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ADHD symptoms and problematic digital media use in emerging adults: Investigating the role of cognitive deficits as mediators

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ABSTRACT

This study examined the relationship between ADHD symptoms and problematic social media use (PSMU) and problematic gaming (PG) in a community sample of emerging adults. Cognitive deficits underlying ADHD – inhibitory control deficits, reward sensitivity, and temporal processing deficits – were investigated as potential mechanisms linking ADHD symptoms to PSMU and PG. In a sample of 111 emerging adults ($M_{age} = 21.2$, $SD = 2.7$; 84% female), ADHD symptoms, PSMU, and PG were assessed using self-report scales, while cognitive deficits were evaluated through both self-report scales and behavioural tasks. Parallel mediation analyses revealed significant positive direct effects between ADHD symptoms and both PSMU and PG, but found no significant mediating effects of the hypothesised mechanisms. Exploratory analyses suggested that inhibitory control and temporal processing deficits may play a role in linking hyperactivity/impulsivity symptoms to PSMU, and inhibitory control deficits emerged as a possible transdiagnostic factor for concurrent ADHD symptoms and PSMU. Nonetheless, the main analyses did not support mediation by cognitive deficits, indicating no evidence that they explained the associations between ADHD symptoms and problematic digital media use. Future research may explore such prospective mechanisms in longitudinal designs with representative samples to inform interventions which may reduce problematic digital media use in individuals with elevated ADHD symptoms.

1. Introduction

Different forms of problematic digital media use, such as problematic social media use (PSMU) and problematic gaming (PG), are growing concerns. PSMU affects 5% of the general population and 33% of young adults (Cheng et al., 2021; Tang et al., 2017), although with great variance in prevalence depending on factors like measures used and cultural background, while PG affects 3% of the general population and 10% of young adults (Gao et al., 2022; Kim et al., 2022; Stevens et al., 2020). PSMU and PG can negatively impact mental health, academic performance, and social functioning, including reduced well-being, increased stress, and lower academic outcomes (Boer et al., 2020; Limone et al., 2023; Shannon et al., 2022). Both are particularly prevalent among youth with symptoms of attention-deficit/hyperactivity disorder (ADHD; Hong et al., 2023; Thorell et al., 2022), a condition characterized by inattention, hyperactivity, and/or impulsivity (American Psychiatric Association, 2013). ADHD may increase susceptibility to problematic digital media use (i.e., PSMU and PG), which would be consistent with its high comorbidity with behavioural addictions (Karaca et al., 2016). According to the Triple-Pathway Model (Sonuga-Barke et al., 2010), ADHD symptoms arise from three distinct neuropsychological pathways: an inhibitory control pathway representing difficulties with suppressing impulsive responses, a reward sensitivity pathway representing heightened preference for immediate rewards, and a temporal processing pathway representing difficulties in perceiving time and structuring behaviour in time. This study investigated whether cognitive deficits in these three neuropsychological domains explain the relationship between ADHD symptoms and PSMU and PG in emerging adults.

PSMU and PG are framed as behavioural addictions. PSMU revolves

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around usage of apps such as Instagram, TikTok, and Snapchat (Hendrikse & Limniou, 2024; Kircaburun et al., 2018), but it has no formal status and its diagnostic classification remains debated (Bickham, 2021). PG revolves around usage of video games via smartphones and computers (Li et al., 2022; Paik et al., 2017), and it is classified as gaming disorder in the International Classification of Diseases (11th revision; World Health Organization, 2019) and as a research diagnosis warranting further investigation in the Diagnostic and Statistical Manual of Mental Disorders (5th edition [DSM-5]; APA, 2013). PSMU and PG show a small-to-moderate correlation (Király et al., 2014; Sánchez-Fernández et al., 2024), with PG being more common among males, and PSMU among females (Fam, 2018; Mari et al., 2022; Su et al., 2020). However, there are notable similarities between PSMU and PG in some associated mental health and social difficulties, such as depressive and anxiety symptoms (Moreno et al., 2021), psychosomatic symptoms, low self-concept, and social problems (Burén et al., 2021).

