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**Emotional dysregulation and problematic gaming in children and youth:
A cross-sectional and longitudinal approach**

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Manuscript

**Emotional dysregulation predicts problematic gaming in children and youths:
A cross-sectional and longitudinal approach**

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Emotional dysregulation predicts problematic gaming in children and youths: a cross-sectional and longitudinal approach

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Abstract

Adolescents show a high vulnerability for addictive gaming patterns on the one hand and immature emotion regulation (ER) abilities as a risk factor for mental disorders on the other hand. We investigated the predictive value of ER difficulties on problematic gaming (PG) considering age groups (children vs. youths) and gender cross-sectionally and prospectively in a representative sample of German adolescents via online survey with two measurement points 14 months apart. General Poisson, logistic, and multinomial regression models were estimated to predict gaming patterns by ER difficulties controlling for age group and gender. Results revealed ER difficulties to be significantly associated with PG. Moreover, subgroup analyses indicated differing ER patterns for children vs. youths and boys vs. girls: for children, higher PG values were associated with emotional awareness and emotional clarity whereas for youths it was the acceptance of emotional responses. Moreover, gender differences implicated that boys with PG had more deficits in goal-oriented behavior as well as emotional awareness while affected girls were lacking emotional clarity and had problems with the acceptance of their emotional responses. Interestingly, procrastination was a significant predictor for PG irrespective of subgroups. Furthermore, longitudinal analyses indicated that difficulties in ER promoted PG while stronger procrastination tendencies maintained it. With the inclusion of procrastination, which can be understood as a maladaptive ER strategy, a broader picture of ER difficulties as a risk factor for PG could be drawn. The findings support a better understanding of PG etiology and the development of targeted prevention and intervention measures.

Keywords Gaming disorder · Problematic gaming · Adolescents · Emotion regulation · Longitudinal study

Introduction

Problematic gaming in adolescents

In the course of the technological progress of the last decade, computer, console and mobile games became a regular companion in the everyday life of many adolescents. Gaming times increased during the COVID-19 pandemic and repeated (partial) lockdowns with the closure of schools or leisure facilities [1, 2]. Most adolescents use digital games in an unproblematic recreational way, but for some, excessive gaming leads to serious consequences due to the

development of an addictive behavior interfering with academic, family, and/or social life. A recent meta-analysis with an average subject age of 17.5 years indicated a global prevalence of addictive gaming around 3% [3]. The authors of this paper emphasize the prevalence to be highest in adolescents.

Problematic gaming (PG) behavior was first introduced as Internet Gaming Disorder (IGD), a “condition for further research”, in the appendix of the fifth version of the “Diagnostic and Statistical Manual for Mental Disorders” (DSM-5) in 2013 [4]. For an IGD, five out of nine diagnostic criteria based on pathological gambling and substance use disorders need to be fulfilled within the past 12 months. Moreover, the term Gaming Disorder (GD) was recently included in the eleventh version of the “International Classification of Diseases and Related Health Problems” (ICD-11) [5]. GD is described by the following criteria: (1) loss of control over gaming, (2) increasing prioritizing of gaming and (3) continued gaming despite negative consequences which have to be present for at least 12 months and lead to

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significant impairment in personal, educational and social life. Furthermore, to understand potentially harmful precursor GD patterns, Hazardous Gaming (HG) has been included to describe at-risk behavior. The conceptualization of PG varies between the two classification systems due to a differing weighting of symptoms as well as resulting impairments [6]. While the DSM-5 allows a broader screening on a population level, the ICD-11 has a higher specificity to differentiate between normal, at-risk and pathological gaming [6, 7]. To account for both definitions, in this paper the term PG will be used as an umbrella term for IGD and GD.

PG is based on a complex etiology and a wide range of biological, psychological, family, and other environmental risk factors have been identified [8–10]. Regarding gender, the occurrence of PG is substantially associated with being male [8, 9]. The influence of adolescent age on PG is unclear, partly because little research has been conducted among children [9]. Especially adolescents with high levels of family conflict and poorer relationships are at high-risk for PG [8, 11]. Hence, an escape into the world of gaming might be a dysfunctional coping strategy to alleviate negative feelings and stressful situations [12, 13].

Emotion regulation

The concept of emotion regulation (ER) and its association with psychopathology have been intensively studied during the last years [14–16]. Tull and Aldao differentiate between ER abilities and strategies [17]. The ability to recognize, understand and regulate one's own emotions is seen as dispositional and describes the typical way in which people experience their emotions. Therefore, it focuses primarily on the person's general regulation potential while ER strategies like reappraisal, suppression or procrastination refer to specific behaviors that actively influence the experience or expression of emotions and can be directly targeted in psychotherapy [18]. The maladaptive strategy procrastination describes the delay of necessary or important activities even though the postponement of these obligations results in negative consequences [19] and is seen as a failure of self-regulatory competencies [20]. Current research indicates that the general procrastination tendency of a person is a relatively stable trait, even though contextual factors might influence the degree of procrastination [21]. Accordingly, difficulties in ER are associated with mental disorders including behavioral addictions [22, 23].

The development of ER continues into early adulthood [24, 25]. Contrary to a linear assumption that the efficacy of ER skills grows with age, current research suggests that there is a major reorganization of ER during adolescence with an increased use of maladaptive strategies [25–27]. These findings emphasize the severe challenges adolescents face during puberty—a critical developmental period

with a high vulnerability for mental disorders in general [24]. Moreover, neurobiological evidence indicate that immature prefrontal and limbic regions promote insufficient emotion regulation and might therefore be especially affected by conflicting emotions in decision-making processes [24].

Problematic gaming and emotion regulation

Cross-sectional studies could find an association between emotional dysregulation and PG among adolescents [23, 28–31]. Regarding the maladaptive ER strategy procrastination, there are hints for a positive association between high levels of procrastination and the clinical severity of PG in young adults [32]. First longitudinal studies highlight that ER difficulties could predict PG [33–35].

However, the listed studies display various limitations: firstly, comparability of studies and generalizability is limited due to varying definitions of PG not including all diagnostic criteria of DSM-5 or ICD-11 [23, 28, 31–33] and only one study having investigated a representative sample [31]. Moreover, the assessment of ER does not implement the differentiation in ER abilities and strategies proposed by Tull and Amendola (2015) and, therefore, does not capture the concept in its full complexity [30, 31, 34]. Among children and adolescents the current research supports an association between procrastination and problematic social media or internet use [36–38]. To the best of our knowledge, procrastination and its specific association with PG in adolescents have not yet been examined. Furthermore, no differentiated analyses on ER and PG accounted for adolescent age groups (older children vs. youths) and gender as well as the time course of gaming patterns.

The present study

From a developmental perspective, it remains an open question which ER aspects specifically promote or maintain the occurrence of PG and its manifestations as hazardous or disordered gaming in adolescence. The current study aimed to close a significant gap in the understanding of ER difficulties and PG in a critical age group. For the first time, a representative sample of older children (10–13 years) and youths (14–17 years) was investigated regarding symptoms of PG based on standardized DSM-5/ICD-11 criteria and ER abilities from a cross-sectional and prospective perspective. Different ER strategies, the effects of age groups and gender as well as the development of different gaming patterns over time were considered to identify specific risk factors for a better understanding of PG and detect potential targets in individualized prevention and treatment measures.

