

The Separation of Adult ADHD Inattention and Hyperactivity-Impulsivity Symptoms and Their Association with Problematic Short-Video Use: A Structural Equation Modeling Analysis

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Purpose: This study investigates the relationship between attention-deficit/hyperactivity disorder (ADHD) symptoms and problematic short-video use (PSVU) in adults, particularly focusing on the affective and cognitive processes that mediate this relationship. The research aims to clarify how different ADHD symptom domains, specifically inattention (IA) and hyperactivity-impulsivity (HI), contribute to PSVU.

Patients and Methods: The study recruited 563 Chinese college students (age: mean±SD = 19.85±1.56) through an online survey platform. Participants were assessed for ADHD symptoms, PSVU, cognitive reappraisal, emotional distress (including anxiety and depression), and boredom proneness. Structural equation modeling (SEM) was employed to analyze the mediation effects of these variables on the relationship between adult ADHD symptoms and PSVU. Additionally, the shared and distinct pathway from IA and HI to PSVU in adults were also explored.

Results: The results revealed a serial mediating effect of cognitive reappraisal, emotional distress, and boredom proneness for the association between ADHD and PSVU (Estimate = 0.005, 95% CI = [0.001, 0.014]). Both IA and HI symptoms were found to influence PSVU with increased emotional distress and boredom proneness (IA, Estimate = 0.055, 95% CI = [0.021, 0.099]; HI, Estimate = 0.088, 95% CI = [0.043, 0.150]). However, divergent pathways were found by which IA increased the PSVU indirectly by heightening susceptibility to boredom proneness (Estimate = 0.044, 95% CI = [0.016, 0.086]), whereas HI primarily influenced PSVU through cognitive reappraisal, emotional distress, and boredom proneness (Estimate = 0.009, 95% CI = [0.003, 0.020]).

Conclusion: These findings shed light on how PSVU develops in adults with different ADHD symptoms, which provide valuable insights for developing more targeted prevention and treatment strategies for short-video addiction in ADHD adults.

Keywords: I-PACE model, cognitive reappraisal, emotional distress, boredom proneness, serial mediation, structural equation model

Introduction

Adult ADHD and Problematic Short-Video Use

Attention deficit hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders with a 2.5% and 7.6% global prevalence rate in adults and children respectively, which is primarily characterized by inattention (IA), hyperactivity, or impulsivity (HI).¹⁻³ Consistent evidence from previous human behavioral and neuroimaging meta-analyses have documented that ADHD symptoms in both clinical and community populations are closely associated with addictive behaviors, such as problematic gambling^{4,5} and problematic internet use.⁶⁻⁸ These associations are often paralleled by neural abnormalities in regions mainly involved in reward processing, response inhibition, and attention control.^{9,10}

Specifically, with the rapid growth of short-video platforms such as Douyin (Chinese version of TikTok) and Kuaishou which were known for their brief videos, vertical layout and personalized recommendations, problematic short-video use (PSVU), a specific form of problematic internet use, has gained increased attention recently.¹¹ PSVU refers to excessive and compulsive use of short-video apps, where individuals spend significant time on these platforms despite being aware of the potential negative outcomes. This behavior is often characterized by an inability to regulate usage, leading to interference with normal daily activities, emotional well-being, and social relationships.^{12,13} Some studies have focused on the behavioral and neural patterns of excessive users to validate whether PSVU could be manifested by addiction-like behaviors.¹⁴ One study using fMRI has revealed that TikTok users showed higher brain activations in some regions located at default mode network (DMN) and reward processing network when viewing personalized recommended videos compared to non-personalized ones.¹⁵ Another study assessed the psychosocial factors in addictive TikTok users showing that excessive users exhibited higher levels of ADHD symptoms as well as emotional distress compared to their control counterparts,¹¹ which indicated the potential adverse impacts of PSVU on human well-being and mental health.

ADHD adults are more vulnerable to be problematic short-video users,^{11,16} a trend supported by increasing evidence from animal models and human studies which showed that ADHD not only shares some common gene loci but also is a causal factor for substance abuse and behavioral addictions.^{17–19} Adult ADHD is often accompanied by severe emotion dysregulation, which is characterized by maladaptive coping mechanisms during emotional experiences and responses, such as difficulties in emotion understanding or limited ability to use context-appropriate emotional regulatory strategies.^{20–22} According to the compensatory internet use theory,²³ internet-related activities such as PSVU could be an alternative strategy to cope with negative affect. However, few studies have been conducted to examine the association between ADHD symptoms and PSVU. More specifically, IA and HI symptoms are reported to be differently related to co-occurring neurodevelopmental and behavioral problems.^{24–26} Such as, some studies suggest that HI, but not IA, was primarily related to problematic internet use,^{10,27–30} although other studies show that IA, rather than HI, is a significant predictor for problematic video game use.^{6,31} Despite these findings, it remains unclear whether PSVU is associated with specific ADHD symptoms. To address this, the present study will examine the association between ADHD symptom domains and PSVU in adults, as well as potential mediating variables between them.

