Computers in Human Behavior 145 (2023) 107751

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Depression and social anxiety in relation to problematic TikTok use severity: The mediating role of boredom proneness and distress intolerance

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ARTICLE INFO

Handling Editor: Bjorn de Koning

Keywords:
Psychopathology
Problematic TikTok use
Boredom proneness
Distress intolerance

ABSTRACT

With a rapid rise in TikTok use, problematic TikTok use has become a contemporary concern. However, little is known about how problematic TikTok use develops. The current study examined two important cognitive and emotional processes (i.e., boredom proneness and distress intolerance) through which depression and social anxiety may contribute to problematic TikTok use. We recruited 822 regular TikTok users from China through an online survey service provider and assessed their levels of depression, social anxiety, boredom proneness, distress intolerance, and problematic TikTok use severity on two assessment occasions with a two-month interval. Using structural equation modeling, we examined the associations between depression and social anxiety (time 1 predictors) with problematic TikTok use severity (time 2 dependent variable) through boredom proneness and distress intolerance (time 1 mediators). Results revealed a significant mediating effect of distress intolerance, whereas boredom proneness played no significant mediating role. These findings suggest that the perceived inability to withstand distress may contribute to the development of problematic TikTok use, and may explain relations between psychopathology symptoms and problematic TikTok use.

1. Introduction

TikTok (with the Chinese sister app: 抖音短视频, Pinyin: Dǒuyīn duǎnshìpín) is a video platform that originated in China and has been widely used across the world (Montag, Yang, & Elhai, 2021). The number of TikTok users has grown exponentially since the release of TikTok in 2016. There were more than 550 million monthly active TikTok users as of February 2021 in China[1] and more than a billion monthly active users as of March 2022 worldwide.[2] TikTok allows users to watch, share, comment on, and create short-form videos and live streams, satisfying their needs for recreation, socialization, and information seeking (Bucknell Bossen & Kottasz, 2020; Omar & Dequan, 2020; Yang & Ha, 2021). In addition, TikTok learns about users' content preferences and customizes users' home feeds automatically, serving to enhance users' attention to TikTok (Bhandari & Bimo, 2022). Further, personalization of one's feed due to their TikTok use history activates diverse brain areas, which has been the focus of a recent fMRI study (Su et al., 2021).

1.1. Problematic TikTok use

With the rapid rise in TikTok use, concern has emerged about problematic TikTok use. Problematic TikTok use could be regarded as a specific form of general problematic social media use (PSMU), which involves addiction-like symptoms, such as loss of control over social media use, psychological withdrawal without access to social media, craving for use, and usage despite consequent disturbance in daily life (Smith & Short, 2022). PSMU is associated with a range of mental health

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[1] http://www.cnnic.cn/NMediaFile/old_attach/P020220721404263787858.pdf (accessed Nov 23, 2022).
[2] https://www.omnicoreagency.com/tiktok-statistics/(accessed Nov 23, 2022).

https://doi.org/10.1016/j.chb.2023.107751
Received 15 December 2022; Received in revised form 15 March 2023; Accepted 17 March 2023
Available online 21 March 2023

problems, such as depression, (social) anxiety, general psychological distress, ADHD symptoms, and sleep problems (Bozzola et al., 2022; Huang, 2022; Hussain & Starcevic, 2020; Marino, Gini, Vieno, & Spada, 2018). Previous studies have indicated that the motive of "escaping from negative emotions" was a significant predictor of PSMU severity (Brailovskaia, Schillack, & Margraf, 2020). During the COVID-19 pandemic, PSMU was found associated with anxiety and burden caused by the pandemic situation (Brailovskaia, Cosci, Mansueto, & Margraf, 2021, 2022). Out of these problems, depression and (social) anxiety were most associated with PSMU (Huang, 2022; Hussain & Griffiths, 2018; for an overview on Chinese literature see Hussain, Wegmann, Yang, & Montag, 2020). The question arises regarding whether literature on PSMU can be transferred understanding problematic TikTok use, because social media platforms differ in their design (for theoretical background on design elements see Montag, Lachmann, Herrlich, & Zweig, 2019), potentially attract different user groups (Marengo, Sindermann, Elhai, & Montag, 2020), and also elicit different levels of addictive potential (Rozgonjuk, Sindermann, Elhai, & Montag, 2021). Hence, such links need to be established in studies focusing exclusively on TikTok.

Overall, the literature on problematic TikTok use is still scarce. What do we know at the moment? Although TikTok has the potential to be used excessively (Cleofas, 2022; Marengo, Angelo Fabris, Longobardi, & Settanni, 2022; Wang, Zhao, Zhang, Chen, & Chang, 2021), TikTok itself is not inherently good or bad. Rather, how and why people use TikTok, as well as who uses it, can influence whether TikTok use becomes problematic (Montag et al., 2021). Risk factors for problematic TikTok use have included being female, younger, having lower income, and being less educated (Huang, Hu, & Chen, 2022; Lewin, Ellithorpe, & Meshi, 2022). Additionally, individuals who spent more time on short-form video platforms, had greater stress levels, valued immediate rather than delayed rewards, or engaged in greater social comparison, tended to have a greater risk for problematic use (Huang et al., 2022; Lewin et al., 2022; Wang et al., 2021). These existing studies undoubtedly advance our understanding of risk factors of problematic TikTok use. However, more research is needed to elucidate mechanisms underlying problematic TikTok use.

