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Short-Video Social Media Use on Anxiety: Evidence from Graduate Students

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Abstract

In the context of digital transformation, short-video social media has become a central element in graduate students' daily lives. The mental health risks and behavioral deviations resulting from its excessive use have emerged as a critical topic in organizational behavior and higher education management. Drawing on an integrated perspective of self-regulatory failure theory and conservation of resources theory, this study develops a moderated mediation model in which sleep procrastination mediates the relationship between short-video social media use and anxiety, and time management skills serves as a boundary condition. Using survey data from 486 graduate students across six universities and structural equation modeling for empirical testing, this study finds that short-video social media use is positively and significantly related to graduate students' anxiety, and that short-video social media use is also positively and significantly associated with sleep procrastination. Sleep procrastination partially mediates the link between short-video social media use and anxiety, and time management skills significantly moderates the association between sleep procrastination and anxiety. This study reveals the underlying mechanism through which digital media use affects graduate students' mental health, broadens the application of self-regulatory failure theory in digital behavior research, and provides empirical implications for universities to implement targeted management practices and for graduate students to enhance self-regulation abilities.

Keywords: Short-Video Social Media Use; Sleep Procrastination; Anxiety; Time Management Skills; Graduate Students

1. Introduction

The rise of Digital Natives has propelled short-video social media to become the dominant vehicle for social interaction and information dissemination. As a core user group with advanced academic backgrounds, graduate students have exhibited continuously growing penetration and dependence on short-video platforms (Przybylski et al., 2021; Van den Bulck et al., 2022; Orben,

2020). According to the China Graduate Student New Media Usage Report (2025), graduate students in China spend an average of 1.5 hours per day on short videos, 82.3% use short videos within one hour before bedtime, and 91.5% categorize such platforms as indispensable tools for academic research and daily life.

With fragmented content, algorithm-driven personalized recommendations, and highly interactive experiences, short-video platforms satisfy graduate students' needs for information acquisition, academic communication, and leisure. Meanwhile, they have also triggered a series of behavioral and psychological problems (Rideout & Robb, 2019; Orben & Przybylski, 2019; Kross et al., 2021). Among these issues, the association between excessive usage and anxiety has drawn extensive scholarly attention. However, graduate students face unique stressors, including academic pressure, graduation anxiety, and career uncertainty. The mechanism linking short-video usage to anxiety differs fundamentally from that of undergraduate samples. The underlying transmission path and boundary conditions between these constructs remain underexplored, calling for systematic empirical investigation.

Excessive use of short-video social media may induce anxiety among graduate students through multiple mechanisms. From the perspective of social comparison theory, overly polished displays of academic achievements and career development narratives on such platforms tend to trigger upward social comparison, resulting in biased self-perception and relative deprivation, thereby intensifying perceived pressure from academic competition (Festinger, 1954; Tromholt, 2016; Chou & Edge, 2012). According to cognitive resource theory, the "information cocoons" formed by algorithmic recommendations can restrict academic vision and generate uncertainty and loss of control over research directions (Pariser, 2011; Sun et al., 2023; Vaidya et al., 2022). Furthermore, the substantial time resources consumed by short-video use crowd out core academic activities such as experimental research, literature review, and academic writing, pushing graduate students into a state of resource scarcity in academic productivity and career development and ultimately eliciting anxiety (Baumeister et al., 1998; Wang et al., 2022; Hofmann et al., 2012).

Existing studies have confirmed a positive association between short-video use and anxiety in young populations (Kross et al., 2021; Przybylski et al., 2021). However, targeted research on graduate students remains limited, leaving the core question of how short-video use specifically affects graduate students' anxiety largely unanswered. Accordingly, this study first examines the direct effect and transmission mechanism of short-video social media use on anxiety among graduate students.

Sleep procrastination (bedtime procrastination), a typical manifestation of self-regulatory failure, may serve as a critical mediator between short-video social media use and anxiety among graduate students. Sleep procrastination is defined as the voluntary delay of an intended bedtime in the absence of external impediments, reflecting the prioritization of immediate hedonic needs over long-term health goals (Kroese et al., 2014, 2016; Exelmans & Van den Bulck, 2017). Graduate students often face heavy research workloads and irregular schedules. The high arousal, instant feedback, and infinite-scroll design of short videos can easily lead to immersive use before sleep, as individuals use entertainment to escape academic pressure and thus delay bedtime

(Exelmans & Van den Bulck, 2017; Adams & Rinne, 2022; Cain & Gradisar, 2010). Chronic sleep procrastination results in sleep deprivation and circadian disruption, impairing the prefrontal cortex's emotional regulation and academic cognitive functions, reducing stress-coping capacity, and ultimately providing physiological and psychological foundations for the emergence of anxiety (Curcio et al., 2006; Goldstein & Walker, 2014; Gruber & Cassoff, 2014).

Prior research has separately established positive links between short-video use and sleep procrastination (Exelmans & Van den Bulck, 2017; Adams & Rinne, 2022) and between sleep procrastination and anxiety in young populations (Kroese et al., 2016; Jansson-Fröjmark & Lindblom, 2008). However, no studies have verified the complete chain of "usage behavior → procrastinatory behavior → emotional problems" among graduate students. Therefore, this study further tests the mediating role of sleep procrastination in the relationship between short-video social media use and anxiety among graduate students.

