T1)	20.36	7.72	-									
2.Experiantial avoidance(T2)	18.30	7.69	0.485**	-								
3.Experiantial avoidance(T3)	17.49	7.65	0.528**	0.569**	-							
4.Depression(T1)	5.89	6.78	0.638**	0.409**	0.431**	-						
5.Depression(T2)	2.52	5.06	0.324**	0.443**	0.337**	0.427**	-					
6.Depression(T3)	3.73	6.17	0.334**	0.375**	0.544**	0.447**	0.474**	-				
7.Internet addiction(T1)	44.74	14.44	0.490**	0.325**	0.347**	0.402**	0.239**	0.221**	-			
8.Internet addiction(T2)	43.29	15.27	0.379**	0.522**	0.408**	0.323**	0.317**	0.263**	0.544**	-		
9.Internet addiction(T3)	44.00	45.19	0.342**	0.378**	0.482**	0.304**	0.277**	0.305**	0.545**	0.609**		

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**p<0.01

strong invariance model ($\Delta CFI < 0.010$; $\Delta TLI < 0.010$; $\Delta RMSEA < 0.015$; $\Delta SRMR < 0.010$) did not compromise the model fit. The configural, weak, and strong invariance models all fit the data well for depression and IA as well. Taken together, the results provided evidence of longitudinal invariance for EA, depression, and IA, allowing a valid test of the study hypotheses in the following step (Little, 2013).

Longitudinal cross-lagged mediation analysis

A nested comparison approach was applied to compare the fit for each of the four models to select the most parsimonious (see Table 2). Model 0 produced adequate model fit in terms of CFI, TLI, and RMSEA, while the SRMR estimates were above recommended levels. All stability coefficients were significant (p < 0.001) with estimates ranging from 0.380 to 0.599. Model 1 had a better model fit than Model 0 (Δ CFI<0.010; Δ TLI<0.010; Δ RMSEA<0.015; Δ SRMR = 0.021). Next, the reversed mediation pathways were entered into Model 1, and the change in model fit from Model 2 to Model 1 was minimal ($\Delta CFI < 0.010$; $\Delta TLI < 0.010;$ $\Delta RMSEA < 0.015;$ Δ SRMR < 0.010). The Model 3 did not significantly improve the model $(\Delta CFI < 0.010; \Delta TLI < 0.010; \Delta RMSEA < 0.015;$ fits Δ SRMR < 0.010) compared to Model 1. Finally, Model 4 was calculated, and the results showed a slight improvement in model fit from Model 1 (Δ CFI<0.010; Δ TLI<0.010; $\Delta RMSEA < 0.015$; $\Delta SRMR = 0.014$), while there was no

significant change to Model 2 and Model 3. Moreover, compared to Model 1, Model 4 is much less parsimonious since the reversed causal mediation paths, the direct, and reversed direct paths were added. Therefore, the causal mediation model (Model 1) was chosen as our final model.

The results of this final model are presented in Fig. 2. EA positively predicted depression from T1 to T2 (estimate = 0.157, SE = 0.023, p < 0.001) and from T2 to T3 (estimate = 0.171, SE = 0.025, p < 0.001). Additionally, depression predicted an increase in IA from T1 to T2 (estimate = 0.092, SE = 0.019 p < 0.001) and from T2 to T3 (estimate = 0.082, SE = 0.017, p < 0.001). A significant indirect effect of EA (T1) on IA (T3) through depression (T2) was determined by bias-corrected bootstrapping ($\beta = 0.010, 95\%$ CI [0.003,0.018], *p*<0.001).

Multigroup analysis

Finally, we examined whether the relationships between EA, depression, and IA differed between males and females (see Supplementary Table 3). The fully unconstrained model provided good-to-acceptable fit to the data $(\chi^2/df = 2.97; CFI = 0.921; TLI = 0.919; RMSEA = 0.055;$ SRMR = 0.077). Building on this model, the cross-lagged paths were constrained to be equal across gender, and results suggested no significant change in model fit from the unconstrained model to the constrained model ($\Delta CFI < 0.001$; ΔTLI < 0.001; ΔRMSEA < 0.001; ΔSRMR < 0.001), indicating comparable cross-lagged associations across gender.