ADHD symptomatology is positively correlated to both PSMU and PG. Meta-analyses and systematic reviews report positive associations between ADHD and PSMU in children and adolescents (Dekkers & Van Hoorn, 2022; Werling et al., 2022). Studies in adults show strong correlations between ADHD symptoms and PSMU (Hussain & Wegmann, 2021), with young adults with more ADHD symptoms experiencing greater susceptibility to PSMU (Aydin et al., 2023). Regarding PG, adolescents with ADHD consistently show increased susceptibility to PG (Berloffa et al., 2022; Folgar et al., 2024), with systematic reviews and meta-analyses confirming positive associations between ADHD symptoms (and symptom dimensions of inattention and hyperactivity) and PG (Coutelle et al., 2024; Dullur et al., 2020; Koncz et al., 2023; Panagiotidi, 2017). The reasons behind these associations remain unclear, as previous research has not extensively examined underlying neuropsychological deficits, such as executive functioning or reward sensitivity, as potential mediators (Thorell et al., 2022).

The Triple-Pathway Model identifies three causal pathways in ADHD symptomatology: inhibitory control deficits, increased reward sensitivity, and temporal processing deficits (Sonuga-Barke et al., 2010). Inhibitory control deficits, characterized by difficulties with impulse control, may increase addiction risk by impairing control over impulses related to problematic substances and behaviours (Grant & Chamberlain, 2014; Smith et al., 2014). Reward sensitivity, characterized by a preference for immediate rewards and manifesting as delay discounting (i.e., reduced valuation of delayed rewards), may predispose individuals to value short-term choices that can lead to addiction (MacKillop et al., 2011). Temporal processing deficits, characterized by difficulties in perceiving and managing time, may contribute to a cognitive-behavioural profile that predisposes individuals to suboptimal decision-making (Sonuga-Barke & Fairchild, 2012; Wittmann & Paulus, 2007) and have been associated with impaired time estimation in individuals with addictive behaviours (Gu et al., 2024). Additionally, these constructs are also relevant in prominent models of behavioural addictions, such as the I-PACE model (Brand et al., 2016; Brand et al., 2019) and the cognitive-behavioural model of Internet gaming disorder (Dong & Potenza, 2014), which emphasise inhibitory control deficits and altered reward processing as relevant factors in problematic digital media use. Overall, these findings and models align with the idea that cognitive deficits shape behavioural regulation in ways which could increase susceptibility to PSMU and PG.

Research has linked the factors of the Triple-Pathway Model to both PSMU and PG. Inhibitory control deficits have been positively associated with PSMU (Gou et al., 2023; Moretta & Buodo, 2021; Soares et al., 2023; Wegmann et al., 2020; Xu et al., 2024) and PG (Argyriou et al., 2017; Şalvarlı & Griffiths, 2019). Reward sensitivity has been positively associated with problematic smartphone and internet use in adolescents and young adults (Deng et al., 2021; Vargas et al., 2019) and PG (Raiha et al., 2020; Pirrone et al., 2023; Wang et al., 2024). Delay discounting, a related construct, also correlates positively with internet addiction (Cheng et al., 2020). Temporal processing deficits have been positively associated with smartphone addiction in adolescents (Marciano & Camerini, 2022) and young adults (Lin et al., 2015) and might show a relationship with PG, although findings are inconsistent (Nuyens et al., 2019). Overall, these findings suggest that inhibitory control deficits, reward sensitivity, and temporal processing deficits are plausible mechanisms underlying PSMU and PG, warranting further investigation into their roles.

Building on this, we use the Triple-Pathway Model as a framework to examine inhibitory control, reward sensitivity, and temporal processing as potential mechanisms linking ADHD symptoms with PSMU and PG. In order to capture differential aspects of these constructs and address the generally weak correlation between self-report and behavioural measures (Dang et al., 2020), we operationalised these constructs both as self-report and behavioural measures. By including both types of measures, we provided complementary perspectives, while also accounting for the possibility that individuals with ADHD struggle with accurately estimating their symptoms and functional impairment (Harrison & Edwards, 2023; Mörstedt et al., 2015).

Previous research has not investigated whether the cognitive deficits from the Triple-Pathway Model explain the link between ADHD symptoms and PSMU and PG in emerging adults. Therefore, the main aim of this study was to investigate whether the relationship between ADHD symptoms and PSMU and PG is mediated by inhibitory control deficits, reward sensitivity, and temporal processing deficits. It was expected that higher ADHD symptoms would be associated with increased inhibitory control deficits, reward sensitivity, and temporal processing deficits, which were in turn expected to be associated with higher levels of PSMU and PG. Furthermore, we expected that ADHD symptoms would have indirect effects on PSMU and PG through these deficits. We also explored the relevance of the ADHD symptom dimensions of hyperactivity/impulsivity and inattention, addressing the limited research in this area (Halkett & Hinshaw, 2024). In addition, we explored a transdiagnostic model to examine potential shared factors related to concurrent problems (such as ADHD symptoms and PSMU/PG), aligning with the growing focus on transdiagnostic research that seeks to identify shared mechanisms underlying co-occurring problems (Alsem et al., 2023; Nolen-Hoeksema & Watkins, 2011).