Individual differences may shape the strength of the relationship between sleep procrastination and anxiety among graduate students. As a core self-regulatory capacity, time management skills is expected to act as a key moderator. Time management skills refers to individuals' ability to plan, allocate, and control time resources to achieve academic goals, with its core function being to improve the efficiency of academic resource utilization and enhance self-regulation (Macan, 1994; Claessens et al., 2007; Gollwitzer, 1999). Graduate students are required to balance multiple tasks, including research, coursework, and daily life. Individuals with high time management skills are more effective at developing and implementing schedules and academic plans. Even when sleep procrastination occurs, they can mitigate stress accumulation and prevent heightened anxiety by rationally arranging subsequent time and prioritizing research tasks (Gollwitzer, 1999; Van Eerde, 2003; Ferrari et al., 2020). In contrast, individuals with low time management skills are prone to a vicious cycle of "sleep deprivation → academic procrastination → amplified stress," which strengthens the detrimental effect of sleep procrastination on anxiety (Schouwenburg & Lay, 1995; Ferrari et al., 2020; Claessens et al., 2007).

Although existing research has validated the buffering effect of time management skills on procrastination and negative emotions (Van Eerde, 2003; Macan, 1994), few studies have focused on the specific context linking sleep procrastination and anxiety among graduate students. Accordingly, this study further examines the moderating role of time management skills in weakening the adverse impact of sleep procrastination on anxiety among graduate students.

The theoretical contributions of this study are threefold. First, by integrating self-regulatory failure theory and conservation of resources theory, this study constructs an integrated model explaining how digital media use shapes graduate students' mental health, thereby expanding the application boundaries of these theories in the digital behavior domain of highly educated populations. Whereas prior studies have largely focused on undergraduate samples, this study addresses the unique stress context of graduate students and explains the transmission mechanism from short-video social media use to sleep procrastination and further to anxiety via a dual-theoretical framework, thus enhancing theoretical explanatory power.

Second, from a mediation perspective, this study unlocks the black box between short-video social media use and graduate students' anxiety by verifying the critical mediating role of sleep procrastination. This fills a research gap regarding the intermediate pathways linking digital behavior and mental health among highly educated individuals.

Third, by introducing time management skills as a moderator, this study identifies the boundary condition of the link from sleep procrastination to anxiety, providing new empirical evidence for understanding how individual differences shape graduate students' mental health. Fig. 1 displays the theoretical model of this study.

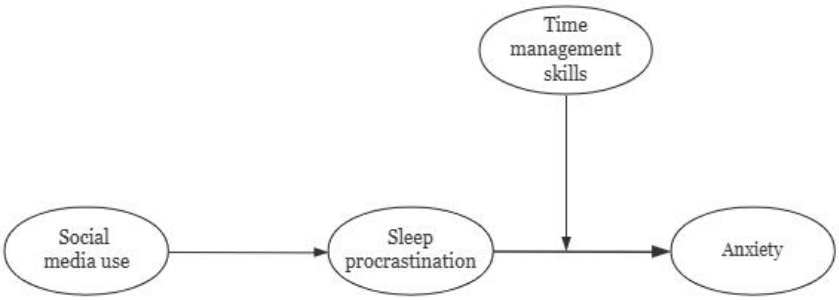

Figure 1. Theoretical model

2. Theoretical Foundations and Hypotheses

2.1. Theoretical Foundations

2.1.1. Self-Regulatory Failure Theory

Self-regulatory failure theory was proposed by Baumeister et al. (1998). Its core argument is that individuals' self-regulatory capacity relies on a limited pool of psychological resources. Sustained self-control efforts deplete these resources, reducing subsequent self-regulatory ability and leading to impulsive or procrastinatory behaviors, known as the resource depletion effect. Baumeister and colleagues validated this proposition through classic experiments: participants who engaged in a temptation-resistance task (which consumes self-regulatory resources) exhibited significant performance declines in subsequent cognitive tasks, confirming the direct impact of psychological resource depletion on self-regulation.

This theory has been widely applied to research on digital media use, accounting for self-regulatory failure induced by excessive engagement (Hofmann et al., 2012; Kim et al., 2018; Przybylski et al., 2021). In the present study, graduate students face persistent academic pressure. The high-arousal and instant-feedback features of short videos continuously deplete their self-regulatory resources, making it difficult for them to resist immediate gratification in the goal conflict between "sleeping on time" and "continuing to use short videos to escape pressure," thereby triggering sleep procrastination. In turn, sleep deprivation caused by sleep procrastination further depletes psychological resources, weakens emotional regulation and academic stress-coping capacity, and ultimately generates anxiety.

2.1.2. Conservation of Resources Theory

Conservation of Resources (COR) theory was developed by Hobfoll (1989). Its core tenet is that individuals possess an innate motivation to protect existing resources and acquire new ones; resource loss triggers psychological stress and negative affective outcomes, whereas resource gain and effective management buffer against stress. Resources in this theory include time, effort, academic cognition, and other psychological resources (Hobfoll, 2001; Hobfoll et al., 2018).