The Potential Emotional and Cognitive Variables Between ADHD and PSVU

The I-PACE model (The Interaction of Person-Affect-Cognition-Execution, I-PACE model) proposed by Brand,^{32,33} provides us a comprehensive theoretical framework to understand the psychological and neurobiological mechanisms underlying the development of internet-related addictions. This model proposes that individual's psychopathological symptoms will affect emotional and cognitive responses which may act as triggers to their addictive behaviors such as PSVU.³³

Previous study proposed that emotional distress and boredom proneness play an important role as affective and cognitive risk factors during the development of addictive behaviors.³⁴ Emotional distress, as a form of internalizing symptoms including depression and anxiety, has been found to mediate the association between ADHD symptoms and increased addiction behaviors such as eating disorder^{35,36} and problematic Internet use.³⁷ Research suggests that higher levels of emotional distress may result from the failure to employ adaptive emotion regulation strategies, such as cognitive reappraisal.³⁸ Cognitive reappraisal, which involves altering one's interpretation of a situation to change its emotional impact, is particularly effective in reducing negative emotions and preventing excessive emotional responses.³⁹ Specifically, consistent evidence indicates that adults with ADHD use fewer adaptive emotion regulation strategies like cognitive reappraisal compared to those without ADHD,^{21,40,41} which may contribute to their higher levels of emotional distress.^{42,43} Thus, in the present study, the use of cognitive reappraisal and emotional distress were measured as affective variables, which may mediate the relationship between adult ADHD symptoms and PSVU. Notably, accumulating studies and reviews have shown that HI, but not IA, symptoms are correlated with emotional dysfunction in ADHD,^{44–46} and higher HI symptoms positively predicted difficulties in emotion regulation in ADHD.⁴⁵ Based on foregoing evidence, we assumed that emotional regulation and its related emotional distress mostly contributes to the pathway from the HI rather than IA to PSVU.

Boredom is defined as a relatively low arousal and dissatisfactory state in which the individual feels a lack of interest and is inattentive in the current activities.⁴⁷ Previous research had supported that less use of adaptive emotion regulation strategies was linked to increased emotional distress and boredom proneness.^{43,48–50} Individuals with higher boredom proneness are driven to increase short-video use,^{51–53} which could provide a constant stream of novel stimuli via a simple swipe of the finger across the screen. Thus, the affective factors including less use of cognitive appraisal and emotional distress together with cognitive factors such as boredom proneness play important roles in the association between ADHD and PSVU. In addition, boredom proneness is closely related to attention deficits such as the failure in maintaining attention and the proper allocation of attentional resources.^{54–56} It has also been reported to mediate the relationship between ADHD symptoms and addiction behaviors like smoking⁵⁷ or problematic smart phone use.⁵⁸ Therefore, we assumed that boredom proneness would act as an important cognitive variable to mediate the association between ADHD symptoms, especially the IA and PSVU.

The Current Study

The current study was conducted to examine the pathway with potential cognitive and emotional processes as mediating variables through which ADHD symptoms as well as IA and HI dimensions contribute to PSVU in adults within the framework of I-PACE model with structural equation modeling. Cognitive reappraisal and its associated emotional distress, including anxiety and depression, were measured as affective variables and boredom proneness as the cognitive variable. Based on previous empirical evidence, the following hypotheses were tested:

Hypothesis 1. ADHD symptoms would be associated with decreased cognitive reappraisal, increased emotional distress, boredom proneness, and PSVU.

Hypothesis 2. A serial mediation effect of cognitive reappraisal, emotional distress, and boredom proneness would exist between ADHD symptoms and PSVU.

Hypothesis 3. HI symptoms would be associated with decreased cognitive reappraisal, increased emotional distress and PSVU while IA symptoms would be associated with increased boredom proneness and PSVU.

Hypothesis 4. HI symptoms would contribute to PSVU with mediation effects of cognitive reappraisal and emotional distress while IA symptoms would contribute to PSVU with mediation effect of boredom proneness.

Material and Methods

Participants and Data Collection

The assessments were conducted via Chinese online survey platform (Wenjuanxing, <http://www.wjx.cn>) in Hangzhou Normal University (HZNU). Participants were excluded if they reported any current or prior diagnosis of neurological or psychiatric disorders, including ADHD. A total of 563 Chinese right-handed participants (female: $n = 280$; age range: 18–26; $\text{mean}_{\text{age}} \pm \text{SD} = 19.85 \pm 1.56$) were included in the current study. An informed consent statement was provided before the questionnaire test, and the study procedures were approved by the HZNU ethics committee. Participants could get 8 RMB after finishing the questionnaire set.

Measurements

Adult ADHD Symptoms

Adult ADHD Self-Report Scale (ASRS, Chinese version) with a good psychometric property was used to assess current adult ADHD symptoms.⁵⁹ The 18-items ASRS was developed according to the criteria of the DSM-IV, which consisted of IA and HI subscales with each one including 9-items.⁶⁰ Each item is rated on a 5-point Likert scale. Individuals with sum scores of 0–16 are classified as unlikely, 17–23 as likely to be with ADHD, and the ones with subscale scores greater than 24 are considered to be highly likely. Internal consistencies in the current sample for the total ADHD scale, IA and HI subscales was 0.84, 0.77, and 0.75 respectively.

Problematic Short-Video Use

The measurement of PSVU was adapted from the Facebook Intrusion Questionnaire (FIQ)⁶¹ in which the word “Facebook” was replaced by “short-video applications”. It consisted of eight items and each was rated on a 5-point Likert scale. Participants were asked to answer the questionnaire based on their usual usage of short-video applications with examples of popular platforms (eg, Douyin, Kuaishou) explicitly listed in the instructions. The internal consistency in the current sample was 0.85.

Cognitive Reappraisal

Cognitive Reappraisal (CR) was measured by the subscale of the Emotion Regulation questionnaire (ERQ).^{62,63} It consisted of 6 items and each item was rated on a 7-point Likert scale, where higher scores indicate better use of cognitive reappraisal as an emotion regulation strategy. In the current sample, the internal consistency for CR was 0.84.