2. Methods

2.1. Participants

The sample consisted of 111 emerging adults ($M_{age} = 21.20$, $SD_{age} = 2.77$) representing diverse nationalities (53% European, 41% Asian, 6% Other). The majority of the sample ($n = 93$; 84%) was female. Inclusion criteria for the analyses were that participants confirmed using social media ($n = 111$) or gaming ($n = 88$) in the past year. Participants were excluded ($n = 2$) if they failed any attention checks from the questionnaire section (i.e., "Please respond with "never" to this item."), the delay discounting task (unrealistically fast responses), or the stop-signal task (unrealistically low accuracy). Therefore, the PSMU analysis sample contained 109 participants ($M_{age} = 21.24$, $SD_{age} = 2.77$; 84% female), and the PG analysis sample contained 87 participants ($M_{age} = 21.21$, $SD_{age} = 2.81$; 83% female).

2.2. Materials

2.2.1. Self-report instruments

2.2.1.1. Problematic social media use. The Social Media Disorder Scale (SMDS; Van den Eijnden et al., 2016) is a validated instrument with 9 items (answered "yes/no"), developed based on the corresponding DSM-5 criteria for internet gaming disorder. The total score is a sum of scored responses and ranges between 0 and 9, with a proposed cut-off score ≥ 5 indicating problematic use. The scale had acceptable internal consistency in the current study ($\alpha = 0.69$).

2.2.1.2. Problematic gaming. The Internet Gaming Disorder Scale (IGDS; Pontes and Griffiths, 2014) is a validated instrument with 9 items (answered "yes/no"), developed based on the DSM-5 criteria. The total score is a sum of scored responses and ranges between 0 and 9, with a proposed cut-off score ≥ 5 indicating problematic use. The scale had acceptable to good internal consistency in the current study ($\alpha = 0.74$).

2.2.1.3. ADHD symptoms. The Adult ADHD Self-Report Scale (ASRS; Kessler et al., 2005) is a validated instrument with 18 items, developed based on the DSM-5 criteria, and answered with a 5-point Likert scale ("never" to "very often"). The total score is a sum of scored responses and ranges between 0 and 72, with a proposed cut-off score ≥ 37 indicating clinically significant symptom levels. The ASRS includes two symptom dimensions, inattention and hyperactivity/impulsivity, which can be scored separately. The scale had good to excellent internal consistency in the current study ($\alpha = 0.88$).

2.2.1.4. Inhibitory control. The Inhibition Subscale of the Teenage Executive Functioning Inventory (TEXI; Thorell et al., 2020) is a validated instrument with 11 items, answered with a 5-point Likert scale ("definitely not true" to "definitely true"). The total score is a sum of scored responses and ranges between 11 and 55. The scale had good to excellent internal consistency in the current study ($\alpha = 0.88$).

2.2.1.5. Reward sensitivity. The Delay Discounting Subscale of the Quick Delay Questionnaire (QDQ; Clare et al., 2010) is a validated instrument with 5 items, answered with a 5-point Likert scale response options ("not like me at all" to "very like me"). The total score is a sum of scored responses and ranges between 5 and 25. The scale had acceptable internal consistency in the current study ($\alpha = 0.65$).

2.2.1.6. Temporal processing. The Individual Time Span Scale (ITSS; Nowack, 2023) is a validated instrument with 10 items, answered with a 7-point Likert scale ("very uncharacteristic of me" to "very characteristic of me"). The total score is a sum of scored responses and ranges between 10 and 70. The scale had good internal consistency in the current study ($\alpha = 0.73$).