 Table 2
 Model fit indices and nested model comparisons

Model	Model fit indices					Model comparisons					
	$\chi^2(df)$	RMSEA	CFI	TLI	SRMR	Comparison	ΔRMSEA	ΔCFI	ΔTLI	ΔSRMR	
Model 0:	4353.899(933)	0.053	0.928	0.924	0.094						
Model 1	4286.684(931)	0.053	0.930	0.925	0.073	1 vs. 0	< 0.001	0.002	0.001	0.021	
Model 2	4265.233(929)	0.053	0.930	0.925	0.066	2 vs. 1	< 0.001	< 0.001	< 0.001	0.007	
Model 3	4256.935(928)	0.053	0.930	0.925	0.064	3 vs. 1	< 0.001	< 0.001	< 0.001	0.009	
Model 4	4233.002(927)	0.052	0.931	0.926	0.059	4 vs. 1	0.001	0.001	0.001	0.014	

Note: Model 0: stability model. Model 1: causal-mediation model. Model 2: full-mediation model. Model 3: direct-effects model. Model 4: reversed-direct-effects model. χ^2 = Chi-Square Test, df = Degrees of Freedom, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI=Tucker-Lewis Index, SRMR=Standardized Root Mean Square Residual.

Fig. 2 Final longitudinal mediation model of experiential avoidance (EA), depression (DEP) and Internet addiction (IA) across three time points *Note:* All path coefficients and significance levels are standardized. ***p < 0.001



We also examined whether the relationships between EA, depression, and IA differed from the groups of residence before 12-age-old and the results suggested no significant differences (Δ CFI < 0.001; Δ TLI < 0.001; Δ RMSEA < 0.001; Δ SRMR < 0.001; see Supplementary Table 4).

Discussion

The current study aims to examine the mediating role of depression in the prospective effect of experiential avoidance on Internet addiction using a longitudinal research design. The effect of gender was considered as well. The cross-lagged panel models using three-wave data over 12 months were established for statistical analysis. Results demonstrated that EA predicted subsequent depression, which led to subsequent IA. Mediation analysis showed that depression mediated the longitudinal contributions of EA to IA. Additionally, the pattern of structural relations held for both men and women. Taken together, these findings suggest that there was a depression-mediated pathway from EA to IA, providing a new perspective on the mechanism of IA, which further explaining the potential role of depression in the relationship between EA and IA.

The findings of our study indicated that EA predicted future depression. The result is coherent with previous studies that showed EA is associated with depression (Cribb et al., 2006; Mellick et al., 2017, 2019; Ruiz & Odriozola-Gonzalez, 2015; Spinhoven et al., 2014; Tull & Gratz, 2008; Tull et al., 2004). For example, a longitudinal study indicated that EA may have a causal effect on the further course of depression (Spinhoven et al., 2014). Our finding is also consistent with ACT theory that the resistance to distress may lead to the individual failing to adapt to situational demands, and thus result in greater experiences of depression (Hayes et al., 2006). Research also supported that maladaptive responses to negative moods, such as EA, often maintain the negative moods and are linked to long-term depression (Barnhofer et al., 2014). Furthermore, rumination, as one of the critical symptoms and prognostic factors of depression, may induce emotional avoidance and plays a role in the relationship between EA and depression (Cribb et al., 2006). Other researchers also proposed that rumination and EA are parts of the same psychological model or maladaptive processing pattern in depression (Williams et al., 2008), which might also explain the reason for this result.

Results also showed that university students who experienced higher level of depression are more likely to exhibit IA behaviors in the future, which is in line with many psychological models and hypotheses such as the I-PACE model (Brand et al., 2016, 2019) and the problematic Internet use theory (Caplan, 2003). The mood enhancement hypothesis also proposed that individuals with negative emotions are more likely to seek recreational activities to ease stress (Bryant & Zillmann, 1984). Furthermore, according to Kardefelt-Winter's Compensatory Internet Use model, the Internet may function as an approach to deal with struggles in life and negative emotions, and therefore resulting in the problematic use of the Internet (Kardefelt-Winther, 2014). In addition, our results are also consistent with several past studies, suggesting that depression would increase the risk of IA (Ha et al., 2007; Seki et al., 2019; Tian et al., 2021). A possible explanation is that university students with depression use the internet as a tool or platform to escape from everyday life. If their psychological issues are not properly addressed, they may spend a large amount of time on the Internet to alleviate their unpleasant emotional symptoms, leading to IA eventually.

Our study demonstrated that depression would mediate the longitudinal relationship between EA and IA, which was consistent with the self-medication hypothesis of addiction (Khantzian, 1997) and a previous cross-sectional research which suggested that EA may be indirectly associated with IA through mental health problems including depression (Chou et al., 2017). The mediating role of depression in the development of IA was also found in other studies. For example, an earlier study found that depression mediates the relationship between rumination and IA (Bagatarhan & Siyez, 2022). Another study indicated the mediating role of depression between the association of negative life events and IA (Zhao et al., 2017). This may be explained by that the fixed EA pattern would further lead to negative emotional states including depression, and the Internet may be a more accessible way to get rid of painful and unwanted feelings for individuals experiencing depression. Namely, EA could lead to IA through depression.