Emotional Distress

Emotional Distress (ED)⁶⁴ is a latent variable indicated by depression and anxiety scores, which was measured by the Self-Rating Depression Scale (SDS; 20 items)^{65,66} and Self-Rating Anxiety Scale (SAS; 20 items).^{67,68} Each item was rated on a 4-point Likert scale. The standard score was calculated (total raw score multiplied by 1.25 and then find the integer) and used in the current study. Internal consistencies in the current sample for SDS and SAS were 0.85 and 0.87 respectively.

Boredom Proneness

The short version of the Boredom Proneness Scale (SBPS)^{69,70} was used to assess the boredom tendency of participants. It consists of 8 items, and each was rated on a 7-point Likert scale. Higher scores indicate higher levels of boredom proneness. The internal consistency was 0.88 in the current sample.

Data Analysis

Descriptive statistics and Pearson correlations with Bonferroni correction were computed in IBM SPSS Statistics version 25.0.⁷¹ Mediation analysis with latent variables were performed using Structural Equation Modeling (SEM) in Mplus version 8⁷² and a two-stage SEM model including confirmatory factor analysis (CFA) and full structural model test⁷³ were employed. The CFA was conducted to validate the measurement model with latent variables including ADHD, cognitive reappraisal, emotional distress, boredom proneness, and PSVU. ADHD was indicated by subscales scores, emotional distress was indicated by SAS and SDS scores, and the others including cognitive reappraisal, boredom proneness and PSVU were indicated by scores of each item. Then, the structural model examining the influence of ADHD symptoms on PSVU through potential affective and cognitive variables was evaluated with the latent variables of ADHD or the IA and HI symptoms as predictor variables, the latent variables of cognitive reappraisal, emotion distress, and boredom proneness functioned as mediators and the latent variable of PSVU as a dependent variable. Indirect effects were estimated with 5000 bootstrap samples and 95% confidence intervals (CIs). In addition, to evaluate the full model, several goodness-of-fit indices were calculated including the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). In line with previous studies,^{74–76} values of CFI and TLI greater than 0.90 and RMSEA less than 0.06 was considered to be a model with a good fit.

Results

Descriptive Statistics and Correlation Analyses

Descriptive statistics and correlations between variables were presented in Table 1 and Figure 1 respectively.

Correlation analysis showed that the total ADHD, IA, and HI symptoms were all positively associated with anxiety ($r = 0.41\text{--}0.54$, $p < 0.001$), depression ($r = 0.53$, $p < 0.001$), and boredom proneness ($r = 0.47$, $p < 0.001$). Cognitive reappraisal was negatively associated with the ADHD total score ($r = -0.15$, $p < 0.001$) and the HI symptoms ($r = -0.19$, $p < 0.001$), but not associated with the IA symptoms ($r = -0.08$, $p = 0.057$). In addition, cognitive reappraisal was also significantly associated with anxiety ($r = -0.29$, $p < 0.001$), depression ($r = -0.38$, $p < 0.001$), and boredom proneness ($r = -0.29$, $p < 0.001$). PSVU was positively associated with ADHD ($r = 0.31\text{--}0.35$, $p < 0.001$), anxiety ($r = 0.27$, $p < 0.001$), depression ($r = 0.31\text{--}0.35$, $p < 0.001$), and boredom proneness ($r = 0.31\text{--}0.35$, $p < 0.001$).

Table 1 Sample Characteristics of Study Measures

Characteristics	Mean	SD	N
Age	19.85	1.56	563
Male	50.3% (ratio)		283
IA	15.22	4.46	563
HI	12.35	4.44	563
Total ADHD	27.57	7.95	563
CR	31.26	5.23	563
Anxiety	41.78	9.91	563
Depression	46.99	9.59	563
BP	27.13	10.49	563
PSVU	16.56	6.30	563

Abbreviations: IA, Inattention; HI, Hyperactivity and Impulsivity; ADHD, Attention Deficit Hyperactivity Disorder; CR, Cognitive Reappraisal; BP, Boredom Proneness; PSVU, Problematic Short-Video Use; SD, standard deviation.

0.001), depression ($r = 0.27$, $p < 0.001$), and boredom proneness ($r = 0.35$, $p < 0.001$). However, PSVU showed no significant correlation with cognitive reappraisal ($r = -0.11$, $p = 0.012$) after Bonferroni correction.

Model Testing

The five-factor CFA was tested regarding the measurement model. The results of the five-factor CFA (Figure 2) show that all indicator variables were reliable and valid measures of their respective latent variables, supported by a significant moderate-to-high factor loading ($\beta = 0.50\text{--}0.93$, $ps < 0.001$). Furthermore, five latent variables were significantly correlated with each other ($r = -0.17\text{--}0.68$, $ps < 0.01$).

The structural model (Figure 3) examining the influence of total ADHD symptoms on PSVU through cognitive reappraisal, emotion distress, and boredom proneness was evaluated to have a fair model fit ($\chi^2 = 859.922$, $df = 287$, $p < 0.01$, $RMSEA = 0.060$ [0.055,0.064], $CFI = 0.915$, $TLI = 0.904$, $SRMR = 0.055$). In addition, the influences of IA and HI symptoms on PSVU were also explored with the structural model separately (Figure 4), which showed a good fit for the data (IA: $\chi^2 = 780.166$, $df = 264$, $p < 0.01$, $RMSEA = 0.059$ [0.054,0.064], $CFI = 0.919$, $TLI = 0.908$, $SRMR = 0.054$; HI: $\chi^2 = 789.450$, $df = 264$, $p < 0.01$, $RMSEA = 0.059$ [0.055,0.064], $CFI = 0.918$, $TLI = 0.907$, $SRMR = 0.055$).