Short-video social media use depletes graduate students' academic time and attentional resources, representing a form of resource loss that creates scarcity for constructive academic activities such as experiments and scholarly writing. Sleep procrastination further erodes physical and psychological resources, exacerbating resource loss. In contrast, time management skills, as a critical resource-management capability, enable graduate students to optimize the allocation of academic resources, reduce unnecessary resource depletion, and mitigate the impact of resource loss on anxiety.

By integrating self-regulatory failure theory and COR theory, this study provides a more comprehensive account of the mechanisms underlying the relationships among short-video social media use, sleep procrastination, time management skills, and anxiety in graduate students.

2.2. Hypotheses

2.2.1. Short-video Social Media Use and Anxiety

Excessive short-video social media use can induce anxiety among graduate students through multiple pathways. First, narratives such as "instant academic success" and "rapid career advancement" on these platforms trigger upward social comparison, resulting in self-denial and psychological discrepancy (Festinger, 1954; Tromholt, 2016; Chou & Edge, 2012). Second, the "information cocoons" formed by algorithmic recommendation generate uncertainty and a loss of control over frontier developments in one's research field (Pariser, 2011; Sun et al., 2023; Vaidya et al., 2022). Third, fear of missing out (FOMO) induced by short-video use places graduate students in a state of constant academic information monitoring, as they worry about missing critical research advances, thereby fostering anxiety (Przybylski et al., 2013; Oberst et al., 2017; Alt, 2015). Finally, short-video engagement consumes substantial academic time and crowds out core research activities, leading to heightened graduation pressure and career-related anxiety (Baumeister et al., 1998; Wang et al., 2022; Hofmann et al., 2012).

Prior research has established a positive relationship between excessive short-video use and anxiety among young populations (Kross et al., 2021; Orben & Przybylski, 2019; Przybylski et al., 2021). Accordingly, we propose the following hypothesis:

H1: Short-video social media use is positively and significantly related to anxiety among graduate students.

2.2.2. Short-video Social Media Use and Sleep Procrastination

Algorithmic recommendation and infinite-scroll design of short videos reinforce continuous usage motivation, leading graduate students into immersive engagement and impaired time

perception (Exelmans & Van den Bulck, 2017; Adams & Rinne, 2022; Wood et al., 2013). When graduate students use short videos before bedtime, high-arousal content elevates cognitive and physiological arousal, suppresses melatonin secretion, and reduces sleep willingness (Cain & Gradisar, 2010; Wood et al., 2013; Gradisar et al., 2013). Meanwhile, academic pressure predisposes graduate students to escape negative emotions through short videos, forming a coping cycle of "stress → short-video use → sleep procrastination" (Kroese et al., 2014, 2016).

According to self-regulatory failure theory, self-regulatory resources consumed by short-video use reduce individuals' ability to resist immediate hedonic temptations, preventing them from falling asleep as scheduled and thus inducing sleep procrastination (Baumeister et al., 1998; Kroese et al., 2014; Hofmann et al., 2012). Furthermore, the academic social function of short videos—such as sharing research findings and disseminating conference updates—encourages pre-sleep interaction among graduate students and further prolongs usage duration (Rideout & Robb, 2019; Exelmans & Van den Bulck, 2017). Accordingly, we propose the following hypothesis:

H2: Short-video social media use is positively and significantly related to sleep procrastination among graduate students.

2.2.3. Sleep Procrastination and Anxiety

Sleep is a central process for restoring physical energy, regulating emotions, and maintaining academic cognitive functioning (Walker, 2009; Curcio et al., 2006; Goldstein & Walker, 2014). Sleep deprivation and circadian disruption caused by chronic sleep procrastination impair prefrontal cortical functioning, reducing emotional regulation, academic concentration, and stress-coping capacity (Goldstein & Walker, 2014; Gruber & Cassoff, 2014; Baglioni et al., 2011).

From the perspectives of self-regulatory failure theory and COR theory, sleep loss resulting from sleep procrastination depletes graduate students' psychological and physical resources, impeding their ability to address research pressure and academic challenges and thereby eliciting anxiety (Baumeister et al., 2007; Hobfoll et al., 2018; Sivertsen et al., 2015). Meanwhile, insufficient sleep undermines next-day research efficiency and academic productivity, creating a vicious cycle: sleep deprivation → delayed research progress → elevated pressure → intensified anxiety (Kroese et al., 2016; Sivertsen et al., 20 a15; Jansson-Fröjmark & Lindblom, 2008). Prior research has confirmed a positive association between sleep procrastination and anxiety among young populations (Jansson-Fröjmark & Lindblom, 2008; Kroese et al., 2016; Baglioni et al., 2011). Accordingly, we propose the following hypothesis:

H3: Sleep procrastination is positively and significantly related to anxiety among graduate students.

2.2.4. The Mediating Role of Sleep Procrastination

Short-video social media use triggers sleep procrastination by depleting self-regulatory resources and providing an outlet for stress avoidance (H2), and sleep procrastination exacerbates anxiety through resource loss and diminished academic functioning (H3). Together, these three

constructs form a transmission chain: usage behavior → procrastinatory behavior → emotional problems.

From an integrated theoretical perspective, short-video social media use depletes self-regulatory resources (self-regulatory failure theory) and reduces academic time resources (COR theory), which jointly lead to sleep procrastination. Sleep procrastination then further intensifies resource depletion and ultimately elicits anxiety. Previous studies have preliminarily supported the mediating role of sleep procrastination in the relationship between digital media use and mental health (Exelmans & Van den Bulck, 2017; Adams & Rinne, 2022; Gradisar et al., 2013). Accordingly, we hypothesize:

H4: Sleep procrastination mediates the relationship between short-video social media use and anxiety among graduate students.