Materials and methods

Participants and procedures

The current study was part of a large representative online survey on digital media use among adolescents and conducted with the help of the established German market and opinion polling company forsa in September 2019 and November 2020. Initially, 23,716 adults between the ages of 28 and 75 were contacted via e-mail with a response-rate of 12,427 individuals. 1733 of these households reported to have children between the ages of 10 and 17. After asking them to participate, 1221 adolescents agreed to be part of the study and completed the questionnaires at the first measurement point. 659 of those participated in the follow-up. In terms of age, gender and region of residence, representativity of the proportion was given. Two adolescent age groups were considered based on the German social code (“Sozialgesetzbuch”) defining children as being younger than 14 years and youths as being younger than 18 years [39]. All adolescents and their caregivers provided informed consent prior to the participation and could withdraw from the study at any time. Participants did not receive any compensation. The overall average response time to complete all questionnaires was 26 min including breaks. Both national and international ethical guidelines, in accordance with the Declaration of Helsinki, were followed in the realization of the study. The “Local Psychological Ethics Commission at the Center for Psychosocial Medicine” (LPEK) of the “University Medical Center Hamburg Eppendorf” (UKE) gave its approval.

Measures

Problematic gaming

The Internet Gaming Disorder Scale (IGDS) by Lemmens et al. [40], based on the DSM-5 criteria for IGD [40], was used to assess PG symptoms among adolescents in the baseline-sample. Composed of nine questions with binary answer options (0 = “no”/1 = “yes”), the cut-off for pathological gaming was reached at five or more points. Accordingly, higher scores in the IGDS indicated more severe PG. The questionnaire was repeatedly used among German adolescents and showed an overall suitability and validity to identify IGD among this age group on a population level [39]. In the baseline sample, Cronbach’s α for the IGDS was 0.85, indicating a good internal consistency.

The Gaming Disorder Scale for Adolescents (GADIS-A), an instrument created by Paschke et al. [6], was used to assess PG based on the ICD-11 criteria of GD and

HG [6]. It comprises two factors, cognitive behavioral symptoms and negative consequences, combined with a time criterion. The questionnaire was composed of nine statements regarding the symptomatology with response options on a five-point Likert-scale (0 = “strongly disagree” to 4 = “strongly agree”). An additional item, the time criterion, assessed the frequency of symptoms with four response options (0 = “not at all” to 3 = “almost daily”). GD was assumed, if the cut-offs for both factors were reached and the time criterion was fulfilled. However, if the time criterion and/or the cut-off value for negative consequences were not reached, HG was indicated [6]. Cronbach’s α values of 0.93 in the follow-up sample (factor 1 “cognitive behavioral symptoms” = 0.89; factor 2 “negative consequences” = 0.90) demonstrated an excellent internal consistency.

The development of gaming patterns between the two measurement points was described by four categories: (1) no or unproblematic gaming behavior (IGDS < cut-off at baseline and GADIS-A < cut-offs at follow-up); (2) remission of PG (IGDS \geq cut-off at baseline and GADIS-A < cut-offs at follow-up); (3) constant PG (IGDS \geq cut-off at baseline and GADIS-A \geq cut-offs at follow-up); (4) new PG (IGDS < cut-off at baseline and GADIS-A \geq cut-offs at follow-up).

Emotional dysregulation

Emotional dysregulation was assessed through the short form of the Difficulties in Emotional Regulation Scale (DERS-SF) by Kaufman et al. [41]. In this widely used 18-item measure with response options on a five-point Likert-scale (1 = “almost never” to 5 = “almost always”), higher scores indicated greater emotional regulation difficulties. In the past, the instrument has demonstrated a good fit for adolescents [42, 43]. The internal consistency for the total questionnaire among the baseline-sample was good (Cronbach’s $\alpha = 0.90$). Six subscales were differentiated with excellent to questionable internal consistency in the present sample: deficits in emotional awareness (Cronbach’s $\alpha = 0.67$), lack of emotional clarity (Cronbach’s $\alpha = 0.81$), non-acceptance of emotional responses (Cronbach’s $\alpha = 0.71$), deficits in engaging in goal-directed behavior (Cronbach’s $\alpha = 0.84$), difficulties in impulse control (Cronbach’s $\alpha = 0.90$) and limited access to emotion regulation strategies (Cronbach’s $\alpha = 0.78$) [14]. Due to the novel differentiated ER strategy approach with respect to PG, the subscale emotional awareness was kept for further analysis although its internal consistency was below the threshold that is regarded as acceptable (Cronbach’s $\alpha > 0.70$) [44].

The Procrastination Questionnaire for Students (PFS-4) [45] was used to measure tendencies of behavioral avoidance, a short-term (maladaptive) emotion regulation strategy. Higher values in the PFS-4 indicated stronger

tendencies to procrastinate [46]. Initially, it was validated among German university students [45] but due to its simple structure with four items, answered on a five-point Likert-scale (1 = “[almost] never” to 5 = “[almost] always”) related to academic tasks, it could prove suitability for high school students in clinical and research settings [47]. Moreover, an excellent internal consistency in the baseline sample further supported the use among adolescents (Cronbach’s $\alpha=0.90$).

Data analyses

All statistical analyses were performed with the software package R version 4.0.3 [48]. The data was analyzed calculating absolute and relative frequencies with 95% confidence intervals for categorical variables and mean values with standard deviations for metric variables with the statistical package *psych*. To account for the right-skewed distribution of IGDS and GADIS-A scores, Poisson regression models were computed for the cross-sectional and the longitudinal analyses (package *stats*). Adolescent age groups (children vs. youths) and gender were included as covariates. DERS and PFS scores were z-scaled for easier interpretability. Moreover, general logistic regression models were estimated to differentiate between the different patterns of PG over time. Finally, a multinomial logistic regression analyzed predictors for different gaming patterns (no gaming, HG and GD compared to frequent, but unproblematic gaming behavior; R package *nnet*). All model requirements have been carefully reviewed before analysis.

Results

Sample characteristics

Demographic, emotion-regulation, and gaming pattern characteristics for the baseline and follow-up survey are presented in Table 1.

Cross-sectional analyses

General Poisson model

To evaluate the influence of emotional dysregulation on PG while controlling for age groups and gender, we conducted a multivariate general Poisson regression analysis (see Table 2). Both ER measures, based on DERS and PFS score, and the covariates were significantly associated with more symptoms of PG. The overall model showed a variance explanation of 59.9% (R^2 Nagelkerke = 0.60).

Subsample analyses at baseline

To gain further insight into the developmental role of ER on PG, different ER aspects were separately investigated for age groups (while controlling for gender; Table 3). For children, a lack of emotional clarity and deficits in emotional awareness were significantly associated with more PG scores. For youths, however, higher values in non-acceptance of emotional responses were a significant predictor for PG symptoms. Higher procrastination and male gender (covariate) were significantly associated with PG in both subsamples.

With regard to gender differences (controlled for age group), a subgroup analysis between girls and boys showed that more deficits in goal-directed behavior and problems with emotional awareness in boys was associated with higher PG scores. For girls on the other hand, significant predictors for higher PG scores were greater non-acceptance of emotional responses and a lack of emotional clarity. Higher scores for procrastination were significantly associated with higher PG scores among both genders (see Table 4).

Longitudinal analyses

Longitudinal general Poisson model

Risk factors for prospective PG were identified estimating a general Poisson model in the 14-month-follow-up sample. Accordingly, the influence of emotional dysregulation on PG based on the ICD-11 criteria of GD were investigated while controlling for the gaming pattern at baseline, gender, and age group. Higher GADIS-A-scores after one year were significantly predicted by higher scores on both emotional dysregulation scales at baseline (see Table 5). Moreover, baseline IGDS scores served as a significant covariate whereas the variables age group and gender did not. The overall model explained a total variance of 87.7% (R^2 Nagelkerke = 0.88).