1.2. The Interaction of Person-Affect-Cognition-Execution model

The current study focused on how problematic TikTok use develops by examining psychopathology risk factors, as well as cognitive and emotional processes underlying the association between psychopathology and such problematic use. It was posited that a process or mechanistic perspective is critical for investigating how PSMU develops (Kross et al., 2021). Different process models of PSMU provided us with a theoretical basis to investigate psychological mechanisms underlying problematic TikTok use (Brand, Young, Laier, Wölfling, & Potenza, 2016, 2019; Elhai, Yang, & Montag, 2019; Kardefelt-Winther, 2014). Among these models, the Interaction of Person-Affect-Cognition-Execution (I-PACE) model is a comprehensive theoretical model, and is most relevant in understanding the development of problematic TikTok use (Brand et al., 2016, 2019).

I-PACE posits that certain personal factors confer vulnerability to the development of PSMU (Brand et al., 2016, 2019). Psychopathology is an important personal factor that is closely related to PSMU and is presented in the realm of a Person variable (P-variable), where – for instance – history of or current depression might make persons more vulnerable to develop problematic online use patterns. Meanwhile, affective and cognitive responses to external or internal stimuli play an important role in linking personal factors to PSMU (Brand et al., 2016, 2019). Urge for mood regulation is one of the affective and cognitive processes that can act as a mediator between personal factors and PSMU. I-PACE suggests that individuals who lack effective self-regulatory strategies would experience an urge for mood regulation when faced with negative emotion. This urge then leads to the decision of using the internet to cope with negative affect and the consequent overreliance on the internet as a way of coping, resulting in PSMU.

1.3. Psychopathology, boredom proneness, and distress intolerance in relation to PSMU

Depression and social anxiety are among the most prominent psychopathological risk factors that increase the severity of PSMU (Brand et al., 2016, 2019; Huang, 2022; Hussain & Griffiths, 2018; Marino et al., 2018). Boredom proneness and distress intolerance fit as affective and cognitive components in I-PACE, as they are associated with poor self-regulation and contribute to the urge for mood regulation (Elhai et al., 2019). According to I-PACE, boredom proneness and distress intolerance may mediate associations between both depression and social anxiety with PSMU.

Specifically, boredom proneness is defined as a tendency to experience boredom, reflecting an inability to regulate attention and to engage in meaningful activities (Struk, Scholer, & Danckert, 2016, 2017). Depression and social anxiety are associated with deficits in attention regulation (e.g., attention bias to negative information, and increased self-focused attention; LeMoult & Gotlib, 2019; Schultz & Heimberg, 2008). This may prevent individuals from allocating and maintaining attention to activities that could effectively satisfy their needs, thereby increasing their proneness to experiencing boredom (Struk et al., 2016). Unable to have their needs met in an effective manner, individuals with high boredom proneness are motivated to seek stimulation and are more likely to use the internet as a rapid means to avoid or alleviate boredom (Elhai et al., 2019; Wegmann, Ostendorf, & Brand, 2018).

Meanwhile, distress intolerance is the perceived inability to withstand distressful feelings (McHugh & Otto, 2011). Depression and social anxiety are associated with impaired emotion processing, such as low tolerance for negative emotions (Dryman & Heimberg, 2018). The inability to tolerate negative emotions increases a tendency to avoid experiential distress and may lead to maladaptive coping behaviors (Simons & Gaher, 2005; Zvolensky, Vujanovic, Bernstein, & Leyro, 2010). As such, individuals with high distress intolerance are more likely to cope with negative feelings using the internet and, consequently, use the internet excessively (Elhai et al., 2019).

Empirical evidence provides support for the proposal that boredom proneness and distress intolerance are important cognitive and emotional processes underlying the association between depression/social anxiety with PSMU. First, depression and (social) anxiety are associated with higher levels of boredom proneness (Elhai, Rozgonjuk, Alghraibeh, & Yang, 2021; Struk, Carriere, Cheyne, & Danckert, 2017) and distress intolerance (Laposa, Collimore, Hawley, & Rector, 2015; McHugh & Otto, 2011). Second, boredom proneness increased the severity of problematic internet use in general (Skues, Williams, Oldmeadow, & Wise, 2016), problematic use of online communication applications, including social networking sites, blogs, and messengers (Wegmann et al., 2018), and problematic smartphone use (Wang, Yang, Montag, & Elhai, 2022; Wolniewicz, Rozgonjuk, & Elhai, 2020). Research has also found that using social media to alleviate boredom increases the severity of problematic use (Stockdale & Coyne, 2020). Similarly, distress intolerance predicted a failure to control recreational internet use time (Yamada, Moshier, & Otto, 2016), greater problematic internet use (Akbari, 2017) and problematic smartphone use severity (Elhai, Levine, O'Brien, & Armour, 2018). Relatedly, the inability to regulate negative emotions related to disordered use of internet or social media platforms (Faghani, Akbari, Hasani, & Marino, 2020; Hussain, Wegmann, & Griffiths, 2021; Marino, Gini, Angelini, Vieno, & Spada, 2020). Finally, research shows that boredom proneness (Elhai, Vasquez, Lustgarten, Levine, & Hall, 2018; Wang et al., 2022) and distress tolerance (Elhai, Levine, et al., 2018) mediated the relationship between psychopathology factors (e.g., depression, anxiety) and problematic smartphone use severity. In addition, psychopathology increases the expectation of using internet to avoid negative emotions, which in turn increases the severity of problematic use of online communication

applications (Wegmann & Brand, 2016; Wegmann, Oberst, Stodt, & Brand, 2017).