Effects of Total ADHD Symptoms on PSVU

For the standardized direct effects (Figure 3), the total ADHD symptoms that exerted significant direct effects on cognitive reappraisal ($\beta = -0.17$, $p < 0.01$), emotional distress ($\beta = 0.64$, $p < 0.001$), boredom proneness ($\beta = 0.18$, $p < 0.05$), and PSVU ($\beta = 0.34$, $p < 0.001$). However, while boredom proneness emerged as a significant direct predictor of PSVU ($\beta = 0.21$, $p < 0.01$), the direct effects of cognitive reappraisal ($\beta = -0.04$, $p > 0.05$), and emotional distress ($\beta = -0.05$, $p > 0.05$) on PSVU were not significant.

For the standardized indirect effects of total ADHD symptoms on PSVU through one mediator (Table 2), the ADHD-boredom proneness-PSVU condition was significant (Estimate = 0.037, 95% CI = [0.007, 0.092]) which suggests that ADHD symptoms can influence PSVU through increased boredom proneness. The condition with cognitive reappraisal (Estimate = 0.007, 95% CI = [-0.012, 0.031]) or emotional distress (Estimate = -0.034, 95% CI = [-0.166, 0.076]) as mediators were not significant. For the two-mediator pathways (Table 2), while significant indirect effects were found for the ADHD-cognitive reappraisal-boredom proneness-PSVU (Estimate = 0.004, 95% CI = [0.001, 0.012]) and ADHD-

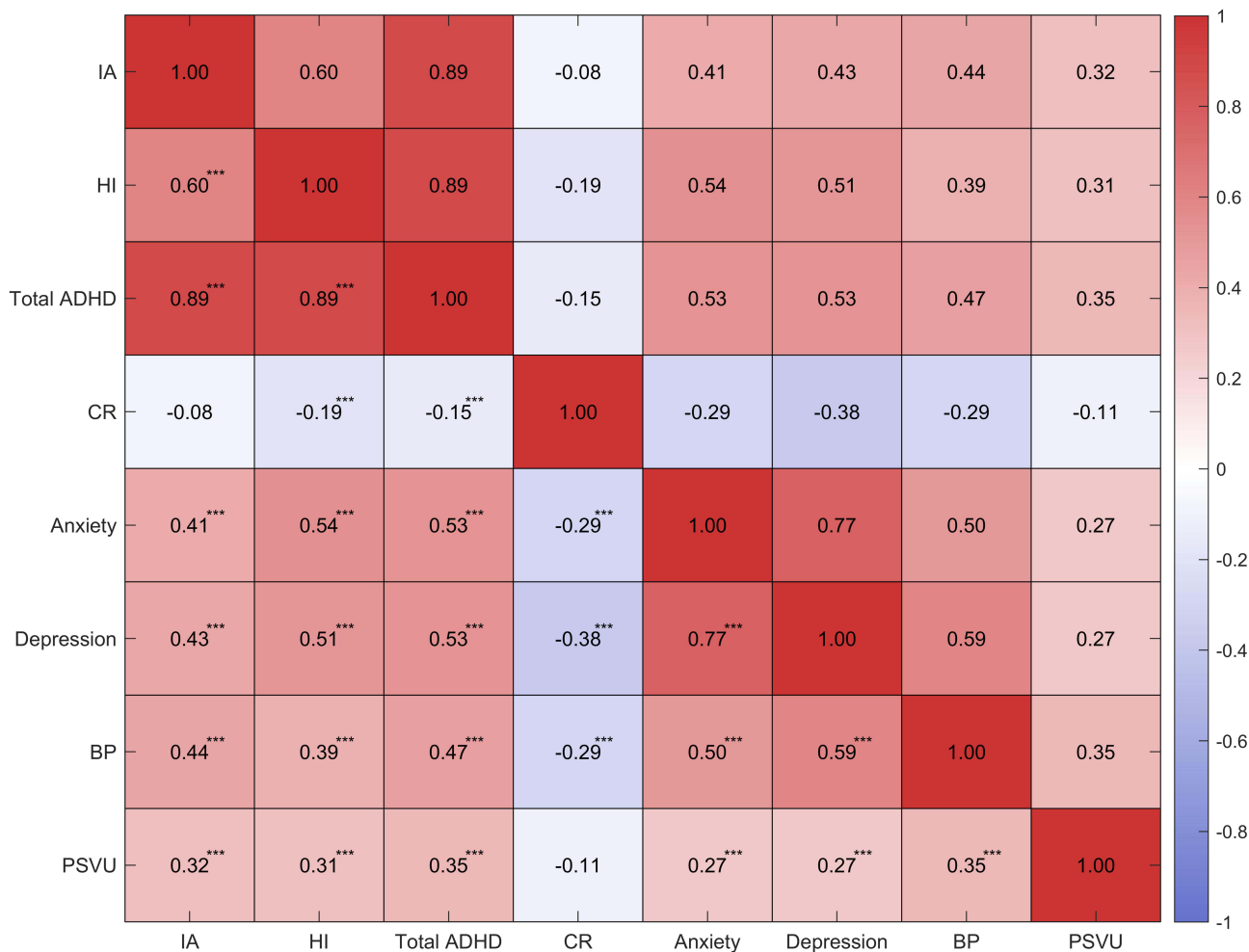


Figure 1 Correlation metric. Correlation coefficients are present. *** $p < 0.001$.
Abbreviations: IA, Inattention; HI, Hyperactivity-Impulsivity; ADHD, Attention Deficit Hyperactivity Disorder; CR, Cognitive Reappraisal; BP, Boredom Proneness; PSVU, Problematic Short-Video Use.