Emotion regulation and prospective stability of problematic gaming

Based on the follow-up investigation after 14 months, four different gaming groups were identified. Their sample characteristics are presented in Table 6.

By estimating a logistic regression model, the group of adolescents with new PG was compared to participants without PG (see Table 7). Age and gender could not be identified as significant covariates in the general longitudinal Poisson model (after controlling for baseline gaming patterns) and were therefore not considered in the logistic regression model. The DERS total score reached the level of significance when comparing new PG to no PG groups. Accordingly, higher scores in the DERS increased the odds

Table 1 Sample characteristics

Categories	Baseline sample <i>N</i> (%) / mean (\pm SD; range)	Follow-up sample
Sociodemographic measures		
Absolute frequency	1221	659
Children (10–13 years)	720 (58.97%)	378 (57.36%)
Youths (14–17 years)	501 (41.03%)	281 (42.64%)
Age in years	13.04 (2.39; 10–17)	13.11 (2.38; 10–17)
Gender		
Female	563 (46.11%)	308 (46.74%)
Male	658 (53.89%)	351 (53.26%)
Place of residence		
Rural living	249 (20.39%)	111 (16.84%)
Urban living	972 (79.61%)	548 (83.16%)
School attendance		
Yes	1132 (92.71%)	601 (91.2%)
No	88 (7.21%)	58 (8.80%)
Educational level (EL)		
Low	99 (8.11%)	54 (8.19%)
Middle or high	1069 (87.55%)	579 (87.86%)
Gaming pattern		
IGDS score (sum)	1.03 (2.46; 0–9)	1.87 (2.49; 0–9)
IGDS-based gaming groups at baseline		
Unproblematic gaming (<5)	1022 (83.7%)	545 (83.72%)
Problematic gaming (\geq 5)	199 (16.3%)	106 (16.28%)
GADIS-A score (sum) at follow-up	6.61 (6.74; 0–36)	5.93 (6.81; 0–36)
Cognitive behavioral symptoms (sum)		2.05 (3.36; 0–20)
Negative consequences (sum)		3.88 (3.98; 0–20)
GADIS-A-based gaming groups at follow-up		
No frequent gaming		98 (14.87%)
Unproblematic gaming		477 (72.38%)
Hazardous gaming (HG)		69 (10.47%)
Gaming disorder (GD)		8 (1.21%)
Emotion regulation measures		
DERS score (sum)	40.47 (12.46; 18–82)	39.55 (12.28; 18–82)
DERS subscales		
Strategies	6.30 (2.83; 3–15)	6.19 (2.87; 3–15)
Non-acceptance	6.30 (2.83; 3–15)	6.25 (2.79; 3–15)
Impulsiveness	5.78 (3.06; 3–15)	5.63 (3.04; 3–15)
Goal-oriented behavior	7.21 (3.08; 3–15)	6.98 (3.00; 3–15)
Clarity	6.48 (2.82; 3–15)	6.40 (2.80; 3–15)
Awareness	8.39 (2.89; 3–15)	8.27 (2.85; 3–15)
PFS score (sum)	11.08 (4.03; 4–20)	10.91 (4.00; 4–20)

Missing values: migration background t_0 — n =25 (0.9%), t_1 — n =1 (0.15%), EL t_0 — n =53 (4.34%), t_1 — n =26 (3.95%), gaming group t_0 — n =14 (1.15%), gaming group t_1 — n =7 (1.06%)

SD standard deviation, EL estimated educational degree of the participant; EL low no, special school (“Förderschulabschluss”) or lower school certificate (“Hauptschulabschluss”), EL middle/high secondary school certificate (“Realschulabschluss”) to university entry qualification (“Abitur”); equivalence testing revealed no differences in the sample characteristics between baseline- and follow-up sample, IGDS internet gaming disorder scale, GADIS-A gaming disorder scale for adolescents, DERS difficulties in emotion regulation scale, PFS procrastination questionnaire for students

Table 2 Emotion regulation characteristics as risk factors for problematic gaming in adolescents

IGDS score			
Predictors	Incidence rate ratios	CI	<i>p</i>
(Intercept)	0.14	0.11–0.19	< 0.001 ***
DERS sum score	1.36	1.27–1.46	< 0.001 ***
PFS sum score	1.34	1.24–1.44	< 0.001 ***
Covariates			
Gender (boys)	2.00	1.73–2.30	< 0.001 ***
Age group (children)	1.39	1.21–1.59	< 0.001 ***
Observations	1128		
<i>R</i> ² Nagelkerke	0.599		

IGDS internet gaming disorder scale, *DERS* difficulties in emotion regulation scale, *PFS* procrastination questionnaire for students, *DERS* and *PFS* sum scores are z scaled, *CI* Confidence interval; age groups were comprised of children (10–13 years) and youths (14–17 years), level of significance: *p** < 0.05, *p*** < 0.01, *p**** < 0.001

of developing new PG behavior in the follow-up investigation by 1.83. Moreover, the group of remitted gamers were compared to participants with constant PG over the two measurement points to identify variables maintaining PG. In this model, lower procrastination scores increased the probability of being categorized into the group of remitted gamers significantly among the follow-up sample (see Table 8).

Emotion regulation and gaming patterns at follow-up

Finally, a multinomial logistic regression was conducted to examine the differences between gaming patterns according to ICD-11 definitions (see Table 9). While among hazardous gamers, both ER measurements were significant, for participants with a manifest GD only the *DERS* total score was a significant predictor.

Discussion

Within the present study, emotional dysregulation as a potential risk factor for PG was investigated in detail in a representative sample of adolescents while accounting for the PG criteria of the two most influential classifications systems as well as for age and gender effects from a cross-sectional and prospective perspective for the first time. Accordingly, risk factors for children and adolescents as well as for boys and girls with regard to their ER competencies could be identified. By implementing the ICD-11 criteria it was possible to distinguish ER factors contributing to HG or GD separately [24]. Lee and colleagues (2017) claim that PG should be seen as a heterogenous disorder and identify different subtypes [13]. Therefore, besides an impulsive-aggressive and a socially conditioned type, they discuss a subgroup with emotionally vulnerable traits using gaming as an escape or coping strategy [13]. Hence, emotional distress might trigger those adolescents, lacking

Table 3 Differential emotion regulation characteristics as risk factors for problematic gaming: children vs. youths

IGDS score							
Children				Youths			
Predictors	Incidence rate ratios	CI	<i>p</i>	Predictors	Incidence rate ratios	CI	<i>p</i>
(Intercept)	0.19	0.13–0.28	< 0.001 ***	(Intercept)	0.12	0.07–0.20	< 0.001 ***
DERS subscales				DERS subscales			
Strategies	1.14	1.00–1.29	0.058	Strategies	1.04	0.87–1.24	0.648
Nonacceptance	0.98	0.88–1.10	0.726	Nonacceptance	1.20	1.02–1.41	0.027 *
Impulsivity	0.99	0.89–1.10	0.849	Impulsivity	1.04	0.90–1.20	0.629
Goal-oriented behavior	1.13	0.99–1.28	0.064	Goal-oriented behavior	1.15	0.97–1.36	0.116
Clarity	1.17	1.05–1.29	0.003 **	Clarity	1.02	0.88–1.18	0.795
Awareness	1.12	1.03–1.22	0.010 **	Awareness	1.02	0.90–1.15	0.792
PFS	1.32	1.20–1.44	< 0.001 ***	PFS	1.31	1.15–1.50	< 0.001 ***
Covariate				Covariate			
Gender (boys)	1.69	1.42–2.01	< 0.001 ***	Gender (boys)	2.99	2.25–3.98	< 0.001 ***
Observations	627			Observations	462		
<i>R</i> ² Nagelkerke	0.568			<i>R</i> ² Nagelkerke	0.640		