1.4. The present study

Based on I-PACE and supporting empirical evidence, the current study investigated paths through which depression and social anxiety exerted effects on problematic TikTok use severity, focusing on the mediating roles of boredom proneness and distress intolerance. To our knowledge, few studies to date have examined the relationship between psychopathology and problematic TikTok use along with cognitive and emotional processes explaining their association. This study contributes to the existing literature by adopting a process or mechanistic perspective and examining mechanisms of problematic TikTok use based on I-PACE theory (Brand et al., 2016, 2019; Elhai et al., 2019). We recruited a sample of regular TikTok users through an online survey service provider and included two assessment occasions at a two-month interval. Participants' depression and social anxiety symptoms, boredom proneness, and distress intolerance at time 1 were used as predictors of the severity of problematic TikTok use at time 2. We developed the following hypotheses based on the results of previous studies:

Hypothesis 1. *(H1)*. Depression and social anxiety would be associated with higher levels of boredom proneness and distress intolerance (Fig. 1, path A; Elhai et al., 2021; Laposa et al., 2015; McHugh & Otto, 2011; Struk et al., 2017).

Hypothesis 2. *(H2)*. Boredom proneness and distress intolerance would lead to more severe problematic TikTok use (Fig. 1, path B; Akbari, 2017; Wegmann et al., 2018; Wolniewicz et al., 2020; Yamada et al., 2016).

Hypothesis 3. *(H3)*. Boredom proneness and distress intolerance would mediate the relationship between depression/social anxiety and problematic TikTok use severity (Fig. 1, the product of A and B; Elhai, Levine, et al., 2018; Elhai, Vasquez, et al., 2018; Wang et al., 2022).

2. Material and methods

2.1. Participants

We recruited participants through Credamo (https://www.credamo.com). Credamo is an online survey service provider in China and has similar functions to Amazon's Mechanical Turk. Credamo has an online research participant sample of 2.8 million participants. These participants are mainly from the following sources[3]: 1) customers in grocery stores and shopping malls; 2) participants recruited by Credamo for offline surveys; 3) registered users from colleges, universities, and companies. Credamo's online research sample includes participants from different regions of China and of different ages, education levels, and economic status.[4]

We used three questions to screen for regular TikTok users and tested 2500 participants from the Credamo online research sample. Regular TikTok users were defined as individuals whose most used short-form video platform is TikTok,[5] have a TikTok account, and use TikTok at least several times a week. 1428 individuals met these criteria and were invited to participate in the current study. We delivered a battery of online questionnaires (Chinese versions) assessing TikTok use behaviors and related psychological constructs. Of the 1428 individuals, 829 (58.1%) adult users responded at time 1. After a two-month interval, the same battery of questionnaires was delivered to these 829 participants, and 722 of them (87.1% of the baseline sample) responded at time 2.

To ensure data quality, the participant was only allowed to answer questionnaires once at each assessment occasion. In addition, we included three attention check questions (e.g., "choose the third option") in our questionnaires at each assessment. Participants needed to answer all attention check questions correctly to be included in data analysis. All except 7 participants met this criterion. Thus, a sample of 822 participants at time 1 and 715 at time 2 were used for the data analysis.[6] An informed consent statement was provided to participants before showing them the screening questions and questionnaires. Only participants who agreed to participate after reading the informed consent statement could answer the screening questions and questionnaires. The current study was approved by the local ethics committee of a university in Beijing, China. We performed a Monte Carlo power analysis in Mplus (Muthén & Muthén, 2002, 2017) for a path analysis with five continuous variables (2 predictors, 2 mediators, and 1 outcome). Assuming a small to medium effect between variables, a sample size of 250 is needed for power of 0.80 to detect the indirect effects. By adding 50% of missingness in the outcome variable, a sample size of 450 is needed for power of 0.81–0.82 to detect the indirect effects. Given that there were several stages of data collection that involved attrition, we collected as much data as possible in the first stage.

At time 1, participants had a mean age of 27.50 (5.93) ranging from 18 to 56.[7] There were 537 females, constituting 65.3% of the current sample. 699 (85.0%) participants had a bachelor's degree. Participants who dropped out, as compared to those who remained, were younger (remained: M(SD) = 27.92 (6.01); dropped out: M(SD) = 24.75 (4.47); $d = 0.60$; $p < 0.001$) and had higher levels of depression (remained: M (SD) = 0.64 (0.46); dropped out: M(SD) = 0.75 (0.46); $d = 0.24$; $p = 0.02$), anxiety (remained: M(SD) = 2.02 (0.79); dropped out: M(SD) = 2.19 (0.80); $d = 0.21$; $p = 0.04$), and boredom proneness (remained: M (SD) = 3.16 (1.31); dropped out: M(SD) = 3.47 (1.23); $d = 0.24$; $p = 0.02$) at baseline; these effects were small in magnitude.

2.2. Measures

Chinese versions of the following questionnaires were used in the current study.