2.2.2. Behavioural instruments

2.2.2.1. Inhibitory control. A computerized stop-signal task (Verbruggen et al., 2019) included one practice block (20 trials) and three testing blocks (68 trials each) with randomly presented "go" and "stop" trials. In "go" trials, participants responded by indicating the direction of the arrow on the keyboard. In "stop" trials (25% of trials), an auditory signal following the arrow instructed participants to suppress their response. Each trial began with a 250ms fixation circle, followed by a 1250ms arrow. The stop-signal delay (SSD) in "stop" trials started at 250ms and adjusted by $\pm$ 50ms based on trial success. Stop-signal reaction time (SSRT), estimated using the integration method (Verbruggen et al., 2019) was a measure of inhibitory control deficits. The SSRT has demonstrated reliability in neurotypical young adults (ICC $= 0.71$; Congdon et al., 2012) and youth with ADHD (ICC $= 0.72$; Soreni et al., 2009).

2.2.2.2. Reward sensitivity. A computerized delay discounting task (Frye et al., 2016) had participants choose between a variable immediate reward and a fixed delayed reward of €100 across two practice blocks and seven testing blocks with different delays (6h, 1 day, 1 week, 1 month, 3 months, 1 year, 5 years). Immediate amounts of €50 were adjusted based on responses, reducing by half in subsequent trials. For each delay, the indifference point was calculated as the average of the last immediate chosen and rejected amounts. The k-value, representing the discounting rate, was calculated for each delay and averaged across delays, to measure sensitivity to immediate rewards (Gray et al., 2016). The task demonstrated good internal consistency ($\alpha = 0.89$) and moderate discriminant validity (Hurst et al., 2010), and acceptable to good internal consistency for the seven indifference points in this study ($\alpha = 0.79$).

2.2.2.3. Temporal processing. A computerized duration discrimination task (Wittmann et al., 2007) had participants compare the duration of auditory intervals (a standard and a comparison interval) across one practice trial and two testing blocks (36 trials each), with standard intervals of 100ms and 1000ms tested in separate blocks. Initial comparison intervals were 300ms and 3000ms, adjusted dynamically using a staircase procedure based on performance, with step sizes decreasing after response shifts (correct to incorrect, or vice versa). Threshold durations, representing the interval at which participants achieved 75% accuracy, were estimated using an accelerated stochastic approximation method (Faes et al., 2007). These durations were then transformed into z-scores and averaged, to measure temporal processing deficits. Similar tasks have shown good reliability in youth with ADHD ($r = 0.55$–0.86; Smith et al., 2002).

2.2.2.4. Procedure. The Ethical Review Board of the Faculty of Social and Behavioural Sciences at the University of Amsterdam approved the study (FMG-7155_2024). Data collection took place in April 2024 during a single 30-minute session at the university lab. After receiving instructions and providing informed consent, the participants completed the behavioural and self-report measures, including demographic questions, in a random sequence to avoid order effects. The session concluded with a debriefing, and the participants chose a reward of €10 or 1 University Research Credit.

2.2.2.5. Analysis plan. The study was pre-registered on AsPredicted.org (identifier 168263). Before conducting the main analysis, we tested the model assumption of linearity (no violations), while the assumptions of homoscedasticity and normality of residuals were accounted for by bootstrapping (10,000 iterations). An a-priori power analysis for parallel mediation indicated that 90 participants were sufficient for detecting medium effects with 80% power. The main analysis was a parallel mediation, where the relationship of ADHD symptoms to PSMU/PG was mediated by three mediators (see Fig. 1). Data analyses were conducted using Hayes' PROCESS Model 4 (Hayes, 2013) in RStudio (Posit team, 2024). We also conducted exploratory analyses, where we repeated the mediation models separately for each ADHD symptom dimension