Age groups were comprised of children (10–13 years) and youths (14–17 years), level of significance: *p** < 0.05, *p*** < 0.01, *p**** < 0.001

IGDS internet gaming disorder scale, *DERS* difficulties in emotion regulation scale, *PFS* procrastination questionnaire for students, *DERS* and *PFS* sum scores are z scaled, *CI* Confidence interval

Table 4 Differential emotion regulation characteristics as risk factors for problematic gaming: boys vs. girls

IGDS score							
Boys				Girls			
Predictors	Incidence rate ratios	CI	<i>p</i>	Predictors	Incidence Rate Ratios	CI	<i>p</i>
(Intercept)	0.32	0.22–0.48	< 0.001 ***	(Intercept)	0.09	0.05–0.18	< 0.001 ***
DERS subscales				DERS subscales			
Strategies	1.06	0.90–1.20	0.311	Strategies	1.14	0.93–1.41	0.213
Nonacceptance	1.00	0.90–1.11	0.976	Nonacceptance	1.23	1.03–1.47	0.025 *
Impulsivity	1.04	0.94–1.16	0.395	Impulsivity	0.97	0.83–1.14	0.751
Goal-oriented behavior	1.15	1.02–1.29	0.019 *	Goal-oriented behavior	1.07	0.89–1.30	0.467
Clarity	1.07	0.97–1.18	0.172	Clarity	1.17	1.01–1.37	0.043 *
Awareness	1.13	1.05–1.23	0.002 **	Awareness	0.95	0.82–1.10	0.488
PFS	1.31	1.20–1.44	< 0.001 ***	PFS	1.30	1.14–1.50	< 0.001 ***
Covariate				Covariate			
Age group (children)	1.15	0.97–1.35	0.100	Age group (children)	2.06	1.54–2.77	< 0.001 ***
Observations	581			Observations	508		
<i>R</i> ² Nagelkerke	0.492			<i>R</i> ² Nagelkerke	0.528		

Age groups children comprised of participants from 10 to 13 years, level of significance: *p** < 0.05, *p*** < 0.01, *p**** < 0.001

IGDS internet gaming disorder scale, *DERS* difficulties in emotion regulation scale, *PFS* procrastination questionnaire for students, *DERS* and *PFS* sum scores are z scaled, *CI* Confidence interval

Table 5 General Poisson model: Risk factors for problematic gaming among adolescents after one year

GADIS-A total score			
Predictors	Incidence rate ratio	CI	<i>p</i>
(Intercept)	1.44	1.02–2.04	0.037 *
DERS (sum)	1.17	1.07–1.28	0.001 **
PFS (sum)	1.16	1.06–1.27	0.002 **
Covariates			
IGDS (sum)	1.37	1.27–1.49	< 0.001 ***
Gender (male)	1.17	0.99–1.38	0.066
Age group (child)	1.04	0.88–1.23	0.628
Observations	607		
<i>R</i> ² Nagelkerke	0.877		

GADIS-A gaming disorder scale for adolescents, *DERS* difficulties in emotion regulation scale, *PFS* procrastination questionnaire for students, *IGDS* internet gaming disorder scale, *CI* Confidence interval, *DERS* and *PFS* sum scores are z scaled, level of significance: *p** < 0.05, *p*** < 0.01, *p**** < 0.001

efficient ER competencies and then result in excessive gaming. Additionally, the I-PACE-model, developed by Brand and colleagues (2016) emphasizes the relevance of deficient ER processes in gaming based on neurobiological evidence indicating an imbalance between ER circuits and cognitive flexibility [49]. Furthermore, alexithymia, the inability to describe and name emotions both in oneself and others, is found to be associated with PG among young adults [50].

Consistent with these findings, the present data suggested that difficulties in cognitive and behavioral ER processes, including greater tendencies to procrastinate, represented risk factors for the development of PG in children and adolescents cross-sectionally as well as prospectively. With the combination of the *DERS-SF* and *PFS-4* it was possible to depict a broad picture of the different dimensions underlying emotional dysregulation based on the concept of ER abilities and strategies [17, 18].

ER characteristics as risk factors for more PG symptoms differed between children and adolescents. While for children difficulties in clearly identifying and being aware of their own emotions seemed to be most relevant, for adolescents it was their acceptance. Emotional clarity and awareness are found to be foundational for every further aspect of ER [51] and therefore pose a relevant developmental task for children. Previous research indicates that awareness of one's emotions is a metacognitive task that children are not yet capable of [52], which is partly explained by premature executive control functions [22, 52, 53]. Moreover, the children's age group was a significant covariate for more PG symptoms in the baseline indicating the importance to consider potential age effects. This link might be explained by neurostructural and neurofunctional similarities of immature ER and PG, especially among prefrontal and frontolimbic regions [10, 24]. Given limited available research findings on age and PG [9], further studies should look at adolescent age groups more closely.

Table 6 Characteristics of adolescents with different gaming patterns over time

Categories	No PG <i>N</i> (%) / mean (\pm SD; range)	Remission	Constant PG	New PG
<i>N</i> ^a	499 (75.72%)	73 (11.10%)	31 (4.70%)	38 (5.77%)
Age	13.24 (2.42; 10–17)	12.52 (2.14; 10–17)	13.0 (2.35; 10–17)	12.74 (2.04; 10–17)
Gender				
Female	257 (51.5%)	21 (28.77%)	8 (25.81%)	14 (36.84%)
Male	242 (48.5%)	52 (71.23%)	23 (74.19%)	24 (63.16%)
Region				
Rural	83 (16.63%)	13 (17.81%)	6 (19.35%)	7 (18.42%)
Urban	416 (83.37%)	60 (82.19%)	25 (80.65%)	31 (81.58%)
Education				
Low	34 (7.04%)	11 (15.49%)	2 (6.9%)	5 (13.51%)
Middle/High	449 (92.96%)	60 (84.51%)	27 (93.1%)	32 (86.49%)

PG: problematic gaming, *No PG*: No PG at t0 and t1, *Remission*: PG at t0, no PG at t1, *Constant PG*: PG at t0 and t1, *New PG*: No PG at t0, PG at t1, *SD* standard deviation, *EL* estimated educational degree of participants, *Education low* no, special school (“Förderschulabschluss”) or lower school certificate (“Hauptschulabschluss”), *Education middle/high* secondary school certificate (“Realschulabschluss”) to university entry qualification (“Abitur”)

^aNo classification due to severe missing values *n* = 18 (2.73%)

Table 7 Logistic regression model: emotion regulation characteristics as risk factors for new problematic gaming in adolescents after 14 months

I. New PG vs. No PG			
Predictors	Odds ratio	CI	<i>p</i>
(Intercept)	0.01	0.00–0.02	< 0.001***
DERS (sum)	1.83	1.29–2.57	0.001**
PFS (sum)	1.13	0.79–1.63	0.494
Observations	511		
<i>R</i> ² Nagelkerke	0.036		