2.2.1. Depression

The Patient Health Questionnaire-9 (PHQ-9; Kroenke, Spitzer, & Williams, 2001; Chinese version: Bian, He, Qian, Wu, & Li, 2009) was used to measure severity of depression. Participants indicated how frequently they experienced symptoms over the last 2 weeks on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day). The PHQ-9 contains 9 items and exhibits good reliability and validity (Bian et al., 2009; Kroenke et al., 2001). The PHQ-9 had adequate reliability in the current sample: Time 1, $\alpha = 0.84$, $\omega = 0.84$; Time 2, $\alpha = 0.83$, $\omega = 0.84$.[8]

2.2.2. Social anxiety

The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998; Chinese version: Ye, Qian, Liu, & Chen, 2007) was used as a measure of social anxiety. Participants indicated the degree to which a statement about social fears was characteristic of them on a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely). Given that the reverse-scored items may primarily reflect extraversion (Rodebaugh,

[3] https://help.credamo.com/web/#/4?page_id=215 (accessed Nov 23, 2022).

[4] https://www.credamo.com/ (accessed Nov 23, 2022).

[5] Users whose most-used video platform was the Huoshan version or Jisu version of TikTok were not included. Both the Huoshan and Jisu versions of TikTok involve monetary rewards to engage users and are not considered in the current study.

[6] The pattern of results did not change when participants who failed the attention check were included.

[7] Two participants did not provide a valid report of their age.

[8] Items of each scale were treated as ordinal when calculating coefficient omega.

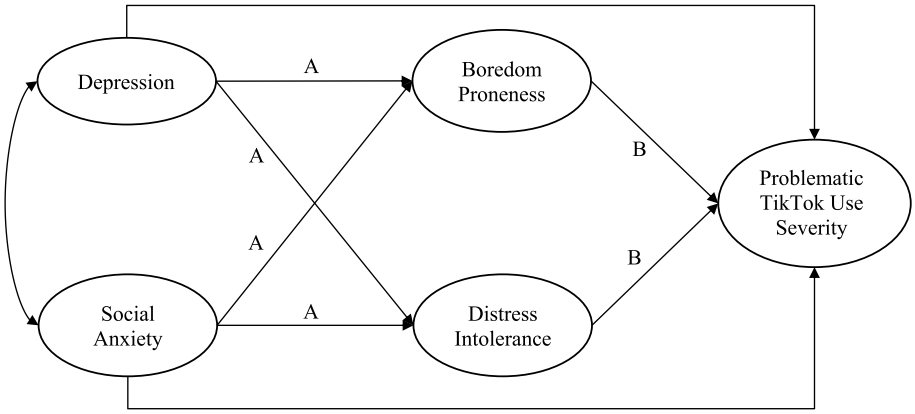

Fig. 1. Hypothesized Model
Note. Path A represents hypothesis 1; path B represents hypothesis 2; the product of path A and path B represents hypothesis 3.

Woods, & Heimberg, 2007), only the 17 straightforwardly worded items were used for data analysis. The 17-item SIAS has adequate psychometric properties (Rodebaugh et al., 2007). In the current sample, the 17-item SIAS showed good reliability: Time 1, $\alpha = 0.95$, $\omega = 0.96$; Time 2, $\alpha = 0.95$, $\omega = 0.96$.

2.2.3. Boredom proneness

The short version of the Boredom Proneness Scale (SBPS; Struk et al., 2017; Chinese version: Peng et al., 2019) with a total of 8 items was used to measure the tendency to experience boredom. Each item was rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The SBPS has good reliability and validity (Peng et al., 2019; Struk et al., 2017). In the current sample, the SBPS had a Cronbach's alpha value of 0.92 and an omega value of 0.92 at both time points.

2.2.4. Distress intolerance

The Distress Intolerance Scale (DIS; McHugh & Otto, 2012) was used to measure the perceived inability to tolerate distressing emotions. The DIS contains 10 items and has good reliability and validity (Keller et al., 2019; McHugh & Otto, 2011). Each item was rated on a 5-point Likert scale ranging from 1 (very little) to 5 (very much). The English version of the DIS was translated into Chinese through the following procedure. First, the English version was translated into Chinese by two bilingual researchers independently. Second, the two translators and several graduate students compared the translations, resolved inconsistencies, and selected the best translation. Third, the translation was back-translated into English by another researcher. Finally, the original English version and back-translated version were compared and checked for consistency (see Supplementary Materials Table S1 for the Chinese translation). The DIS had Cronbach's alpha values of 0.90 and 0.91 at time 1 and time 2, and omega values of 0.93 and 0.94 at time 1 and time 2, respectively, and a two-month test-retest reliability of 0.76 ($p < 0.001$) in the current sample.

2.2.5. TikTok use

Participants indicated their daily TikTok use time (1 = less than or equal to 10min, 2 = 11–20min, 3 = 21–30min, 4 = 31–60min, 5 = 1–1.5 h, 6 = 1.5–2 h, 7 = 2–3 h, 8 = 3–4 h, 9 = 4–5 h, 10 = more than 5 h). In addition, their use frequency of various TikTok functions (i.e., watch short-form videos, make short-form videos, watch live streams, host live streams) was assessed on a 5-point scale ranging from 1 (never) to 5 (very often).