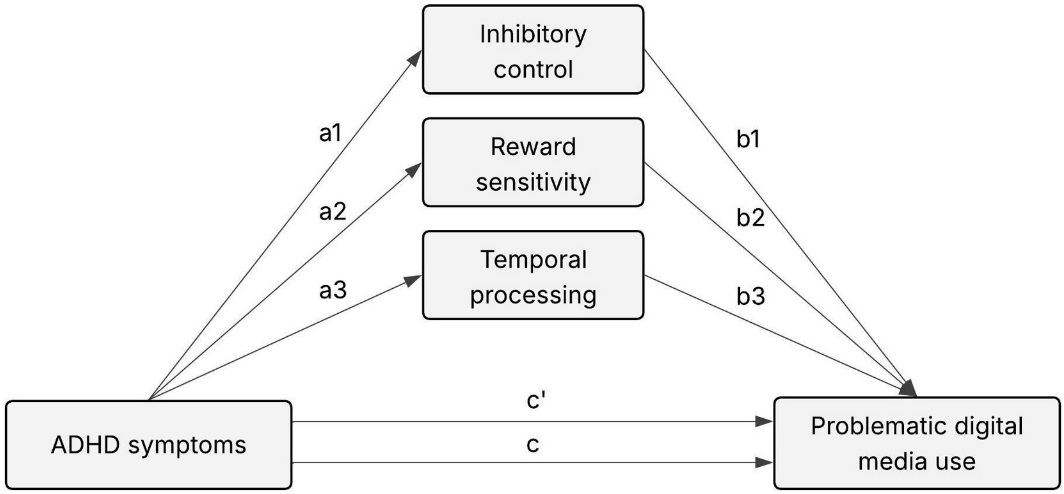

Fig. 1. Conceptual model of the parallel mediation model.

(inattention and hyperactivity/impulsivity) instead of using the total ADHD symptoms score. In addition to the mediation analyses, we estimated transdiagnostic structural equation models to examine whether the cognitive deficits (inhibitory control, reward sensitivity, temporal processing) function as shared predictors of both ADHD symptoms and PSMU/PG. Unlike the mediation models which assume a specific direction, the transdiagnostic models treat cognitive deficits as a common correlate of both outcomes.

3. Results

There were 41% of participants with elevated levels of ADHD symptoms, and 27% and 9% with elevated levels of PSMU and PG, respectively (see Table 1). Table 2 shows correlations between the main variables.

Table 1
Descriptive statistics of the self-report variables.

Variable	*M*	*SD*	% above cut-off
ADHD symptoms	34.22	11.63	41.3
Problematic social media use	3.41	1.98	26.6
Problematic gaming	1.95	1.87	9.2
Inhibitory control	32.17	7.12	–
Reward sensitivity	10.15	3.08	–
Temporal processing	41.69	8.38	–

Note. Cut-offs indicate elevated/problematic levels.

3.1. Main analysis

The parallel mediation analysis with PSMU showed a significant total effect (*c*) between ADHD symptoms and PSMU (see Table 3). However, in the model with self-report mediators, neither the direct effect (*c′*) nor the indirect effects (*a*b*) were significant, indicating null findings, despite significant associations between ADHD symptoms and the mediators (*a*). In the model with behavioural measure mediators, the direct effect (*c′*) remained largely unchanged from the total effect (*c*), as no other significant relationships were observed. The parallel mediation analyses with PG provided similar results in terms of statistical significance (see Table 3), indicating null findings.

3.2. Exploratory analyses

The exploratory mediation analyses, where the same model structure was estimated separately for the two ADHD symptom dimensions, revealed significant total effects (*c*) between hyperactivity/impulsivity and PSMU/PG, as well as between inattention and PSMU/PG (see Table 4). In the hyperactivity/impulsivity models with self-reported mediators, no significant direct effects (*c′*) were found, but for PSMU, significant indirect effects (*a*b*) were observed through inhibitory control deficits, $\beta = 0.221$, 95% CI [0.093, 0.347], and temporal processing deficits, $\beta = 0.078$, 95% CI [0.002, 0.173]. For inattention, the self-report model with PSMU showed a significant direct effect (*c′*) but no significant indirect effects. In the models with behavioural mediators, the direct effects (*c′*) remained largely unchanged from the total effects (*c*), as no other significant relationships were observed (see Supplement).

Table 2
Correlations of the main model variables.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. ADHD symptoms	1	–	–	–	–	–	–	–	–
2. Problematic social media use	**.38**	1	–	–	–	–	–	–	–
3. Problematic gaming	**.30**	.17	1	–	–	–	–	–	–
4. Inhibitory control	**.77**	**.39**	**.30**	1	–	–	–	–	–
5. Reward sensitivity	**.32**	.06	**.28**	**.39**	1	–	–	–	–
6. Temporal processing	**.46**	**.30**	.19	**.38**	.13	1	–	–	–
7. Inhibitory control (task)	−.02	.16	−.10	−.03	**.20**	−.06	1	–	–
8. Reward sensitivity (task)	.04	−.06	**.19**	−.02	**.24**	−.02	−.05	1	–
9. Temporal processing (task)	.14	.12	−.05	.05	.03	.01	**.41**	.09	1
10. Sex	.05	.17	**−.25**	.07	.07	**.21**	.04	−.18	−.07

Note. Point-biserial correlation was used for sex (female = 1, male = 0). Significant correlations ($p < .05$) in bold.