2.2.5. The Moderating Role of Time Management Skills

As a core self-regulatory competency, time management skills encompass academic goal setting, time planning, and research task monitoring (Macan, 1994; Claessens et al., 2007; Gollwitzer, 1999). Grounded in self-regulatory failure theory and COR theory, graduate students with strong time management skills can allocate academic time and psychological resources more efficiently, balance research and rest, and reduce unnecessary resource depletion (Baumeister et al., 1998; Hobfoll et al., 2018; Macan, 1994). Even when sleep procrastination occurs, they can alleviate stress accumulation and prevent intensified anxiety by rationally prioritizing research tasks and optimizing schedules (Gollwitzer, 1999; Van Eerde, 2003; Claessens et al., 2007). In contrast, graduate students with weak time management skills lack effective resource management capabilities and are more likely to fall into a vicious cycle: sleep deprivation → academic procrastination → heightened graduation pressure, which strengthens the detrimental impact of sleep procrastination on anxiety (Schouwenburg & Lay, 1995; Ferrari et al., 2020; Van Eerde, 2003). Prior research has validated the buffering effect of time management skills on procrastination and negative emotions (Van Eerde, 2003; Macan, 1994; Claessens et al., 2007). Accordingly, we propose the following hypothesis:

H5: Time management skills significantly moderate the effect of sleep procrastination on anxiety among graduate students, such that the positive influence of sleep procrastination on anxiety is weaker for individuals with higher levels of time management skills.

3. Method

3.1. Procedure and Sample

To enhance sample representativeness and the generalizability of results, this study adopted a multistage sampling procedure. We selected six typical universities in China, consisting of two comprehensive universities, two science and engineering universities, and two liberal arts universities. These institutions are located across North China, East China, and South China. The sample includes master's and doctoral students spanning multiple disciplines, including humanities, social sciences, natural sciences, engineering, agriculture, medicine, and arts. This

sampling design allows for a comprehensive investigation of short-video usage and mental health conditions among graduate students from diverse university types and disciplinary backgrounds.

Data were collected via Wenjuanxing (a professional online survey platform) in November–December 2025. Prior to participation, master's and doctoral students were fully informed of the study purpose, strict data confidentiality protocols, and voluntary participation rights, with explicit notification that all data would be used exclusively for academic research; an anonymous voluntary lottery was offered post-completion to enhance response quality. A total of 600 questionnaires were distributed to this target group, yielding 542 returns (90.3% response rate). After excluding 56 invalid responses (zero completion time, logical inconsistencies, identical choices for ≥10 consecutive items, missing key information, or non-graduate student status), 486 valid questionnaires remained (81.0% effective response rate), including 352 master's students (72.4%) and 134 doctoral students (27.6%). This sample size meets the minimum requirements for structural equation modeling in social science research (Hair et al., 2017; Kline, 2015).

Descriptive statistics of the sample are reported as follows. Regarding demographic and background characteristics, 47.3% of the respondents were male and 52.7% female; 72.4% held a master's degree and 27.6% a doctoral degree. By academic discipline, 33.1% specialized in engineering, 28.2% in humanities and social sciences, 21.6% in natural sciences, 10.9% in agriculture and medical sciences, and 6.2% in arts. Geographically, 41.2% originated from urban areas, 30.5% from township areas, and 28.3% from rural areas. In terms of economic behavior, 48.8% of the sample reported monthly expenditure between ¥1,000 and ¥2,000, followed by 25.1% between ¥2,000 and ¥3,000, 15.2% below ¥1,000, and 10.9% above ¥3,000. For media usage, 89.3% used short videos daily, 6.8% five to six times per week, 3.1% one to four times per week, and 0.8% rarely used them. With respect to self-assessed capabilities and perceived pressure, 15.4% rated their time management capability as very strong, 38.3% as strong, 40.1% as moderate, 5.3% as weak, and 0.9% as very weak; meanwhile, 28.6% perceived very high research stress, 45.3% high stress, 22.0% moderate stress, 3.3% low stress, and 0.8% very low stress.

3.2. Measures

Short-Video Social Media Use. Short-video social media use was assessed via a revised Short-Video Usage Intensity Scale, adapted from Ellison et al. (2007) and Karikari et al. (2017) with contextual optimization for graduate student samples. The 4-item scale uses a 7-point Likert response format (1 = do not agree at all; 7 = totally agree), with a sample item: "I involuntarily open short-video applications during research intervals". The scale demonstrated excellent internal consistency (Cronbach's $\alpha = 0.892$).

Anxiety. Anxiety was measured using the 7-point revised version of the Generalized Anxiety Disorder Scale (GAD-7; Spitzer et al., 2006). Validated among highly educated populations by Lowe et al. (2008), this 7-item instrument is widely adopted for assessing graduate students' anxiety, with sample items: "I feel nervous, anxious, or irritable due to research pressure" and "I struggle to control worries about graduation and career development" (1 = do not agree at all; 7 = totally agree). The scale exhibited strong internal consistency (Cronbach's $\alpha = 0.873$).