emotional distress-boredom proneness-PSVU (Estimate = 0.072, 95% CI = [0.022, 0.139]) conditions, the ADHD-cognitive reappraisal-emotional distress-PSVU pathway showed a non-significant effect (Estimate = -0.003, 95% CI = [-0.014, 0.005]). For the three-mediator pathway (Table 2), there was a significant indirect effect of ADHD on PSVU through cognitive reappraisal, emotional distress, and boredom proneness in sequence (Estimate = 0.005, 95% CI = [0.001, 0.014]).

Effects of the IA and HI Symptoms on PSVU

To determine whether the IA and HI symptoms would act on PSVU via distinct path patterns with the possible mediating variables of cognitive reappraisal, emotional distress, and boredom proneness, additional SEM models were conducted to assess the associations between HI and IA with PSVU separately. The results showed that both IA and HI could directly predict emotional distress (IA: $\beta = 0.44$, $p < 0.001$; HI: $\beta = 0.53$, $p < 0.001$; Figure 4A and B) and PSVU (IA: $\beta = 0.19$, $p < 0.001$; HI: $\beta = 0.20$, $p < 0.001$). While the effect of IA on boredom proneness ($\beta = 0.19$, $p < 0.001$), but not cognitive reappraisal ($\beta = -0.06$, $p > 0.05$) was significant, the effect of HI on cognitive reappraisal ($\beta = -0.18$, $p < 0.01$), but not boredom proneness ($\beta = 0.04$, $p > 0.05$), was significant, which indicates that IA and HI differently relate to mediators and might influence PSVU by different methods.

For the standardized indirect effects through one mediator (Table 2), boredom proneness was found to be significantly mediated by the IA-PSVU condition (Estimate = 0.044, 95% CI = [0.016, 0.086]) but not the HI-PSVU condition

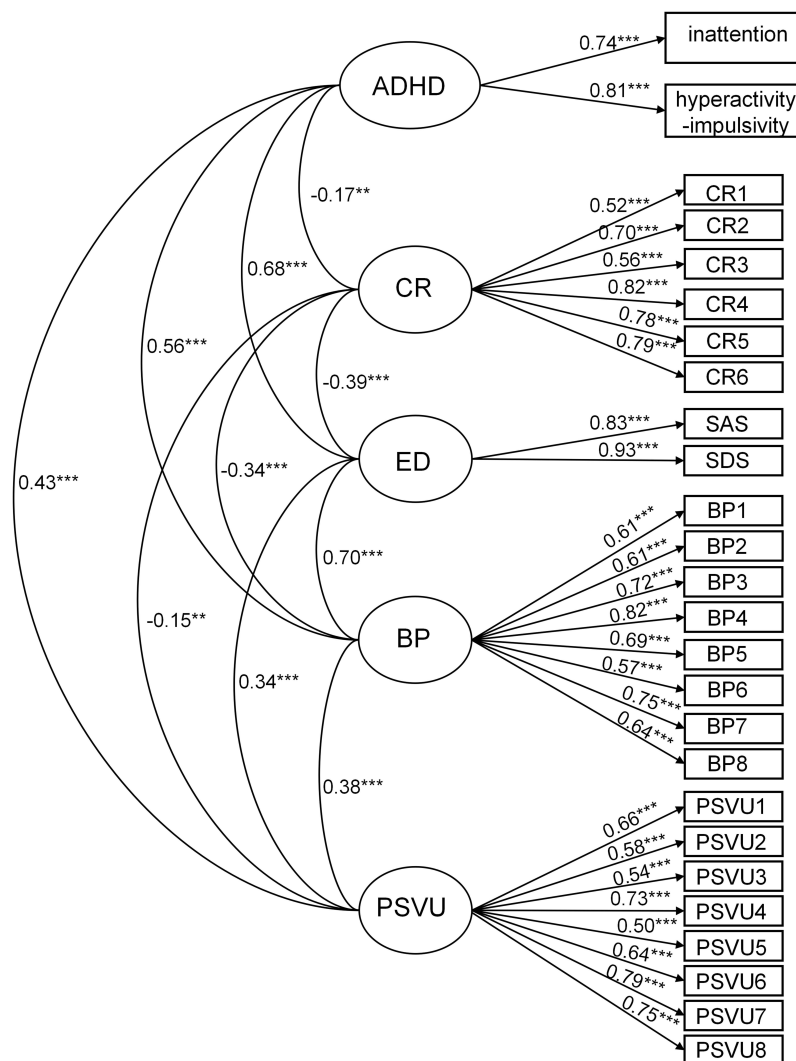


Figure 2 Five factor's confirmatory factor analysis (CFA) model (positing the existence of bivariate correlations among five latent variables). ** $p < 0.01$, *** $p < 0.001$.
Abbreviations: ADHD, Attention Deficit Hyperactivity Disorder; CR, Cognitive Reappraisal; ED, Emotional Distress; BP, Boredom Proneness; PSVU, Problematic Short-Video Use.