PG problematic gaming, *No PG* No PG at t0 and t1, *New PG* No PG at t0, PG at t1, *CI* confidence interval, *DERS* difficulties in emotion regulation scale, *PFS* procrastination questionnaire for students, *DERS* and *PFS* are z-scaled, level of significance: *p** < 0.05, *p*** < 0.01, *p**** < 0.001

Additionally, the present study might add important aspects to the repeatedly replicated gender differences on PG prevalence with boys being affected more often [9, 54]. A decreased awareness of emotions was shown to be a significant risk factor for more PG symptoms in boys, as known from previous research on gender differences among ER processes [55, 56]. Developmental research indicates that the beginning of puberty begins in boys about 2 years later than in girls [57]. Deficits among boys might be partly favored by a delayed onset of puberty and therefore immature executive control functions. If girls’ cognitive capacities developed earlier than boys’, higher difficulties in accepting emotions rather than recognizing them by girls, and similar to the youths age group, could be explained. According to

Table 8 Logistic regression model: emotion regulation characteristics to predict remission of problematic gaming in adolescents after 14 months

II. Remission vs. constant PG			
Predictors	Odds ratio	CI	<i>p</i>
(Intercept)	11.79	1.25–111.46	0.031*
DERS (sum)	1.06	0.66–1.70	0.823
PFS (sum)	0.60	0.36–0.98	0.043*
Observations	93		
<i>R</i> ² Nagelkerke	0.051		

PG problematic gaming, *Remission* PG at t0, no PG at t1, *Constant PG* PG at t0 and t1, *CI* confidence interval, *DERS* difficulties in emotion regulation scale, *PFS* procrastination questionnaire for students, *DERS* and *PFS* are z-scaled, level of significance: *p** < 0.05, *p*** < 0.01, *p**** < 0.001

a bio-psycho-social framework, gender differences in ER processes emerge through a combination of biological differences, social learning theories and the specific interactions of social contexts and expectations [58]. Therefore, in line with previous findings [59], the ER strategies and abilities substantially differed between gender. Interestingly, a significant association between procrastination and PG in adolescents was described for the first time. This maladaptive ER strategy seems to be an important risk factor for PG among children and youths as well as in boys and girls that should be specifically addressed in therapy.

Due to the longitudinal approach, it was possible to observe the development of gaming behavior over time. On the one hand, results of a logistic regression indicated that

Table 9 Multinomial logistic regression: emotion regulation characteristics and prospective gaming group

Gaming groups (compared to unproblematic gaming)			
Predictors	Odds ratio	CI	<i>p</i>
<i>No gaming</i>			
(Intercept)	0.13	0.06–0.32	< 0.001 ***
DERS (sum)	1.25	0.97–1.63	0.087
PFS (sum)	0.88	0.67–1.14	0.330
<i>Hazardous gaming (HG)</i>			
(Intercept)	0.01	0.00–0.03	< 0.001 ***
DERS (sum)	1.60	1.18–2.16	0.003 **
PFS (sum)	1.43	1.05–1.96	0.025 *
<i>Gaming disorder (GD)</i>			
(Intercept)	0.00	0.00–0.00	< 0.001 ***
DERS (sum)	4.46	1.80–11.02	0.001 **
PFS (sum)	1.81	0.73–4.49	0.199
Observations	604		
<i>R</i> ² Nagelkerke	0.220		

CI confidence interval, DERS difficulties in emotion regulation scale, PFS procrastination questionnaire for students, DERS and PFS were z-scaled, level of significance: *p** < 0.05, *p*** < 0.01, *p**** < 0.001

difficulties in ER promoted the emergence of PG. On the other hand, data from adolescents with remitted gaming compared to constant problematic gaming behavior identified the maladaptive ER strategy procrastination to be a maintaining factor for PG. The approach of a more detailed examination of gaming behavior over time with the stratification into different gaming groups has been rarely applied in the currently available research. One longitudinal study analyzed four different gaming patterns among adolescents based on DSM-IV addiction criteria [33]. The authors postulate that the emergence of PG in adolescents is associated with higher impulsivity, lower social competence and empathy, and poorer ER skills [33]. Moreover, the comparison of different gaming groups over time is implemented in a study by Tsai et al. (2020) among young college students with an internet addiction [60]. The authors suggest that higher impulsivity promotes the development of new addictive behavior [60]. Future research should further investigate the development of PG behavior over time to specifically identify facilitating and maintaining factors and gain insight into the temporal stability of PG based on remission rates.

Finally, another strength of this study was the differentiation between normal and hazardous gaming behavior as well as a manifest gaming disorder according to the ICD-11 criteria. Interestingly, difficulties in the ER strategy procrastination seemed to affect especially adolescents who are at risk of developing PG. However, emotional dysregulation in terms of difficulties with the ER abilities influenced adolescents with hazardous gaming behavior as well as a manifest

gaming disorder. Yet, it must be noted, that the sample size of adolescents with GD according to the GADIS-A in the follow-up sample was very small (*n* = 8). Nevertheless, a strong effect could be seen which underlines the importance of impaired ER abilities in PG.

By combining DSM-5 and ICD-11 approaches, a broad screening as well as a specific look of different gaming patterns was achieved and a high correlation between both instruments over time could be shown. With the ICD-11 definition, the impairment of the behavior was crucial and, therefore, especially important for the clinical relevance of the symptomatology among adolescents and the presented findings.

Limitations

Although current research indicate that depression, anxiety or ADHD are closely linked to PG [61], survey participants' comorbidities could not be considered. Accordingly, accompanied mental disorders might have confounded the ability to regulate emotions [62]. In this respect, even though procrastination is not a diagnostic criterion of ADHD, a study among young adults indicates an association between ADHD and greater procrastination scores. Therefore, an assessment of these comorbidities would have been even more relevant [63]. While securing a representative sample was a goal in terms of age, gender and region of residence, the use of online-surveys required internet access which cannot be guaranteed in approximately 5% of the German households [64]. Additionally, a true representativity is uncertain due to unknown factors that might determine who is willing to take online-surveys in the first place. Moreover, households with insufficient knowledge of German could have been neglected because the language in the administered questionnaires was German. Even though equivalence testing of the sample characteristics revealed no significant differences between baseline- and follow-up sample, there were approximately 50% less participants in the follow-up investigation which might have influenced the results as well. A common methodological problem is the use of self-reports due to errors in recollection or socially desired answers. Even though participants were asked to complete the questionnaires on their own, influences from third parties cannot be ruled out completely. Therefore, future studies should consider additional parental questionnaires to complement the assessment [e.g., GADIS-P, [65]] and clinical interviews as the gold standard for a PG diagnosis. Moreover, internal consistency of all standardized scales was assessed using Cronbach's α . The DERS subscale emotional awareness could not reach a sufficient value. Yet, since internal consistency is necessary, but not

sufficient for validity and Cronbach's α reflects not only scale property but also sample attributes [66], we decided to leave this subscale in the analyses. Given the early state of research on ER and PG, this is reasonable but should be kept in mind during interpretation of the results.

Clinical implications

Difficulties with ER in general were found to be predictors of PG. Therefore, the present findings support the inclusion of specific ER trainings in prevention and intervention of PG [67, 68]. However, given the present findings on the role for different ER aspects in boys and girls as well as in children and youths, a tailored approach is warranted including mindfulness-based cognitive therapy, dialective behavioral therapy, or acceptance-based behavioral therapy [69].

Conclusion

Emotional dysregulation in general and procrastination as one specific ER strategy could be shown to be strong predictors for PG across adolescent age groups and gender. With regard to problematic emotion regulation strategies, gender and age differences are evident. While children have difficulty recognizing emotions, adolescents have more problems accepting them. Interestingly, boys seem to have difficulties in the awareness of their emotions, while girls, that are usually further along with their cortical development, show more problems with the acceptance of their own emotions. Moreover, emotional dysregulation including procrastination could predict different gaming patterns and their stability after 14 months.