Results suggested that this model remains consistent in both male and female groups. While we did find significant differences between males and females in their average levels of EA at all three-time points, depression at T1, as well as IA at T2 and T3. The SEM analyses demonstrated that males and females did not differ in the structural relationships between EA, depression, and IA. Although some studies found that depression in female adolescents is more common than in male adolescents among excessive Internet users (Hoare et al., 2017), the current results demonstrated that the mediating role of depression in the EA-IA link did not vary by gender. On the other hand, results showed that the residence type before the age of 12 did not influence the longitudinal association between EA, depression and IA.

Our study may suggest several clinical implications. For instance, university students with Internet addiction may benefit from interventions aimed at decreasing experiential avoidance and depression. Relatedly, ACT, one of the third wave of cognitive behavioral therapies could be efficacious (Hayes et al., 1999) could be efficacious in treating IA. ACT uses strategies of acceptance and mindfulness to change behaviors and values through diversifying individuals' behavioral responses to unpleasant experiences (e.g., feelings, physical sensations, thoughts), and thus decreases the reliance on EA (Hayes et al., 2006). Evidence supported that ACT treatment can improve experiential avoidance over time (Zakiei et al., 2021). Besides, ACT was considered to be a potentially beneficial treatment for depression in adolescents (Hacker et al., 2016). It was also found that ACT demonstrated efficacy in the treatment of problematic Internet pornography use (Twohig & Crosby, 2010). Therefore, using ACT as an intervention for EA may reduce the level of depression and subsequently decrease the level of IA. Additionally, it is recommended to incorporate an assessment of depression and EA when treating people with IA.

Overall, the current study exemplified several strengths. First of all, most previous research that examined the association between EA, depression, and IA is cross-sectional, while the present study employed a longitudinal and multiwave design among a large sample of Chinese university students to determine the longitudinal association among these variables and the mediating role of depression. As suggested in the methodological literature, only longitudinal analyses, but not cross-sectional analyses, provide valid insights into the temporal sequence of predictor, mediator, and outcome (Cole & Maxwell, 2003; Maxwell & Cole, 2007; Selig & Preacher, 2009). Moreover, the present study adds to the existing literature by revealing the longitudinal associations between EA, depression, and IA remain consistent across genders. Collectively, the findings shed light on the important role of depression in the longitudinal association between EA and IA. However, some limitations of this study should also be addressed. First, this research focused only on the general concept of IA instead of focusing on a specific online behavior. Therefore, future research is warranted to investigate the role of variables in this research in different types of Internet applications. Second, the present study included only self-report measures, which are known to be affected by various response biases. Although the selfreport measures chosen for this study are reliable and wellvalidated measures of the constructs, future studies could opt for multimethod approaches that further increase the reliability and validity of our findings.

Conclusion

This study is among the first to examine the prospective relationship between EA, depression, and IA using a three-wave cross-lagged panel design with a large sample of university students. The findings showed that EA predicted subsequent depression, which predicted subsequent IA, and the association between EA and IA was mediated by depression. Furthermore, the relationship of the constructs was not affected by gender. This study revealed the underlying mechanism of IA, and further explained the potential role of depression in the effect of EA on IA. Treatments aimed at reducing EA could help alleviate depression and thus decrease the risk of IA among university students.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-023-04511-6.

Acknowledgements We are grateful for the generosity of time and effort by all the participants, and all colleagues who participated in the data collection. The completion of this project is inseparable from everyone's efforts. We would like to express our thankful to Ms. Tamini Soondrum for editing the language of this article.

Author Contribution Yanyuan Cao: Data curation, Formal analysis, Writing - original draft. Qian Liu: Data curation, Writing - review & editing. Quanhao Yu: Data curation, Writing - review & editing. Jie Fan: Writing - review & editing of the revision. Xiang Wang: Data curation, Writing - review & editing of the original draft. Rui Yao: Data curation. Xiongzhao Zhu: Conceptualization, Supervision.

Funding This work was supported by grants from the Fundamental Research Funds for the Central Universities of Central South Uni-

versity (Quanhao Yu, grant number 2022zzts0274), and the National Natural Science Foundation of China (Xiongzhao Zhu, grant number 82171532).

Data Availability The data that support the findings of the study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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