Sleep Procrastination. Sleep procrastination was operationalized through the 7-point revised Bedtime Procrastination Scale (BPS; Kroese et al., 2014), validated for highly educated samples (Jansson-Fröjmark & Lindblom, 2008; Kroese et al., 2016). The 5-item scale uses a 7-point Likert format (1 = do not agree at all; 7 = totally agree), with sample items: "I frequently go to bed later than planned" and "I stay up late watching short videos even when facing intensive research work the next day". Internal consistency was robust (Cronbach's $\alpha = 0.849$).

Time Management Skills. Time management skills were evaluated using the 7-point revised Time Management Behavior Inventory (TMI; Macan et al., 1990), refined for graduate students by Claessens et al. (2007) and Van Eerde (2003). This 18-item scale encompasses three core dimensions: academic goal setting, research time planning, and task control. Sample items include: "I preplan weekly research tasks and clarify priorities" and "I effectively regulate time use to avoid research procrastination" (1 = do not agree at all; 7 = totally agree). The scale demonstrated excellent internal consistency (Cronbach's $\alpha = 0.897$).

Control Variables. Consistent with prior research (Hofmann et al., 2012; Przybylski et al., 2021; Wang et al., 2022), we included gender, educational level (master's vs. doctoral), academic discipline, hometown origin, and research stress as control variables. These covariates were incorporated to mitigate confounding effects, as they have been theoretically and empirically linked to graduate students' short-video use, sleep procrastination, and anxiety, thereby enhancing the validity and precision of the study's findings.

4. Data Analyses

4.1. Convergent Validity

Convergent validity was assessed via confirmatory factor analysis (CFA). Following established criteria (Fornell & Larcker, 1981; Hair et al., 2017; Kline, 2015), convergent validity is supported when standardized factor loadings ≥ 0.6, composite reliability (CR) ≥ 0.7, and average variance extracted (AVE) ≥ 0.5. As shown in Table 1, standardized factor loadings for all focal constructs ranged from 0.689 to 0.843, well above the 0.6 threshold ($p < 0.001$). Composite reliability values varied between 0.891 and 0.908, exceeding the 0.7 benchmark. Average variance extracted estimates fell between 0.671 and 0.702, satisfying the minimum 0.5 requirement. Collectively, these results demonstrate that the measurement scales exhibit strong convergent validity and reliably capture the underlying theoretical constructs in this study.

Table 1. Convergent validity

Variables	Items	Std.	CR	AVE	Cronbach's alpha
Short-video social media use	4	0.719-	0.908	0.702	0.892
Anxiety	7	0.701-	0.898	0.689	0.873
Sleep procrastination	5	0.689-	0.891	0.679	0.849
Time management skills	18	0.708-	0.906	0.671	0.897

4.2. Discriminant Validity

Discriminant validity was examined using the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) ratio (Fornell & Larcker, 1981; Henseler et al., 2015). The Fornell-Larcker criterion holds that the square root of each construct's average variance extracted (AVE) should exceed its Pearson correlations with all other constructs. The HTMT criterion requires that all inter-construct HTMT values be below 0.9. As presented in Table 2, the square roots of AVE values ranged from 0.819 to 0.838, all substantially larger than the corresponding inter-construct correlations (0.356–0.594). Meanwhile, all HTMT values varied between 0.409 and 0.668, well below the 0.9 threshold. Furthermore, the four-factor confirmatory factor model demonstrated superior fit ($\chi^2/df = 2.15$, RMSEA = 0.046, CFI = 0.956) relative to both the single-factor model ($\chi^2/df = 5.79$, RMSEA = 0.097, CFI = 0.789) and alternative nested models ($p < 0.001$). Collectively, these findings support satisfactory discriminant validity among the focal constructs.

Table 2. Discriminant validity

Variables	1	2	3	4
1.Short-video social media use	1	0.479***	0.518***	-0.356***
2.Anxiety	-	1	0.594***	-0.441***
3.Sleep procrastination	-	-	1	-0.417***
4.Time management skills	-	-	-	1

4.3. Hypothesis Testing

Structural equation modeling (SEM) was employed to test the three core hypotheses (H1, H2, and H3). First, the measurement model's fit was assessed, with results indicating: $\chi^2/df = 2.15$, RMSEA = 0.046, GFI = 0.935, CFI = 0.956, and NFI = 0.931. All fit indices met the ideal criteria recommended by Hair et al. (2017) and Kline (2015), demonstrating a good model-data fit.

As presented in Table 3, the direct effect results revealed the following: (1) The standardized path coefficient of short-video social media use on anxiety was 0.237, indicating that the intensity of short-video use exerts a significantly positive impact on graduate students' anxiety—thus supporting H1. (2) The standardized path coefficient of short-video social media use on sleep procrastination was 0.503 (statistically significant), suggesting that higher intensity of short-video use is associated with more severe sleep procrastination among graduate students—supporting H2. (3) The standardized path coefficient of sleep procrastination on anxiety was 0.529 (significantly positive), indicating that greater sleep procrastination correlates with higher anxiety levels in graduate students—supporting H3.