Table 3
Parallel mediation models with ADHD symptoms predicting PSMU and PG.

Model and mediators	a	b	a*b	95% CI a*b	c'	c	R^2
ADHD symptoms → PSMU					.151	.382***	.194
Questionnaires:							
Inhibitory control	.768***	.252	.194	[−.040, .420]			
Reward sensitivity	.318***	−.101	−.032	[−.104, .024]			
Temporal processing	.458***	.151	.069	[−.010, .171]			
ADHD symptoms → PSMU					.387***	.382***	.180
Behavioural tasks:							
Inhibitory control	−.022	.168	−.004	[−.072, .058]			
Reward sensitivity	.051	−.065	−.003	[−.022, .020]			
Temporal processing	.138	.007	.001	[−.047, .035]			
ADHD symptoms → PG					.219	.362***	.170
Questionnaires:							
Inhibitory control	.776***	.051	.039	[−.219, .311]			
Reward sensitivity	.363***	.195	.071	[−.030, .209]			
Temporal processing	.441***	.072	.032	[−.088, .161]			
ADHD symptoms → PG					.375***	.362***	.177
Behavioural tasks:							
Inhibitory control	.056	−.040	−.002	[−.051, .048]			
Reward sensitivity	.001	.175	.001	[−.034, .055]			
Temporal processing	.121	−.100	−.012	[−.080, .023]			

*** $p < .001$; ** $p < .01$; * $p < .05$.

Table 4
Exploratory mediating models with hyperactivity/impulsivity and inattention predicting PSMU and PG.

Model and Mediators	a	b	a*b	95% CI a*b	c'	c	R^2
Hyperactivity/impulsivity → PSMU					−.038	.240*	.186
Questionnaires:							
Inhibitory control	.589***	.375**	**.221**	[.093, .347]			
Reward sensitivity	.220*	−.097	−.021	[−.078, .017]			
Temporal processing	.414***	.189	**.078**	[.002, .173]			
Hyperactivity/impulsivity → PG					.242	.367***	.188
Questionnaires:							
Inhibitory control	.598***	.079	.047	[−.118, .232]			
Reward sensitivity	.272*	.197	.054	[−.016, .172]			
Temporal processing	.385***	.064	.025	[−.070, .152]			
Inattention → PSMU					.325*	.439***	.226
Questionnaires:							
Inhibitory control	.778***	.125	.097	[−.137, .345]			
Reward sensitivity	.346***	−.114	−.039	[−.115, .019]			
Temporal processing	.402***	.140	.056	[−.007, .140]			
Inattention → PG					.015	.284**	.152
Questionnaires:							
Inhibitory control	.784***	.191	.150	[−.142, .449]			
Reward sensitivity	.374***	.205	.077	[−.028, .217]			
Temporal processing	.403***	.106	.043	[−.067, .164]			

*** $p < .001$; ** $p < .01$; * $p < .05$; significant results based on 95% CI in **bold**.

The transdiagnostic analyses, where ADHD symptoms and PSMU/PG were regressed simultaneously on the three cognitive deficit variables, revealed moderate associations between ADHD symptoms and both PSMU (β = 0.38) and PG (β = 0.36), consistent with the total effects in the main mediation models. For PSMU, self-reported inhibitory control deficits significantly predicted both ADHD symptoms and PSMU (see Table 5), reducing their direct association to be non-significant (β = 0.10). For PG, no self-reported cognitive deficits significantly predicted both ADHD symptoms and PG (see Table 6), although including these predictors reduced their direct association to be non-significant (β = 0.15). Model fit indices supported the added value of self-reported predictors for both PSMU (AIC: 1289 vs. 1189; BIC: 1297 vs. 1213) and PG (AIC: 1015 vs. 938; BIC: 1022 vs. 960). In contrast, behavioural measures did not provide additional explanatory value for either PSMU or PG (see Supplement).

4. Discussion

This study investigated the relationship between ADHD symptoms and problematic digital media use (i.e., PSMU and PG) in emerging adults by looking into the role of three cognitive deficits from the Triple-Pathway Model (inhibitory control, reward sensitivity, and temporal

Table 5
Transdiagnostic model of ADHD symptoms and PSMU, with self-report measures of cognitive deficits.