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Data availability After all results of the parent–child survey will be published, the data can be provided upon request by the corresponding author (K.P.).

Declarations

Conflict of interest The authors declare no conflict of interest. The sponsors had no authority over the study design, the data acquisition, analyses and interpretation, nor over the writing of the manuscript or the publication process.

Ethical approval The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the *Local Psychological Ethics Commission at the Center of Psychosocial Medicine (LPEK)* of the University Medical Center Hamburg Eppendorf (UKE; ethical approval number: LPEK-0218).

Consent to participate Prior to each participation, informed consent was obtained from all subjects involved in the study. Moreover, they could withdraw from the study at any time.

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References

- King DL, Delfabbro PH, Billieux J, Potenza MN (2020) Problematic online gaming and the COVID-19 pandemic. *J Behav Addict* 9:184–186. <https://doi.org/10.1556/2006.2020.00016>
- Paschke K, Austermann MI, Simon-Kutscher K, Thomasius R (2021) Adolescent gaming and social media usage before and during the COVID-19 pandemic. *SUCHT* 67:13–22. <https://doi.org/10.1024/0939-5911/a000694>
- Stevens MW, Dorstyn D, Delfabbro PH, King DL (2021) Global prevalence of gaming disorder: a systematic review and meta-analysis. *Aust N Z J Psychiatry* 55:553–568. <https://doi.org/10.1177/0004867420962851>
- American Psychiatric Association (2013) Diagnostic and statistical manual of mental disorders (DSM-5). American Psychiatric Publishing, Arlington
- World Health Organization (2017) International Classification of Diseases 11th Revision ICD-11
- Paschke K, Austermann MI, Thomasius R (2020) Assessing ICD-11 gaming disorder in adolescent gamers: development and validation of the gaming disorder scale for adolescents (GADIS-A). *J Clin Med*. <https://doi.org/10.3390/jcm9040993>
- Jo YS, Bhang SY, Choi JS et al (2019) Clinical characteristics of diagnosis for internet gaming disorder: comparison of DSM-5 IGD and ICD-11 GD diagnosis. *J Clin Med*. <https://doi.org/10.3390/jcm8070945>
- Sugaya N, Shirasaka T, Takahashi K, Kanda H (2019) Bio-psychosocial factors of children and adolescents with internet gaming disorder: a systematic review. *Biopsychosoc Med*. <https://doi.org/10.1186/s13030-019-0144-5>
- Paulus FW, Ohmann S, Gontard A, Popow C (2018) Internet gaming disorder in children and adolescents: a systematic review. *Dev Med Child Neurol* 60:645–659. <https://doi.org/10.1111/dmcn.13754>
- Schettler L, Thomasius R, Paschke K (2021) Neural correlates of problematic gaming in adolescents: a systematic review of structural and functional magnetic resonance imaging studies. *Addict Biol*. <https://doi.org/10.1111/adb.13093>
- Nielsen P, Favez N, Rigter H (2020) Parental and family factors associated with problematic gaming and problematic internet

- use in adolescents: a systematic literature review. *Curr Addict Rep* 7:365–386. <https://doi.org/10.1007/s40429-020-00320-0>
12. Kardefelt-Winther D (2014) A conceptual and methodological critique of internet addiction research: towards a model of compensatory internet use. *Comput Hum Behav* 31:351–354. <https://doi.org/10.1016/j.chb.2013.10.059>
 13. Lee S-Y, Lee HK, Choo H (2017) Typology of Internet gaming disorder and its clinical implications. *Psychiatry Clin Neurosci* 71:479–491. <https://doi.org/10.1111/pcn.12457>
 14. Gratz KL, Roemer L (2004) Multidimensional assessment of emotion regulation and dysregulation: development, factor structure, and initial validation of the difficulties in emotion regulation scale. *J Psychopathol Behav Assess* 26:41–54. <https://doi.org/10.1023/B:JOBA.0000007455.08539.94>
 15. Thompson RA (2019) Emotion dysregulation: a theme in search of definition. *Dev Psychopathol* 31:805–815. <https://doi.org/10.1017/S0954579419000282>
 16. Gross JJ (2015) The extended process model of emotion regulation: elaborations, applications, and future directions. *Psychol Inq* 26:130–137. <https://doi.org/10.1080/1047840X.2015.989751>
 17. Tull MT, Aldao A (2015) Editorial overview: new directions in the science of emotion regulation. *Curr Opin Psychol* 3:iv–x. <https://doi.org/10.1016/j.copsyc.2015.03.009>
 18. Weiss NH, Kiefer R, Goncharenko S et al (2022) Emotion regulation and substance use: a meta-analysis. *Drug Alcohol Depend* 230:109131. <https://doi.org/10.1016/j.drugalcdep.2021.109131>
 19. Klingsieck KB (2013) Procrastination. *Eur Psychol* 18:24–34. <https://doi.org/10.1027/1016-9040/a000138>
 20. Rebetez MML, Rochat L, Barsics C, van der Linden M (2018) Procrastination as a self-regulation failure: the role of impulsivity and intrusive thoughts. *Psychol Rep* 121:26–41. <https://doi.org/10.1177/0033294117720695>
 21. Johansson F, Rozental A, Edlund K et al (2023) Associations between procrastination and subsequent health outcomes among university students in Sweden. *JAMA Netw Open* 6:e2249346. <https://doi.org/10.1001/jamanetworkopen.2022.49346>
 22. Aldao A, Nolen-Hoeksema S, Schweizer S (2010) Emotion-regulation strategies across psychopathology: a meta-analytic review. *Clin Psychol Rev* 30:217–237. <https://doi.org/10.1016/j.cpr.2009.11.004>
 23. Estévez A, Jáuregui P, Sánchez-Marcos I et al (2017) Attachment and emotion regulation in substance addictions and behavioral addictions. *J Behav Addict* 6:534–544. <https://doi.org/10.1556/2006.6.2017.086>
 24. Ahmed SP, Bittencourt-Hewitt A, Sebastian CL (2015) Neurocognitive bases of emotion regulation development in adolescence. *Dev Cogn Neurosci* 15:11–25
 25. Zimmermann P, Iwanski A (2014) Emotion regulation from early adolescence to emerging adulthood and middle adulthood. *Int J Behav Dev* 38:182–194. <https://doi.org/10.1177/0165025413515405>
 26. Cracco E, Goossens L, Braet C (2017) Emotion regulation across childhood and adolescence: evidence for a maladaptive shift in adolescence. *Eur Child Adolesc Psychiatry* 26:909–921. <https://doi.org/10.1007/s00787-017-0952-8>
 27. Lange S, Tröster H (2015) Adaptive und maladaptive Emotionsregulationsstrategien im Jugendalter. *Zeitschrift für Gesundheitspsychologie* 23:101–111. <https://doi.org/10.1026/0943-8149/a000141>
 28. Uçur Ö, Dönmez YE (2020) Problematic internet gaming in adolescents, and its relationship with emotional regulation and perceived social support. *Psychiatry Res* 296:113678. <https://doi.org/10.1016/j.psychres.2020.113678>
 29. Amendola S, Spensieri V, Guidetti V, Cerutti R (2019) The relationship between difficulties in emotion regulation and dysfunctional technology use among adolescents. *J Psychopathol* 25(1):10–17
 30. Schneider LA, King DL, Delfabbro PH (2018) Maladaptive coping styles in adolescents with internet gaming disorder symptoms. *Int J Ment Health Addict* 16:905–916. <https://doi.org/10.1007/s11469-017-9756-9>
 31. Kökönyei G, Kocsel N, Király O et al (2019) The role of cognitive emotion regulation strategies in problem gaming among adolescents: a nationally representative survey study. *Front Psychol* 10:273. <https://doi.org/10.3389/fpsyg.2019.00273>
 32. Yeh Y-C, Wang P-W, Huang M-F et al (2017) The procrastination of Internet gaming disorder in young adults: the clinical severity. *Psychiatry Res* 254:258–262. <https://doi.org/10.1016/j.psychres.2017.04.055>
 33. Gentile DA, Choo H, Liau A et al (2011) Pathological video game use among youths: a two-year longitudinal study. *Pediatrics* 127:e319–e329. <https://doi.org/10.1542/peds.2010-1353>
 34. Liau AK, Choo H, Li D et al (2015) Pathological video-gaming among youth: A prospective study examining dynamic protective factors. *Addict Res Theory* 23:301–308. <https://doi.org/10.3109/16066359.2014.987759>
 35. Wichstrøm L, Stenseng F, Belsky J et al (2019) Symptoms of internet gaming disorder in youth: predictors and comorbidity. *J Abnorm Child Psychol* 47:71–83. <https://doi.org/10.1007/s10802-018-0422-x>
 36. Wartberg L, Thomasius R, Paschke K (2021) The relevance of emotion regulation, procrastination, and perceived stress for problematic social media use in a representative sample of children and adolescents. *Comput Hum Behav* 121:106788. <https://doi.org/10.1016/j.chb.2021.106788>
 37. Reinecke L, Meier A, Beutel ME et al (2018) The relationship between trait procrastination, internet use, and psychological functioning: results from a community sample of German adolescents. *Front Psychol* 9:913. <https://doi.org/10.3389/fpsyg.2018.00913>
 38. Traş Z, Gökçen G (2020) Academic procrastination and social anxiety as predictive variables internet addiction of adolescents. *IES* 13:23. <https://doi.org/10.5539/ies.v13n9p23>
 39. Paschke K, Sack P-M, Thomasius R (2021) Validity and psychometric properties of the internet gaming disorder scale in three large independent samples of children and adolescents. *Int J Environ Res Public Health*. <https://doi.org/10.3390/ijerph18031095>
 40. Lemmens JS, Valkenburg PM, Gentile DA (2015) The internet gaming disorder scale. *Psychol Assess* 27:567–582. <https://doi.org/10.1037/pas0000062>
 41. Kaufman EA, Xia M, Fosco G et al (2016) The difficulties in emotion regulation scale short form (DERS-SF): validation and replication in adolescent and adult samples. *J Psychopathol Behav Assess* 38:443–455. <https://doi.org/10.1007/s10862-015-9529-3>
 42. Weinberg A, Klonsky ED (2009) Measurement of emotion dysregulation in adolescents. *Psychol Assess* 21:616–621. <https://doi.org/10.1037/a0016669>
 43. Neumann A, van Lier PAC, Gratz KL, Koot HM (2010) Multidimensional assessment of emotion regulation difficulties in adolescents using the difficulties in emotion regulation scale. *Assessment* 17:138–149. <https://doi.org/10.1177/1073191109349579>
 44. Nunnally JC, Bernstein IH (1994) Psychometric theory McGraw-Hill series. Psychology
 45. Glöckner-Rist A, Engberding M, Höcker A, Rist F. Prokrastinationsfragebogen für Studierende (Pfs). [Procrastination Scale for Students.] In: Zusammenstellung sozialwissenschaftlicher Items und Skalen. [Summary of Items and Scales in Social Science.] GESIS, 2009. <https://doi.org/10.6102/ZIS140>