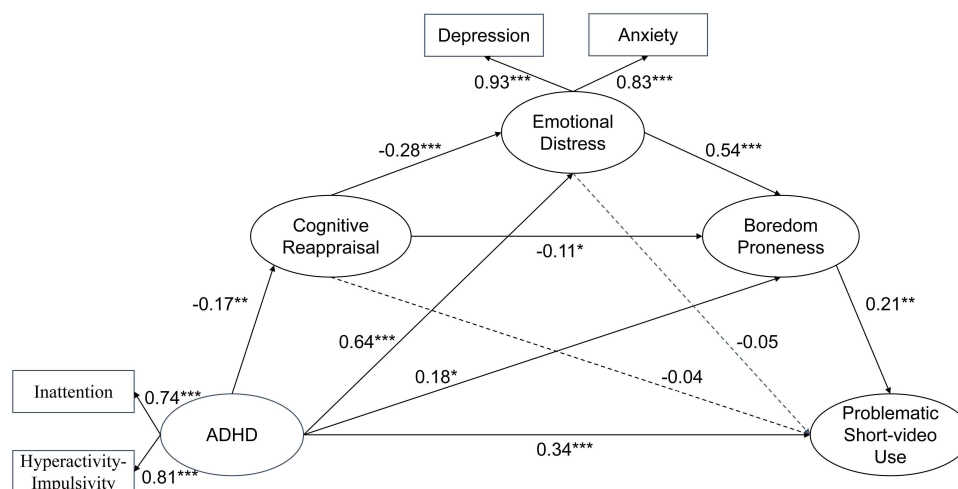


Figure 3 Structural equation model testing the direct and indirect relationships between ADHD symptoms and problematic short-video use. Circles represent latent variables. Rectangles represent measured variables. Standardized coefficients are presented. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The non-continuous arrow refers to a non-significant effect between variables; the continuous arrow refers to a significant effect.

Abbreviation: ADHD, Attention Deficit Hyperactivity Disorder.

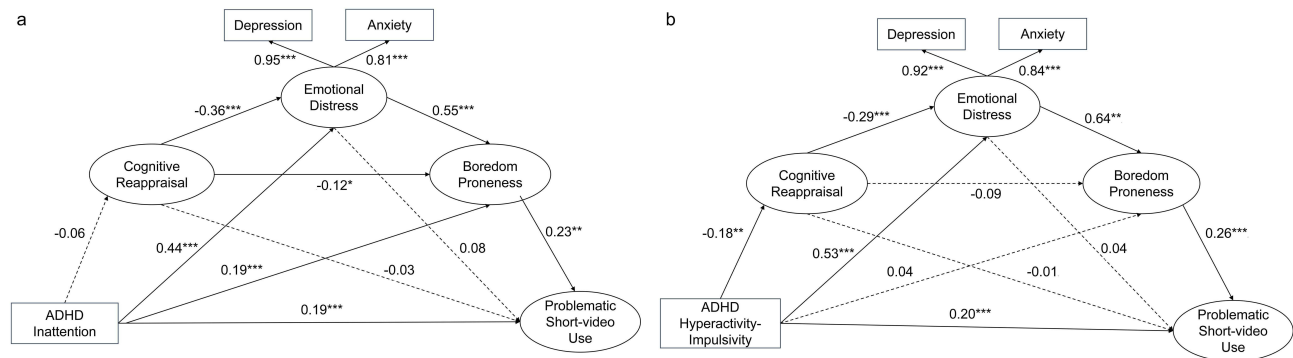


Figure 4 Structural equation model testing the direct and indirect relationships between the IA and HI dimensions and problematic short-video use with IA (a) and HI (b) as the independent variable. Circles represent latent variables. Rectangles represent measured variables. Standardized coefficients are presented. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The non-continuous arrow refers to a non-significant effect between variables; the continuous arrow refers to a significant effect.

Abbreviation: ADHD, Attention Deficit Hyperactivity Disorder.

(Estimate = 0.009, 95% CI = [-0.014, 0.040]). The indirect effects of cognitive reappraisal (IA, Estimate = 0.002, 95% CI = [-0.004, 0.019]; HI, Estimate = 0.001, 95% CI = [-0.021, 0.024]) or emotional distress as mediators (IA, Estimate = 0.033, 95% CI = [-0.030, 0.100]; HI, Estimate = 0.023, 95% CI = [-0.065, 0.112]) were not significant in either the IA nor HI pathways. For conditions incorporating two mediators, the study found significant indirect effects via emotional distress and boredom proneness (IA, Estimate = 0.055, 95% CI = [0.021, 0.099]; HI, Estimate = 0.088, 95% CI = [0.043, 0.150]) in both the IA model and the HI model. Indirect effects through cognitive reappraisal and emotional distress (IA, Estimate = 0.002, 95% CI = [-0.001, 0.012]; HI, Estimate = 0.002, 95% CI = [-0.006, 0.014]) did not reach significance in either symptom domains of the ADHD models. For the effect including three mediators (cognitive reappraisal,