Parameters	*B*	*SE*	*z*	*p*	95% CI	β
Baseline association						
ADHD ↔ PSMU	8.71	2.34	3.73	<.001	[4.13, 13.29]	0.382
Transdiagnostic model						
ADHD ~						
Inhibitory control	1.12	0.11	9.99	<.001	[0.90, 1.34]	0.685
Reward sensitivity	0.09	0.24	0.39	.698	[−0.38, 0.57]	0.025
Temporal processing	0.27	0.09	3.05	.002	[0.10, 0.44]	0.194
PSMU ~						
Inhibitory control	0.10	0.03	3.53	<.001	[0.04, 0.15]	0.355
Reward sensitivity	−0.06	0.06	−1.03	.302	[−0.18, 0.06]	−0.097
Temporal processing	0.04	0.02	1.93	.054	[−0.001, 0.09]	0.180
ADHD ↔ PSMU	1.30	1.22	1.07	.285	[−1.08, 3.69]	0.103

Table 6
Transdiagnostic model of ADHD symptoms and PG, with self-report measures of cognitive deficits.

Parameters	*B*	*SE*	*z*	*p*	95% CI	β
Baseline association						
ADHD ↔ PG	7.48	2.36	3.17	.002	[2.86, 12.10]	0.361
Transdiagnostic model						
ADHD ~						
Inhibitory control	1.08	0.13	8.57	<.001	[0.84, 1.33]	0.69
Reward sensitivity	0.17	0.28	0.63	.529	[−0.37, 0.71]	0.05
Temporal processing	0.22	0.10	2.22	.027	[−0.03, 0.42]	0.16
PG ~						
Inhibitory control	0.05	0.03	1.70	.095	[−0.01, 0.11]	0.20
Reward sensitivity	0.12	0.07	1.85	.064	[−0.01, 0.26]	0.21
Temporal processing	0.02	0.02	0.99	.323	[−0.02, 0.07]	0.11
ADHD ↔ PG	1.71	1.27	1.35	.177	[−0.77, 4.19]	0.146

processing) as mediating variables underlying this relationship. The mechanism variables were operationalized using both self-reports and behavioural tasks. We did not find the hypothesised mediating effects in this sample.

With regards to confirmatory analyses, we observed moderate positive relationships between ADHD symptoms and both PSMU and PG, which is in line with findings indicating that problematic digital media use is more frequent among individuals with ADHD and symptoms thereof (Koncz et al., 2023; Thorell et al., 2022). In the main analysis, the results of the parallel mediation analysis did not indicate that any of the proposed self-report variables mediated these relationships, indicating null findings. There were only significant relationships between ADHD symptoms and the cognitive deficits variables, which aligns with the theoretical framework (Sonuga-Barke et al., 2010). Overall, this suggests that cognitive vulnerabilities alone are not sufficient to explain the relationship between ADHD symptoms and PSMU or PG, as behavioural addictions emerge through interaction of such vulnerabilities with other affective and motivational factors (Brand et al., 2016; Brand et al., 2019).

With regards to exploratory analyses, we observed positive associations between the ADHD symptom dimensions and both PSMU and PG. PSMU was moderately related to inattention and less strongly to hyperactivity/impulsivity, while PG was moderately related to hyperactivity/impulsivity and less strongly to inattention, aligning with prior research (Halkett & Hinshaw, 2024; Koncz et al., 2023), although recent findings suggest inattention as the predominant risk factor for PG (Koncz et al., 2024). Inhibitory control and temporal processing deficits mediated the relationship between hyperactivity/impulsivity and PSMU, consistent with research linking inhibition deficits to PSMU (Soares et al., 2023). Previous research has rarely examined the ADHD symptom dimensions and PSMU/PG, but current findings suggest that these symptom dimensions may contribute to PSMU/PG via distinct mechanisms, although sample differences in PSMU/PG warrant cautious interpretation. The observed pattern is consistent with behavioural addiction frameworks (Brand et al., 2019), which propose that inhibitory control and temporal processing deficits may make it harder for individuals with elevated hyperactivity/impulsivity to disengage from rewarding behaviours such as social media use.

We also explored inhibitory control deficits, reward sensitivity, and temporal processing deficits as transdiagnostic factors using structural equation modelling, with the Triple-Pathway Model factors as common predictors of ADHD symptoms and PSMU/PG. The results indicated that inhibitory control deficits were significantly related to both ADHD symptoms and PSMU, suggesting that these deficits might contribute to difficulties in self-regulation observed in both ADHD and PSMU. This relationship was also reflected in the attenuated association between ADHD symptoms and PSMU, although a somewhat smaller reduction occurred in the model with PG as well, though without significant transdiagnostic factors. Taken together, the exploratory findings suggest that self-reported inhibitory control deficits may be a shared vulnerability factor for ADHD symptoms and PSMU, which aligns with models emphasising executive function deficits in behavioural addictions (Brand et al., 2016). The absence of robust findings in the main models and exploratory models with PG indicates, however, that other mechanisms are likely involved and that these may differ between different forms of problematic digital behaviours.