46. Zhang S, Liu P, Feng T (2019) To do it now or later: the cognitive mechanisms and neural substrates underlying procrastination. *Wiley Interdiscip Rev Cogn Sci* 10:e1492. <https://doi.org/10.1002/wcs.1492>
47. Paschke K, Arnaud N, Austermann MI, Thomasius R (2021) Risk factors for prospective increase in psychological stress during COVID-19 lockdown in a representative sample of adolescents and their parents. *BJPsych open* 7:e94. <https://doi.org/10.1192/bjo.2021.49>
48. R Core Team (2019) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna
49. Brand M, Young KS, Laier C et al (2016) Integrating psychological and neurobiological considerations regarding the development and maintenance of specific Internet-use disorders: an interaction of person-affect-cognition-execution (I-PACE) model. *Neurosci Biobehav Rev* 71:252–266. <https://doi.org/10.1016/j.neubiorev.2016.08.033>
50. Mahapatra A, Sharma P (2018) Association of Internet addiction and alexithymia—a scoping review. *Addict Behav* 81:175–182. <https://doi.org/10.1016/j.addbeh.2018.02.004>
51. Vine V, Aldao A (2014) Impaired emotional clarity and psychopathology: a transdiagnostic deficit with symptom-specific pathways through emotion regulation. *J Soc Clin Psychol* 33:319–342. <https://doi.org/10.1521/jscp.2014.33.4.319>
52. Eisenberg N, Spinrad TL, Eggum ND (2010) Emotion-related self-regulation and its relation to children's maladjustment. *Annu Rev Clin Psychol* 6:495–525. <https://doi.org/10.1146/annurev.clinpsy.121208.131208>
53. Chaku N, Hoyt LT (2019) Developmental trajectories of executive functioning and puberty in boys and girls. *J Youth Adolesc* 48:1365–1378. <https://doi.org/10.1007/s10964-019-01021-2>
54. Fam JY (2018) Prevalence of internet gaming disorder in adolescents: a meta-analysis across three decades. *Scand J Psychol* 59:524–531. <https://doi.org/10.1111/sjop.12459>
55. Bender PK, Reinholdt-Dunne ML, Esbjørn BH, Pons F (2012) Emotion dysregulation and anxiety in children and adolescents: gender differences. *Personality Individ Differ* 53:284–288. <https://doi.org/10.1016/j.paid.2012.03.027>
56. Sarıtaş-Atalar D, Gençöz T, Özen A (2015) Confirmatory factor analyses of the difficulties in emotion regulation scale (DERS) in a Turkish adolescent sample. *Eur J Psychol Assess* 31:12–19. <https://doi.org/10.1027/1015-5759/a000199>
57. Brix N, Ernst A, Lauridsen LLB et al (2019) Timing of puberty in boys and girls: a population-based study. *Paediatr Perinat Epidemiol* 33:70–78. <https://doi.org/10.1111/ppe.12507>
58. Chaplin TM (2015) Gender and emotion expression: a developmental contextual perspective. *Emotion Rev* 7:14–21. <https://doi.org/10.1177/1754073914544408>
59. Pascual A, Conejero S, Etxebarria I (2016) Coping strategies and emotion regulation in adolescents: adequacy and gender differences. *Ansiedad y Estrés* 22:1–4. <https://doi.org/10.1016/j.anyes.2016.04.002>
60. Tsai J-K, Lu W-H, Hsiao RC et al (2020) Relationship between difficulty in emotion regulation and internet addiction in college students: a one-year prospective study. *Int J Environ Res Public Health*. <https://doi.org/10.3390/ijerph17134766>
61. González-Bueso V, Santamaría JJ, Fernández D et al (2018) Association between internet gaming disorder or pathological video-game use and comorbid psychopathology: a comprehensive review. *Int J Environ Res Public Health* 15:668. <https://doi.org/10.3390/ijerph15040668>
62. Young KS, Sandman CF, Craske MG (2019) Positive and negative emotion regulation in adolescence: links to anxiety and depression. *Brain Sci* 9:76
63. Niermann HCM, Scheres A (2014) The relation between procrastination and symptoms of attention-deficit hyperactivity disorder (ADHD) in undergraduate students: role of procrastination in ADHD-related symptoms. *Int J Methods Psychiatr Res* 23:411–421. <https://doi.org/10.1002/mpr.1440>
64. Statista (2021) Share of households in Germany with internet access by 2020.
65. Paschke K, Austermann MI, Thomasius R (2021) Assessing ICD-11 gaming disorder in adolescent gamers by parental ratings: development and validation of the gaming disorder scale for parents (GADIS-P). *J Behav Addict*. <https://doi.org/10.1556/2006.2020.00105>
66. Taber KS (2018) The use of Cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ* 48:1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>
67. Lindenberg K, Kindt S, Szász-Janocha C (2022) Effectiveness of cognitive behavioral therapy-based intervention in preventing gaming disorder and unspecified internet use disorder in adolescents: a cluster randomized clinical trial. *JAMA Netw Open* 5:e2148995. <https://doi.org/10.1001/jamanetworkopen.2021.48995>
68. Torres-Rodríguez A, Griffiths MD, Carbonell X, Oberst U (2018) Internet gaming disorder in adolescence: psychological characteristics of a clinical sample. *J Behav Addict* 7:707–718. <https://doi.org/10.1556/2006.7.2018.75>
69. Moltrecht B, Deighton J, Patalay P, Edbrooke-Childs J (2021) Effectiveness of current psychological interventions to improve emotion regulation in youth: a meta-analysis. *Eur Child Adolesc Psychiatry* 30:829–848. <https://doi.org/10.1007/s00787-020-01498-4>