2.2.6. Problematic TikTok use

The Smartphone Addiction Scale-Short Version (SAS-SV; Kwon, Kim, Cho, & Yang, 2013; Chinese version: Chen et al., 2017) was adapted and used to measure problematic TikTok use by substituting the word "smartphone" with "TikTok". The SAS-SV has been adapted to measure problematic use of different social media platforms (e.g., Facebook; Rozgonjuk et al., 2021). The SAS-SV contains 10 items and shows good reliability and validity (Chen et al., 2017; Kwon et al., 2013). Each item was rated on a 6-point scale ranging from 1 (strongly disagree) to 6 (strongly agree). In the current sample, the adapted SAS-SV had adequate reliabitliy: Time 1, $\alpha = 0.88$, $\omega = 0.99$; Time 2, $\alpha = 0.89$, $\omega = 0.99$.

2.3. Statistical analysis

We used structural equation modeling to examine cognitive and emotional processes through which psychopathological symptoms led to increased problematic TikTok use. Latent variables of depression and social anxiety at time 1 were predictor variables, while latent variables of boredom proneness and distress intolerance at time 1 were treated as mediators. A latent variable of problematic TikTok use severity at time 2 was used as the dependent variable (Fig. 1).

We treated responses to the questionnaires as ordinal and used the WLSMV estimator. Therefore, a polychoric covariance matrix was analyzed, probit path coefficients and factor loadings were produced, and a robust chi-square test was used. For the estimation of indirect effects, we included 5000 bootstrap draws and estimated bias-corrected bootstrap standard errors and 95% confidence intervals (CIs). Some items of the PHQ-9, SIAS, SBPS, and DIS had fewer than ten observations in the highest category of response, raising the possibility of incomplete bootstrap draws due to a failure to have any observations in the highest category. Therefore, we collapsed the highest two categories for these items. The pattern of results did not change without combining categories. All available data were used for analysis with a pairwise present approach to handling missingness (Muthén & Muthén, 1998-2017). We had the same pattern of results using only the complete data. Mplus 8.7 was used for structural equation modeling. Data and code of the current study are available on zenodo.org at https://doi.org/10.5281/zenodo.7726855.

3. Results

3.1. Preliminary results

Descriptive statistics of the study variables and their correlations are presented in Table 1 and Table 2[9] The level of distress intolerance was significantly higher at time 1 than at time 2. The other variables showed

[9] Descriptive statistics of the variables and their correlations for male and female participants are presented in the supplementray materials, Table S4.

Table 1
Descriptive statistics for study variables at time 1 and time 2.

	Mean			SD			Paired-sample *t*-test		
	Time 1 (N = 822)	Time 1 (N = 715)	Time 2 (N = 715)	Time 1 (N = 822)	Time 1 (N = 715)	Time 2 (N = 715)	t values	p values	Cohen's d
Depression	0.65	0.64	0.63	0.46	0.46	0.45	0.61	0.54	0.02
Anxiety	2.04	2.02	2.05	0.79	0.79	0.81	−1.68	0.09	−0.04
BP	3.20	3.16	3.17	1.31	1.31	1.33	−0.22	0.83	−0.01
DI	2.82	2.80	2.66	0.79	0.80	0.81	6.71	0.00	0.17
PTU	3.21	3.22	3.17	0.95	0.94	1.02	1.67	0.09	0.05

Note. We reported two sets of means and standard deviations (SDs) for all study variables assessed at time 1. One set of means and SDs was calculated using the full sample (Time 1, N = 822), and the other set was calculated excluding those who dropped out at time 2 (Time 1, N = 715). Paired-sample t-tests were performed using the complete data (N = 715). BP = Boredom Proneness, DI = Distress Intolerance, PTU = Problematic TikTok Use Severity.

Table 2
Correlation pattern of the study variables used for sturctural modelling and potential covariates.

	N	1	2	3	4	5	6	7	8	9	10	11	12
1 Age	820												
2 Sex	822	−.23**											
3 Education	822	−.03	.01										
4 UseTime (T1)	822	.07	−.01	−.14**									
5 WatchSV (T1)	822	−.02	−.03	−.09*	.32**								
6 MakeSV (T1)	822	.21**	.05	−.05	.25**	.11**							
7 WatchLS (T1)	822	.26**	.02	−.02	.31**	.17**	.39**						
8 MakeLS (T1)	822	.26**	−.06	−.05	.19**	.00	.50**	.40**					
9 Dep (T1)	822	−.25**	.14**	−.02	.02	.04	−.19**	−.18**	−.18**				
10 SA (T1)	822	−.36**	.13**	.01	.02	.04	−.23**	−.15**	−.23**	.64**			
11 BP (T1)	822	−.35**	.11**	−.02	.01	.02	−.26**	−.24**	−.29**	.65**	.69**		
12 DIT (T1)	822	−.30**	.07*	−.01	−.06	.01	−.20**	−.19**	−.29**	.52**	.63**	.61**	
13 PTU (T2)	715	−.10**	.05	−.10**	.19**	.16**	−.01	.06	−.03	.40**	.42**	.39**	.46**

Note. *p < 0.05, **p < 0.01 (2-tailed). T1 = Time 1, T2 = Time2; SV = Short videos, LS = Livestreams; Dep = Depression, SA = Social Anxiety, BP = Boredom Proneness, DIT = Distress Intolerance, PTU = Problematic TikTok Use Severity.