Notably, for all analyses conducted with predictor/mediator variables that were operationalised as behavioural measures (i.e., stop-signal task, delay discounting task, duration discrimination task), the results indicated that they had no explanatory value. There was no correlation between self-report and behavioural measures of the matched constructs, except for a low-to-moderate correlation for reward sensitivity. These findings align with previous research and theory suggesting that self-report and behavioural measures often show low overlap and measure differential aspects of the overarching constructs (Dang et al., 2020). The findings suggest that the explanatory value of the investigated cognitive constructs lies in their manifestation as general behavioural patterns, as opposed to individual performance, which is what the behavioural measures primarily capture.

4.1. Limitations and strengths

This study had several limitations, which impact the interpretation of the findings. The sample consisted mostly of female participants, which limits the generalizability. This could also explain the relatively low average levels of PG in the sample, given that PG is more common among males (Su et al., 2020). The study did not assess clinically diagnosed participants with ADHD or PG (for PSMU, there is currently no clinical diagnosis), which limits the clinical generalizability of the findings. In samples with a more balanced sex ratio and clinically significant levels of ADHD and PSMU/PG, the relationships of interest may be more pronounced. Self-report measures provided clearer insights than behavioural measures, although shared method variance may have inflated the observed relationships. There was sufficient power in the main parallel mediation analysis to detect medium effects, but there was not sufficient power to detect small effects, meaning small effects might have been present despite the non-significant results. Finally, the cross-sectional design limits causal inference, and unmeasured factors such as other aspects of social media use and gaming (e.g., frequency, platform, context), psychiatric comorbidities, personality traits, and affective states may have influenced the observed associations; future studies could address these issues using longitudinal designs and more comprehensive models.

Despite these limitations, the study had several strengths, boosting its scientific relevance. The study investigated the relationship in question using an established theoretical framework, and in doing so assessed the key variables at both the self-report and behavioural measure level. A common limitation in this field of research is overreliance on self-report measures of digital media use (Valkenburg et al., 2022), but the findings of this study indicate that behavioural performance measures of cognitive processes might not be an effective solution to self-report bias related to these constructs; studies could consider the utility of other-report, or more tailored performance measures when it comes to problematic digital media use, such as tasks incorporating social media or gaming cues in assessment of inhibitory control, reward sensitivity, or temporal processing. The study utilised several angles to explore the main research question, including the ADHD symptom dimensions investigation and the transdiagnostic approach, which offers a flexible framework for exploring shared mechanisms and improving treatments.

5. Conclusion

This study investigated whether cognitive deficits from the Triple-Pathway Model mediate the relationship between ADHD symptoms and problematic digital media use (PSMU and PG) in emerging adults. We did not find evidence for such mediating effects. Exploratory analyses suggested that hyperactivity/impulsivity may relate to PSMU through inhibitory control and temporal processing deficits, with inhibitory control deficits emerging as a possible transdiagnostic factor linking ADHD symptoms to PSMU. Behavioural measures did not contribute to explaining these relationships. These findings indicate that cognitive deficits alone are unlikely to account for problematic digital media use, and that PSMU and PG may rely on partly distinct mechanisms. Inhibitory control deficits may be particularly relevant to address for individuals with concurrent ADHD symptoms and PSMU. Future studies should include representative clinical samples and longitudinal designs to assess causality and enhance generalizability.

6. Author agreement

We confirm that the manuscript has not been published elsewhere and is not under consideration by another publication. All authors have reviewed and approved the final manuscript, and we declare no conflicts of interest. The study was preregistered at AsPredicted.org (identifier 168263) and approved by the Ethical Review Board of the Faculty of Social and Behavioural Sciences at the University of Amsterdam (FMG-7155_2024).

CRediT authorship contribution statement

Luka Todorovic: Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Janina Baumer:** Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Data curation. **Helle Larsen:** Writing – review & editing, Supervision, Resources, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2026.108608.

Data availability

Data will be made available on request.

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