Table 3. Results of Hypothesis Testing

Hypotheses	β	E.	Z-value	*p*	Result
H1: Social media use→Anxiety	0.237	0.050	4.74	***	Supported
H2a: Social media use→sleep procrastination	0.503	0.055	9.15	**	Supported
H2b: Procrastination→Anxiety	0.529	0.046	11.50	***	Supported

Note. *** $p < 0.001$, ** $P < 0.01$

4.4. Mediation Analysis

Bootstrap analysis with 5,000 resamples was conducted to examine the mediating role of sleep procrastination. Mediation was supported if the 95% confidence interval (CI) of the indirect effect did not include zero (Hayes, 2013; Preacher & Hayes, 2008). As shown in Table 4, the indirect effect of short-video social media use on anxiety via sleep procrastination was significant (effect = 0.266, SE = 0.039, 95% CI [0.190, 0.342]), with the CI excluding zero. After accounting for the mediator, the direct effect of short-video social media use on anxiety remained significant (β = 0.237, $p < 0.001$), indicating that sleep procrastination plays a partially mediating role between short-video social media use and anxiety among graduate students. The mediating effect accounted for 51.8% of the total effect (0.266/0.513), suggesting that more than half of the influence of short-video social media use on graduate students' anxiety is transmitted through sleep procrastination. Collectively, Hypothesis 4 was supported.

Table 4. Mediation Analysis Results

Effect	Point Estimate	S.E	Z-Value	P-Value	Bias-corrected 95%
Total effect	0.237	0.050	4.74	.001	[0.141, 0.333]
Indirect effect	0.266	0.039	6.82	01	[0.190, 0.342]
Direct effect	0.513	0.043	11.93	.001	[0.429, 0.597]

4.5. Moderating effect analysis

The results of the moderation analysis are shown in Figure 2. For the group with low time management skills(TMS) (M-1SD), the positive effect of sleep procrastination(SP) on anxiety(ANX) was stronger (β = 0.712, $p < 0.001$). For the group with high time management skills (M+1SD), the positive effect of sleep procrastination on anxiety was significantly weaker (β = 0.380, $p < 0.001$). These results indicate that time management skills serve as a significant

buffer in the relationship between sleep procrastination and anxiety among graduate students, thereby supporting Hypothesis 5.

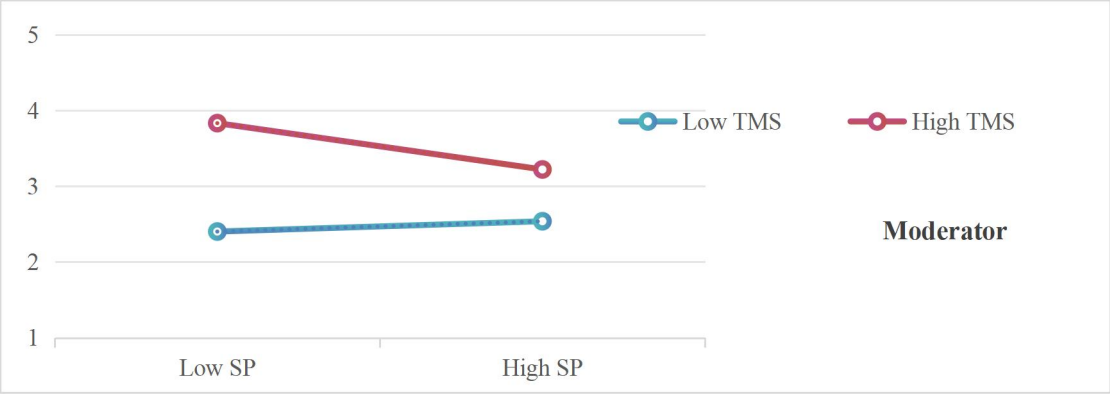

Figure 2. Moderating effect of time management skills

5. Discussion and Conclusion

5.1. Discussion

Hypothesis 1 was supported: Short-video social media use exerted a significant positive effect on graduate students' anxiety. These findings align with those reported by Kross et al. (2021) and Przybylski et al. (2021), yet reveal more targeted mechanisms given the unique context of graduate students. Grounded in an integrated framework of social comparison theory and conservation of resources theory, the overly curated displays of academic achievements and career narratives on short-video platforms readily trigger upward social comparisons among graduate students, fostering biased self-perceptions and psychological discrepancies (Festinger, 1954; Tromholt, 2016; Chou & Edge, 2012). Meanwhile, extensive short-video engagement consumes substantial academic time and attentional resources, crowding out core research activities such as experiments and literature review. This places graduate students in a state of resource scarcity amid graduation and career pressures, thereby eliciting anxiety (Baumeister et al., 1998; Hobfoll et al., 2018; Hofmann et al., 2012).

Hypothesis 2 was supported: Short-video social media use was significantly and positively associated with graduate students' sleep procrastination. These results corroborate those of Exelmans and Van den Bulck (2017) and Adams and Rinne (2022), while highlighting the distinctiveness of graduate students. Under persistent research pressure, the algorithmic recommendation and infinite-scroll design of short-video platforms reinforce immersive usage motives, encouraging escapism from academic stress and impairing temporal awareness (Adams & Rinne, 2022; Wood et al., 2013). Furthermore, exposure to highly arousing content before bed elevates cognitive and physiological arousal, suppresses melatonin secretion, and reduces sleep propensity (Cain & Gradisar, 2010; Wood et al., 2013; Gradisar et al., 2013). Drawing on strength theory of self-control, sustained self-regulation during short-video use depletes graduate students' psychological resources, rendering them less able to resist immediate hedonic temptations in conflicts between timely sleep and continued viewing, ultimately promoting sleep procrastination (Baumeister et al., 1998; Kroese et al., 2014; Hofmann et al., 2012).