no significant difference between timepoints. Regarding TikTok use behaviors at baseline, daily use time of TikTok had a median of 6 (i.e., 1.5–2 h per day). For the different functions in TikTok, participants watched short-form videos (Mean = 4.45, SD = 0.68) and live streams (Mean = 3.40, SD = 0.86) more frequently than making videos (Mean = 2.50, SD = 0.84) or hosting live streams (Mean = 1.44, SD = 0.75) on TikTok (watch vs. make short videos: $d = 2.55$; watch vs. make live-streams: $d = 2.43$; $ps < 0.001$). Also, participants watched short videos more than they watched livestreams ($d = 1.35$), and made short videos more than livestrems ($d = 1.33$; $ps < 0.001$).

Correlation analysis showed that participants who were younger, less educated, and spent more time on TikTok had higher severity of problematic TikTok use (Table 2). We also found that higher frequency of watching short-form videos on TikTok, but not watching livestreams or making short videos/lives, was associated with greater severity of problematic TikTok use. Importantly, the two psychopathology risk factors (i.e., depression, social anxiety) and two cognitive and emotional processes (i.e., boredom proneness, distress intolerance) significantly correlated with problematic TikTok use severity.

3.2. Primary results

One-factor models of depression, social anxiety, boredom proneness, distress intolerance, and problematic TikTok use were estimated (see Supplementary materials Table S2). All fit indices suggested acceptable fit except that RMSEA values were inflated. However, inflated RMSEA values were expected when using WLSMV estimation with ordinal variables (Shi, Maydeu-Olivares, & Rosseel, 2020). Therefore, we focused on other fit indices such as CFI, TLI, and SRMR for the estimation of model fit. A structural model examining the influence of psychopathology on problematic TikTok use through boredom proneness and distress intolerance was evaluated. The model has acceptable fit: Robust Chi-square Value = 6194.49, df = 1366, RMSEA = 0.066 [0.064, 0.067], CFI = 0.92, TLI = 0.92, SRMR = 0.07.

The standardized direct effects and bootstrapped standard errors are presented in Fig. 2. Both depression and social anxiety exerted significant effects on boredom proneness and distress intolerance. The direct effect of distress intolerance on problematic TikTok use severity was significant, but the direct effect of boredom proneness was not. The direct effect of depression, but not social anxiety, on problematic TikTok use severity was significant when the indirect effects were considered.

Standardized results of indirect effects are presented in Table 3. Both depression and social anxiety had significant indirect effects on problematic TikTok use severity through distress intolerance, whereas the indirect effect through boredom proneness was not significant.

Given the preliminary results, we added age, education level, TikTok use time, and frequency of watching short videos at baseline as covariates in the structural model and controlled for their effects on problematic TikTok use severity. The pattern of results was the same with or without these covariates (see supplementary Table S3).

4. Discussion

The current study examined how problematic TikTok use develops and focused on the mediating role of boredom proneness and distress intolerance in depression and social anxiety's relation to problematic TikTok use severity. Based on I-PACE theory (Brand et al., 2016, 2019; Elhai et al., 2019), depression and social anxiety are psychopathological risk factors of PSMU, while boredom proneness and distress intolerance could be regarded as cognitive and emotional processes that link psychopathology to PSMU. We expected that depression and social anxiety would contribute to increased boredom proneness and distress intolerance (H1), while boredom proneness and distress intolerance would increase the severity of problematic TikTok use (H2). Further, we expected that boredom proneness and distress intolerance would mediate the association between depression and social anxiety with problematic TikTok use severity (H3). H1 was supported, while H2 and H3 were partially supported. We found that depression and social anxiety were

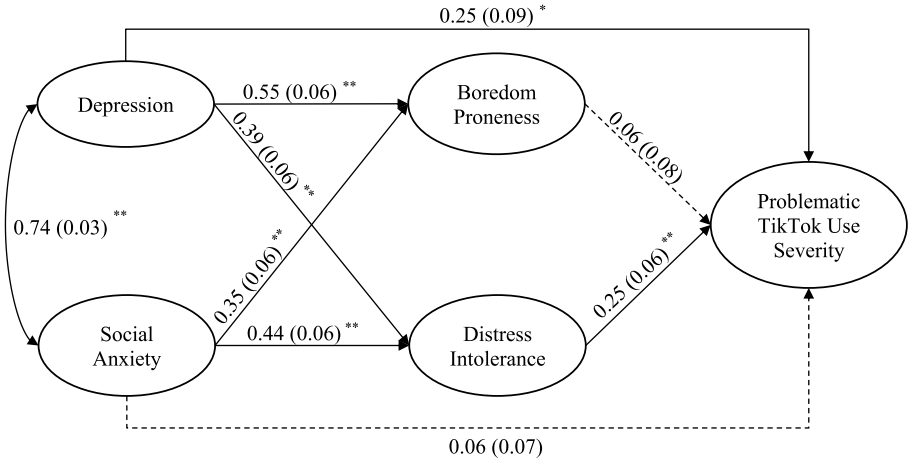

Fig. 2. Psychological Processes Explaining Depression and Social Anxiety's Relation to Problematic TikTok Use Severity

Note. **p < 0.001, *p < 0.01. Standardized coefficients and bootstrapped standard errors (in parentheses) are presented. Depression, social anxiety, boredom proneness, and distress intolerance were assessed at time 1 (N = 822); problematic TikTok use was assessed at time 2 (N = 715). All available data were used for the analysis with a pairwise present approach to handling missingness (Muthén & Muthén, 1998-2017).