Table 2 Indirect Effects of ADHD Symptoms, IA and HI Dimensions on PSVU

Total ADHD Symptom as Independent Variable				
Indirect Effect	Path	Estimate	SE	95% CI
One mediator	ADHD-CR-PSVU	0.007	0.011	[-0.012, 0.031]
	ADHD-ED-PSVU	0.034	0.061	[-0.166, 0.076]
	ADHD-BP-PSVU	0.037	0.020	[0.007, 0.092]
Two mediators	ADHD-CR-ED-PSVU	0.003	0.005	[-0.014, 0.005]
	ADHD-CR-BP-PSVU	0.004	0.003	[0.001, 0.012]
	ADHD-ED-BP-PSVU	0.072	0.029	[0.022, 0.139]
Three mediators	ADHD-CR-ED-BP-PSVU	0.005	0.003	[0.001, 0.014]
IA as independent variable				
One mediator	IA-CR-PSVU	0.002	0.005	[-0.004, 0.019]
	IA-ED-PSVU	0.033	0.033	[-0.030, 0.100]
	IA-BP-PSVU	0.044	0.018	[0.016, 0.086]
Two mediators	IA-CR-ED-PSVU	0.002	0.003	[-0.001, 0.012]
	IA-CR-BP-PSVU	0.002	0.002	[0.000, 0.007]
	IA-ED-BP-PSVU	0.055	0.019	[0.021, 0.099]
Three mediators	IA-CR-ED-BP-PSVU	0.003	0.003	[-0.001, 0.010]

(Continued)

Table 2 (Continued).

HI as independent variable				
One mediator	HI-CR-PSVU	0.001	0.011	[-0.021, 0.024]
	HI-ED-PSVU	0.023	0.045	[-0.065, 0.112]
	HI-BP-PSVU	0.009	0.014	[-0.014, 0.040]
Two mediators	HI-CR-ED-PSVU	0.002	0.005	[-0.006, 0.014]
	HI-CR-BP-PSVU	0.004	0.003	[0.000, 0.012]
	HI-ED-BP-PSVU	0.088	0.027	[0.043, 0.150]
Three mediators	HI-CR-ED-BP-PSVU	0.009	0.004	[0.003, 0.020]

Notes: Standardized coefficients (Estimates), bootstrapped standard errors (SEs), and bias-corrected bootstrapped 95% confidence intervals (CIs) are presented. An indirect effect is considered statistically significant if the 95% confidence interval does not include zero.

Abbreviations: ADHD, Attention deficit hyperactivity disorder; IA, Inattention; HI, Hyperactivity-Impulsivity; CR, Cognitive Reappraisal; ED, Emotional Distress; BP, Boredom Proneness; PSVU, Problematic Short-Video use.

emotional distress, and boredom proneness), there was a significant effect in the condition from HI to PSVU (Estimate = 0.009, 95% CI = [0.003, 0.020]) but not from IA to PSVU (Estimate = 0.003, 95% CI = [-0.001, 0.010]).

Discussion

The current study used SEM to examine Inattentive (IA) and Hyperactive-Impulsive (HI) symptoms of ADHD and their relation to PSVU in adults within the framework of the I-PACE model including potential emotional and cognitive processes that mediate the relationship between them. The results showed a significant mediation effect of cognitive reappraisal, emotional distress, and boredom proneness regarding the connection between ADHD symptoms and PSVU. In particular, both of the IA and HI symptoms influence PSVU via increased emotional distress and boredom proneness. Divergent pathways were found by which IA increased the likelihood of PSVU indirectly by heightening boredom proneness, whereas HI primarily influenced PSVU through cognitive reappraisal, emotional distress, and boredom proneness. Together, these findings shed light on the potential mechanisms underlying associations between different ADHD domain symptoms and PSVU, which might provide valuable insights into developing more nuanced prevention and treatment strategies for ADHD adults with PSVU.

In line with our expectations, ADHD symptoms were directly associated with decreased use of cognitive reappraisal, higher emotional distress and boredom proneness, resulting in increased PSVU. ADHD symptoms have previously been reported to be positive associated with various addictive behaviors, such as internet use and gaming disorder.^{6-8,77} Our findings extend this by highlighting that ADHD symptoms may specifically lead to problematic use of short videos, a behavior that shares the addictive nature observed in other internet-related problems. This underscores the need for increased attention to PSVU in ADHD adults, as it may have similar long-term consequences as other addictive behaviors, such as impaired social functioning and emotional regulation. These results align with prior research, which suggests that adults with ADHD tend to use fewer adaptive emotional regulation strategies⁴¹ and exhibit higher levels of internalizing symptoms such as depression, anxiety, and boredom.^{78,79} Furthermore, Based on previous findings showing that ADHD groups exhibit altered reward system and delay aversion,^{80,81} increased short videos use with the brief and personalized content might provide a way to get immediate gratification for ADHD adults and further feed the tendencies of their ADHD subtype.

Our findings reveal that boredom proneness, but not cognitive reappraisal or emotional distress, directly mediates the relationship between ADHD symptoms and PSVU. Previous research has shown that boredom,⁸² emotion regulation,³⁷ and emotional distress³⁵ each independently mediate the relationship between ADHD symptoms and addictive behaviors.

However, no study has combined them in the same model. Our study extends the literature by demonstrating that when boredom is included in the model, neither cognitive reappraisal nor emotional distress directly mediates the relationship. Instead, both cognitive reappraisal and emotional distress influence PSVU indirectly through their effect on boredom, highlighting boredom as a key cognitive factor in this relationship. In addition, the serial mediating effects of cognitive reappraisal, emotional distress, and boredom proneness were found to be significant for the association between total ADHD symptoms and PSVU. ADHD individuals often struggle with boredom proneness, which acts as a motivational driver for seeking immediate stimulation. The difficulties in emotion regulation associated with ADHD, such as the limited use of cognitive reappraisal, exacerbate this tendency, making short-video consumption an appealing outlet for temporary emotional relief. The constant need for stimulation, coupled with heightened emotional distress and boredom, drives individuals to engage in PSVU as a coping mechanism. Our findings contribute to the literature by integrating emotional and cognitive variables and linking them to ADHD symptoms, providing a clearer and more complete path between ADHD symptoms and PSVU. Therefore, interventions focused on managing boredom, improving emotion regulation skills, and reducing emotional distress could help reduce the risk of PSVU in ADHD adults.