Hypothesis 3 was supported: Graduate students' sleep procrastination was significantly and positively related to their anxiety, consistent with Kroese et al. (2016) and Jansson-Fröjmark and Lindblom (2008). Notably, anxiety among graduate students is disproportionately driven by academic concerns. Sleep is a foundational physiological process that restores physical energy, regulates emotion, and sustains cognitive functioning for academic tasks (Walker, 2009; Curcio et al., 2006; Goldstein & Walker, 2014). Chronic sleep procrastination leads to sleep deprivation and circadian disruption, directly impairing prefrontal cortical functioning and weakening emotional regulation, academic focus, and stress coping capacity (Goldstein & Walker, 2014; Gruber & Cassoff, 2014; Baglioni et al., 2011). From an integrative theoretical perspective, sleep loss due to procrastination constitutes a dual depletion of physical and psychological resources. Consistent with conservation of resources theory, such depletion undermines graduate students' ability to manage research demands and academic challenges, thereby heightening anxiety (Hobfoll et al., 2018; Sivertsen et al., 2015). Moreover, insufficient sleep impairs next-day research productivity and output, creating a vicious cycle: sleep loss → delayed research progress → elevated graduation pressure → intensified anxiety (Sivertsen et al., 2015; Kroese et al., 2016).

Hypothesis 4 was supported: Sleep procrastination played a partially mediating role in the relationship between short-video social media use and graduate students' anxiety, accounting for 51.8% of the total effect. This pattern indicates two distinct pathways: a direct pathway and an indirect pathway. The direct pathway reflects that short-video use directly triggers anxiety via academic social comparison, information overload, and fear of missing out (Przybylski et al., 2013; Orben & Przybylski, 2019; Oberst et al., 2017). The indirect pathway operates through a sequential chain: short-video use depletes self-regulatory resources and facilitates stress escapism, which induces sleep procrastination; sleep procrastination then exacerbates anxiety through resource depletion and reduced academic functioning. This uncovering of the "black box" mechanism advances understanding of the underlying transmission between short-video use and anxiety, and highlights the graduate-student-specific cycle: academic pressure → short-video escapism → sleep procrastination → anxiety.

Hypothesis 5 was supported: Time management skills significantly moderated the link between sleep procrastination and graduate students' anxiety, such that higher time management skills attenuated the positive effect of sleep procrastination on anxiety. As a core self-regulatory competency, time management encompasses academic goal setting, research scheduling, and task monitoring (Macan, 1994; Claessens et al., 2007; Gollwitzer, 1999). Grounded in strength theory of self-control and conservation of resources theory, graduate students with strong time management skills allocate academic time and psychological resources more efficiently, balancing research obligations and rest. Even when sleep procrastination occurs, they can mitigate stress accumulation and prevent anxiety escalation by structuring priorities and optimizing schedules (Gollwitzer, 1999; Van Eerde, 2003; Claessens et al., 2007). In contrast, those with weak time management lack effective resource-regulation strategies and are more prone to a vicious cycle: sleep loss → research procrastination → amplified graduation pressure, which strengthens the adverse impact of sleep procrastination on anxiety (Schouwenburg & Lay, 1995; Ferrari et al., 2020; Van Eerde, 2003). These findings identify time management skills as a critical

protective factor against the detrimental effects of sleep procrastination, with particular relevance for graduate students.

5.2. Theoretical Contributions

First, by focusing on the unique group of graduate students, this study extends the applicability of research on digital media use and mental health. Most existing studies have concentrated on undergraduate samples, neglecting the unique context faced by graduate students, such as intense academic pressure and graduation-related anxiety (Przybylski et al., 2021; Van den Bulck et al., 2022). This study conducts a dedicated investigation among graduate students and verifies that the mechanism linking short-video social media use, sleep procrastination, and anxiety remains valid in this highly educated population. Moreover, the mediating effect accounts for 51.8%, which is slightly higher than that observed among undergraduates, highlighting the distinctiveness of graduate students and providing empirical support for applying relevant theories to advanced education groups.

Second, this study integrates self-regulatory failure theory and conservation of resources theory to construct an integrated framework for understanding how digital media use influences graduate students' mental health. Most prior research adopts a single theoretical perspective to explain the association between short-video use and mental health. By integrating two theories, this study captures both the depletion of self-regulatory resources caused by short-video use (self-regulatory failure theory) and the loss of academic time and cognitive resources (conservation of resources theory). It systematically explains the transmission mechanism of "short-video social media use → sleep procrastination → anxiety", deepens the depth and breadth of theoretical explanation, and expands the application of relevant theories to digital behavior and mental health among highly educated populations (Baumeister et al., 1998; Hobfoll et al., 2018; Hofmann et al., 2012).