Table 3
Indirect effects of depression and social anxiety on problematic TikTok use severity.

	Estimate	SE	p	95% CI
Indirect effects of depression on problematic TikTok use severity through:				
Boredom proneness	0.03	0.05	0.50	[-0.06, 0.12]
Distress intolerance	0.10	0.03	0.00	[0.05, 0.16]
Indirect effects of anxiety on problematic TikTok use severity through:				
Boredom proneness	0.02	0.03	0.50	[-0.03, 0.08]
Distress intolerance	0.11	0.03	0.00	[0.06, 0.18]

Note. Standardized coefficients (Estimates), bootstrapped standard errors (SEs), and bias-corrected bootstrapped 95% confidence intervals (CIs) are presented. All available data were used for the analysis with a pairwise present approach to deal with missing data (Muthén & Muthén, 1998-2017).

associated with increased boredom proneness and distress intolerance (H1). Further, distress intolerance, but not boredom proneness, increased problematic TikTok use severity and mediated the association between depression and social anxiety with problematic use severity (H2 and H3).

We found that distress intolerance fully mediated the association between social anxiety and problematic TikTok use severity and partially mediated depression's relation to problematic TikTok use severity. This result is in line with previous findings that distress intolerance contributed to problematic internet use (Akbari, 2017; Yamada et al., 2016) and mediated the association between psychopathology and problematic smartphone use severity (Elhai, Levine, et al., 2018). Further, our finding provides empirical support for I-PACE theory, which proposed that psychopathology could increase PSMU severity through disrupted emotional processes (Brand et al., 2016).

Specifically, the current results suggest that depression and social anxiety would negatively affect emotion processing and reduce distress tolerance (Dryman & Heimberg, 2018). It is likely that individuals who are intolerant of distress would feel an urge to reduce distress as quickly as possible, as they find distressful feelings unbearable and believe that they cannot effectively cope with distress (Simons & Gaher, 2005). This urge to rapidly avoid or alleviate distress then leads to excessive or problematic use of TikTok to cope with distress. In support of this possibility, previous research showed that individuals with high distress intolerance are more likely to develop substance-related problems and problematic internet use as they are motivated to use substances or the internet to cope with uncomfortable feelings (Akbari, 2017; Simons & Gaher, 2005). Furthermore, it has been posited that low distress tolerance enhances the responsiveness to immediate reward and negative reinforcement (Zvolensky et al., 2010). Previous research found that a propensity to seek immediate reward increased problematic TikTok use severity (Wang et al., 2021). Therefore, it is possible that individuals who are less tolerant of distress have greater difficulty managing their TikTok use and a greater risk for problematic use, as TikTok provides immediate reward and escape from distress (Bucknell Bossen & Kottasz, 2020).

Unexpectedly, we found no significant mediating effect of boredom proneness between psychopathology and problematic TikTok use. Our results revealed significant direct effects of psychopathology on boredom proneness, whereas the effect of boredom proneness on problematic TikTok use was not significant in the structural model. Different from previous studies on PSMU and problematic smartphone use (Elhai, Vasquez, et al., 2018; Stockdale & Coyne, 2020; Wegmann et al., 2018), this pattern of results suggests that depression and social anxiety increased the propensity to experience boredom, but boredom proneness did not necessarily lead to excessive use of TikTok. One possible explanation involves a specific feature of TikTok. Unlike other social media platforms, TikTok gives AI algorithms the dominant role in determining users' home feeds based on their content preferences. This may help to engage users early on when they enter the platform (Yaqi, Lee, & Liu, 2021). However, users may also find that the same type of homogenous content repeats and becomes less stimulating after a period of time (Bhandari & Bimo, 2022). This process could dampen users' motives to continue using TikTok intensively and drive them away to find something else more stimulating (e.g., content on other social media platforms). Hence, the way TikTok manages users' feeds raises the possibility that users who seek novel stimulation on TikTok to alleviate boredom may become bored after using it for a certain period of time, limiting their TikTok use intensity. Another explanation may lie in social media fatigue. Research has shown that boredom proneness was related to social media overload and fatigue (i.e., being overwhelmed by information and communication on social media and having a feeling of burnout), which may in turn cause an avoidance of social media (Whelan, Najmul Islam, & Brooks, 2020). Thus, it is also possible that using TikTok to alleviate boredom may lead to exhaustive feelings, thereby limiting further use of TikTok.

Interestingly, correlation analysis showed that greater frequency of watching short videos at baseline was associated with greater problematic TikTok use severity, whereas frequency of watching lives or making short videos/lives was not associated with problematic use severity. This pattern of results suggests that the way people use TikTok (e.g., watching short videos passively, watching lives and interacting with hosts/other viewers, making videos, etc.) has an influence on the development of problematic TikTok use. Future work can investigate how different patterns of TikTok use affect problematic use as well as mental health and its underlying mechanisms.