In line with our expectations, both IA and HI symptoms were identified as direct predictors of PSVU in the present study. This finding extends the literature by differentiating the effects of ADHD symptom domains on addictive behaviors, an area where scarce research has been conducted and findings are inconsistent. For example, one study conducted with a Middle Eastern sample revealed that both IA and HI are significantly associated with internet gaming addiction,⁸³ while two other studies indicated that IA, rather than HI, is a significant predictor of smartphone usage.^{58,84} This difference may stem from the distinct nature of various addictive behaviors, as the mechanisms driving problematic smartphone use might differ from those underlying PSVU or internet gaming addiction. Our findings suggest that the unique design of short video platforms, which combine engaging, fast-paced, and algorithm-driven content, may appeal to be related to both IA and HI symptoms simultaneously. The rapid and varied stimuli cater to IA tendencies, while the interactive, impulsive nature of swiping aligns with HI behaviors. This dual appeal could explain why both symptom domains emerge as significant predictors of PSVU in our study, bridging the gap in prior inconsistent findings.

Different with our expectation, IA and HI contributed to PSVU via both common and distinct pattern. Both of the IA and HI symptoms influence PSVU via increased emotional distress and boredom proneness. Specifically, IA, but not HI, emerged as a significant predictor of boredom proneness and boredom proneness could independently mediate the link between IA and PSVU. Although existing literature consistently shows a positive association between ADHD symptoms and boredom,^{78,82} few studies have clarified whether this relationship is more closely linked to IA or HI. Our findings expand the literature in this area by demonstrating that IA, in contrast to HI, had a robust association with the propensity for boredom, which may lead to PSVU. This aligns with existing research showing that boredom was associated with ADHD inattention, which could predict increased errors in tasks requiring sustained attention.⁵⁵ Furthermore, neuroimaging evidence from fMRI studies indicated that boredom, mood, and mind-wandering during sustained attention tasks engage common brain areas located in the default mode network.^{85,86} In light of these findings, interventions targeting ADHD individuals with IA symptoms should focus on addressing boredom proneness as a key factor in preventing PSVU. Such as, strategies aimed at increasing attention-demanding activities with interesting stimuli could help alleviate boredom and reduce the likelihood of turning to short videos for emotional relief.

On the other hand, HI directly predicted cognitive reappraisal while IA did not. The serial mediation of cognitive reappraisal, emotional distress, and boredom proneness was significant between the HI-PSVU condition while it failed to reach significance in IA-PSVU condition. This finding extends previous literature on the relationship between HI and emotion regulation strategies by demonstrating that HI contributes to internalizing symptoms through its influence on the use of cognitive reappraisal. In contrast, IA may lead to internalizing symptoms through alternative pathways. The specific associations between HI and cognitive reappraisal were in line with previous findings which showed that emotion dysregulation in ADHD characterized by emotional instability and emotional impulsivity could be significantly predicted by HI rather than IA.⁸⁷ Furthermore, the emotion dysregulation was related to an increased clustering and local efficiency of the right insula in individuals with ADHD prominently characterized by HI,⁸⁸ although one study found that IA was more strongly related to emotion regulation and impairment than HI.⁸⁹ In light of these findings, interventions for ADHD individuals with pronounced HI symptoms could focus on training emotion regulation strategies, particularly

cognitive reappraisal. Such training may not only mitigate internalizing symptoms but also reduce PSVU via enhancing their capacity to manage negative emotions effectively.

Certain limitations in the present study should be acknowledged. Firstly, given the sample consisted mostly of young adults aged between 18 and 25, a broader age range could be considered for future research. Secondly, only one particular emotion regulation strategy, cognitive appraisal, was assessed in the present study. Future investigations could benefit from examining multiple facets of emotion regulation to better understand its relationship with ADHD and PSVU. Thirdly, as a cross-sectional, survey-based study, it does not allow for causal inferences between the variables examined. While the relationships identified are meaningful, the directionality of these associations remains speculative and should be interpreted with caution.

Lastly, psychiatric comorbidities were ruled out solely based on self-reported survey data rather than clinical diagnostic assessments, which may induce potential bias due to underreporting or lack of awareness among participants. Future studies incorporating comprehensive clinical evaluations would provide a more robust understanding of the impact of psychiatric comorbidities.

Conclusion

In conclusion, the results reveal a positive association between adult ADHD symptoms and PSVU, while also highlighting a serial mediation effect with cognitive reappraisal, emotional distress, and boredom proneness. Shared and distinct pathways emerged when examining the relationship between IA and HI with PSVU separately. IA and HI symptoms influence PSVU via increased emotional distress and boredom proneness. However, while IA was found to influence PSVU through boredom proneness, HI was strongly related to cognitive reappraisal and could contribute to PSVU with emotional dysregulation and boredom proneness. These findings could prompt the understanding of relationships between ADHD domain symptoms and PSVU, which might provide novel insights into the PSVU interventions in adults with different ADHD symptoms.

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Disclosure

The authors report no conflicts of interest in this work.

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