Third, this study identifies the moderating role of time management skills, enriching research on the boundary conditions in this field. Existing research has largely ignored the influence of individual difference variables on the relationship between sleep procrastination and anxiety among highly educated samples. This study empirically confirms that time management skills significantly buffer the negative effect of sleep procrastination on graduate students' anxiety, addressing the key question of under what conditions the impact of sleep procrastination on graduate students' anxiety is more pronounced. These findings not only enrich the literature on time management skills and mental health (Van Eerde, 2003; Macan, 1994; Claessens et al., 2007), but also provide important empirical support for expanding the boundary conditions of the theoretical model, contributing to a more comprehensive understanding of the antecedents and protective mechanisms of graduate students' mental health in the digital era.

5.3. Practical implications

5.3.1. Practical Implications for University Management

First, develop an integrated education system of "graduate student-specific digital literacy + academic self-management" by incorporating short-video usage regulation, sleep health knowledge, and research-oriented time management training into graduate training programs. Design hierarchical teaching content tailored to the differences between master's and doctoral

students, and enhance their digital media literacy and academic self-management capabilities through case studies, skill workshops, and one-on-one academic mentoring. Second, establish a big data early warning system for graduate students' mental health, focusing on high-risk groups (e.g., high research pressure + intensive short-video use + severe sleep procrastination + low time management skills), particularly doctoral students. Implement targeted interventions such as academic stress reduction counseling, sleep intervention programs, and time management workshops. Third, optimize the campus research and living environment by setting "mobile phone-free research periods" in laboratories and libraries, and promoting a "pre-sleep digital detox" initiative in graduate dormitories to guide standardized short-video use through physical environment modification. Finally, strengthen the construction of academic stress management mechanisms, establish a dual mentoring system (academic advisors + psychological counselors), and regularly organize stress reduction lectures and group counseling to help graduate students develop healthy stress-coping strategies.

5.3.2. Practical Implications for Individual Graduate Students

First, proactively enhance academic time management skills by adopting scientific methods such as the Eisenhower Matrix and Pomodoro Technique. Develop detailed research task plans and daily schedules, define clear time and scenario boundaries for short-video use (e.g., limiting daily usage to 1 hour and avoiding electronic devices 1 hour before bedtime), and balance research and rest. Second, strengthen self-awareness by regularly reflecting on short-video usage patterns, sleep quality, and anxiety levels. When excessive use or sleep procrastination is identified, implement self-interventions such as setting mobile phone reminders, uninstalling entertainment apps, or seeking guidance from academic advisors. Third, cultivate healthy pre-sleep habits and stress-coping mechanisms: replace short-video use with low-arousal activities (e.g., reading, meditation, listening to soothing music) and release research pressure through healthy channels (e.g., exercise, academic exchanges) to avoid escaping negative emotions via short videos. Fourth, establish a rational academic comparison mindset: objectively view "academic success narratives" on short-video platforms, avoid blind upward social comparison, focus on personal research progress and growth, and set realistic academic expectations. Fifth, actively seek professional support (e.g., from university counseling centers, academic advisors, or medical institutions) when anxiety persists.

5.3.3. Practical Implications for Short-Video Platforms

First, fulfill social responsibilities by optimizing the "graduate student mode" with academic time protection mechanisms (e.g., no notifications during research periods), daily usage limits, pre-sleep reminders, and mandatory logout functions to technically guide rational short-video use among graduate students. Second, adjust algorithmic recommendation systems: reduce the frequency of high-arousal, low-value content, increase the supply of positive science popularization content (e.g., academic frontiers, research methods, mental health), and launch an "academic short-video zone" to balance entertainment and academic service functions. Third, strengthen user education by disseminating scientific short-video usage concepts, sleep health knowledge, and academic time management methods to graduate students through app splash ads and pop-up reminders, enhancing users' self-management awareness. Finally, establish a

feedback mechanism for graduate student users: collect opinions and suggestions on platform functions via questionnaires and interviews, and continuously optimize product design to better meet graduate students' academic and daily needs.

5.4. Limitations and Future Research Directions

This study has several limitations that offer avenues for future improvement. First, the cross-sectional research design only reveals correlations among variables. Future studies could adopt longitudinal tracking or experimental designs (e.g., randomized controlled trials) to further verify the causal effects between variables, with a particular focus on the dynamic changes of graduate students throughout their academic journey from enrollment to graduation (Kroese et al., 2016; Preacher & Hayes, 2008). Second, data collection relied on self-report measures, which may introduce subjective bias. Future research could integrate objective data such as short-video app usage logs, smart device sleep monitoring records, and research task completion metrics for cross-validation (Adams & Rinne, 2022; Exelmans & Van den Bulck, 2017). Third, the research model did not incorporate potential variables such as personality traits, academic support, and digital literacy. Future studies may expand the model to comprehensively uncover multiple influence paths and boundary conditions—for instance, exploring the moderating role of academic support in the relationship between short-video use and sleep procrastination (Hobfoll et al., 2018; Van Eerde, 2003). Fourth, the sample covered only 6 universities in China, limiting generalizability. Future research could expand the sample scope to conduct cross-regional, interdisciplinary, and cross-national comparative studies to test the robustness of the findings (Przybylski et al., 2021; Orben & Przybylski, 2019). Fifth, no empirical intervention studies were conducted. Future work could design specific programs such as time management skills training and sleep health interventions, test their practical effects, and provide more direct support for university graduate student management and individual self-improvement (Claessens et al., 2007; Macan, 1994).

Author Contributions:

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest:

The authors declare no conflict of interest.

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