The current study has several limitations. First, we administered our questionnaires online through an online survey provider (i.e., Credamo)

and it would be difficult to control the quality of data. To ensure data quality, participants could only participate once at each assessment occasion, and those who failed to answer all attention check questions correctly were excluded from data analysis. Second, the current study only focused on adult TikTok users. TikTok has many adolescent users, and it is important to learn more about psychological processes associated with TikTok use among adolescents so as to better protect adolescents from potentially detrimental effects of TikTok use. Future studies can include younger participants. Third, the current study relied on conventional self-report methods to assess TikTok use behaviors. Yet, it would be difficult for participants to recall their exact use patterns and time spent on TikTok (Parry et al., 2021; Ryding & Kuss, 2020). Future studies may use experience sampling methods (e.g., keeping a record of daily use behaviors through a diary for a period of time; Rozgonjuk, Levine, Hall, & Elhai, 2018) to have a more precise assessment of TikTok use. More broadly put, the field would profit from the inclusion of digital phenotyping and mobile sensing principles (Montag & Rumpf, 2021). Finally, with a focus on TikTok use, the current study did not collect data on other forms of internet or social media use, thereby making it difficult to distinguish between effects specific to TikTok use and those common to different forms of internet or social media use. Future studies may benefit from considering different forms of internet or social media use simultaneously to better understand their commonalities and specificities.

Notwithstanding these limitations, the current study has strengths. First, we added to the existing literature on psychological processes underlying problematic TikTok use (Huang et al., 2022; Lewin et al., 2022; Smith & Short, 2022; Wang et al., 2021). Knowledge about underlying psychological mechanisms of problematic TikTok use can serve to develop preventive programs and reduce potential adverse effects of TikTok use. Second, no research has adopted a process or mechanistic perspective and examined how problematic TikTok use develops based on I-PACE theory (Brand et al., 2016, 2019; Elhai et al., 2019). The current study contributes to the literature by focusing on how psychopathology influences overuse of TikTok through two important cognitive and emotional processes, namely, boredom proneness and distress intolerance. Finally, beyond a cross-sectional approach, the current study included two assessment occasions and thus could provide insight into the predictive utility of psychological factors for problematic TikTok use. Our findings also have practical implications for the adaptive use of TikTok. TikTok users should be aware that emotional distress, along with difficulty tolerating distress, can lead to excessive TikTok use. Instead of relying on TikTok to regulate emotions, they may benefit from setting limits on their TikTok use and developing strategies for coping with distress that do not involve TikTok use.

In sum, TikTok is unique because of its video-based nature and, more importantly, its heavy reliance on AI algorithms to learn users' content preferences and determine users' home feeds (Bhandari & Bimo, 2022). As an interface with growing popularity, we believe that studying (problematic) TikTok usage would provide valuable insights into the dynamics between AI algorithms and human behavior (e.g., Su et al., 2021). The current study could be regarded as a starting point to understand this algorithm-human interaction. We found that depression and social anxiety were associated with increased propensity to experience boredom and the perceived inability to withstand distress. High distress intolerance led to increased severity of problematic TikTok use and mediated the association between depression and social anxiety with problematic use severity. We did not find a significant effect of boredom proneness on problematic TikTok use severity, nor a significant mediating effect of boredom proneness, after the effect of distress intolerance was considered. The current results suggest that distress intolerance plays a crucial role in the development of problematic use of TikTok and could explain the association between depression and social anxiety with problematic TikTok use severity. Future research is needed to replicate and extend our study by examining psychosocial processes related to different forms of PSMU including problematic TikTok use.

Credit author statement

Nisha Yao: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft, Writing – Review & Editing. **Jing Chen**: Conceptualization, Investigation, Writing – Original Draft, Writing – Review & Editing. **Siyuan Huang**: Writing – Review & Editing. **Christian Montag**: Writing – Review & Editing. **Jon D. Elhai**: Conceptualization, Methodology, Formal Analysis, Writing – Review & Editing.

Declaration of competing interest

The authors declare no conflict of interest with the present paper. But for full transparency, Dr. Montag mentions that he has received (to Ulm University and earlier University of Bonn) grants from agencies such as the German Research Foundation (DFG). Dr. Montag has performed grant reviews for several agencies; has edited journal sections and articles; has given academic lectures in clinical or scientific venues or companies; and has generated books or book chapters for publishers of mental health texts. For some of these activities he received royalties, but never from gaming or social media companies. Dr. Montag mentions that he was part of a discussion circle (Digitalität und Verantwortung: https://about.fb.com/de/news/h/gespraechskreis-digitalitaet-und-verantwortung/) debating ethical questions linked to social media, digitalization and society/democracy at Meta. In this context, he received no salary for his activities. Finally, he mentions that he currently functions as independent scientist on the scientific advisory board of the Nymphenburg group (Munich, Germany). This activity is financially compensated. Moreover, he is on the scientific advisory board of Applied Cognition (Redwood City, CA, USA), an activity which is also compensated.

Dr. Elhai notes that he receives royalties for several books published on posttraumatic stress disorder (PTSD); is a paid, full-time faculty member at University of Toledo; occasionally serves as a paid, expert witness on PTSD legal cases; and recently received grant research funding from the U.S. National Institutes of Health.

Data availability

Data and code of the current study are available on zenodo.org at DOI: 10.5281/zenodo.7726855.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2023.107751.

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