1. Introduction

1.1. Problematic gaming

1.1.1. Relevance & definition

In recent decades, the influence of games in the everyday life of adolescents and young adults has grown continuously. Computer-, console- and mobile phone games became common leisure activities. Data from the representative study “Jugend, Information, Medien” (JIM) of the “Medienpädagogische Forschungsverband Südwest” (mpfs) highlights that 97% of German adolescents between 12 and 19 have their own smartphone (1). In addition, 71% have a computer or a laptop and 66% have access to gaming consoles (1). The worldwide use of digital games was even more intensified by the COVID-19 pandemic and repeated (partial) lockdowns, where schools or leisure facilities were closed and online schooling became necessary (2, 3). For some adolescents using digital games can become an excessive and uncontrollable activity which might lead to negative developments in their personal life. Negative health-related and psychosocial consequences like increased levels of stress, obesity, sleep disturbances, decreases in life satisfaction or symptoms of depression and anxiety have been described (4–6). Accordingly in the current research, problematic gaming is of special interest and has been intensively studied in the past (4–8). The importance of this addictive behavior is represented by the inclusion of the term “Internet Gaming Disorder” (IGD) as “a condition for further research” into the fifth version of the “Diagnostic and Statistical Manual for Mental Disorders” (DSM-V) (9) as well as the definition of “Gaming Disorder” (GD) in the eleventh version of the “International Classification System of Diseases” (ICD-11) (10).

Based on the diagnostic criteria for substance use disorders and gambling disorders, IGD is described by nine criteria referring to (internet) gaming on any electronic device: 1. preoccupation with gaming, 2. withdrawal when not playing, 3. tolerance, 4. unsuccessful attempts to reduce or stop gaming, 5. giving up other activities, 6. continuation of gaming despite problems, 7. deceiving or covering up gaming, 8. gaming to escape adverse moods, and 9. risking or losing relationships or career opportunities due to excessive gaming. When five or more criteria have been met for the past 12 months, an IGD can be assumed (9).

In the ICD-11, published by the “World Health Organization” (WHO), GD is understood as reoccurring, continuous or episodic gaming behavior that is associated with 1. a loss of control, 2. increasing prioritizing of gaming and 3. continued gaming despite negative consequences for at least 12 months. Moreover, the diagnosis requires significant impairments in the personal, familial, social, or educational life due to the gaming behavior (10).

While the DSM-V allows to screen for pathological or normal gaming behavior on a broader population level, the ICD-11 criteria look on the gaming concept from a continuous scale while differentiating into normal, hazardous, and problematic gaming behavior (11, 12). Accordingly, it focusses on the impairment and therefore the clinical relevance of the symptomatology (10, 11). The inclusion

of the terms IGD and GD into the two most influential classification systems further emphasizes the need to develop diagnostic and therapeutic concepts concerning problematic gaming among adolescents. Moreover, a clear definition of problematic gaming is essential to a consistent diagnosis of the disorder. This is especially important because in recent years various terms have been used to define the problematic use of technologies such as video game addiction, problematic internet use or internet addiction among numerous others (13). In line with our study, I will be using the term “problematic gaming” (PG) as an umbrella term for both IGD and GD (12).

1.1.2. Prevalence

With regard to prevalence estimates, the data varies due to the differing diagnostic criteria (8). When applying the DSM-V criteria, representative samples of German adolescents and young adults between 12 and 25 years of age display an IGD of 3.5% (14). After the implementation of the ICD-11, a study by Paschke et al. indicate a prevalence rate around 3.6% among a representative sample of German adolescents (11). A recent review and meta-analysis look at pathological gaming on a global scale and identifies prevalence rates around 3% as well (15). When looking more closely at exclusively adolescent samples, prevalence rates seem to be even higher (5, 15, 16). Compared to a younger age, adolescence is a period where youths have more responsibilities but also more autonomy and free time, which might partly explain the potential engagement in problematic behavior on an excessive level (17).

The temporal stability of PG is still a subject of continuous discussions. Longitudinal studies indicate that 20-50% of adolescents still display PG after one year (5), but more observations are necessary to gain insight into the development of this disorder over time.

Regarding gender, consistent evidence highlights that PG affects boys more often than girls (4, 15). Moreover, the motives to use technologies differ between the sexes. While girls engage more often in social media tools, boys tend to play more games (18).

1.1.3. Comorbidities

It has been an ongoing debate whether the addictive behavior to games is an independent disorder or rather a symptom of an underlying disease (19). However, research highlights that comorbidities, especially ADHD, depression, and anxiety disorder, accompany many adolescents with PG (7, 20, 21). First longitudinal studies show mixed results (22, 23). While Gentile and colleagues indicate that adolescents who continue excessive gaming are associated with higher levels of depression, anxiety and social phobia after a two year period compared to adolescents who reduced their gaming behavior (22), results by Brunborg and colleagues highlight a positive correlation between depression and gaming which only manifests at one of the surveyed time points (23). More longitudinal

observations are necessary to detect the directionality of gaming and their psychopathologies and give insights into the temporal stability of PG especially among adolescents.

1.1.4. Etiology

Multiple models try to map the complex etiology of problematic gaming (4, 17, 24–28). While looking at risk factors for PG more closely, research derives mostly from cross-sectional data (4, 8, 29), although some longitudinal observations are available as well (5).

Paulus and colleagues divide potential risk factors for PG into internal (neurobiology, personal traits, comorbidities) and external (family, school environments, game features) characteristics (4).

Similar to Paulus, Benarous et al. (2019) identify internalized and externalized pathways to PG based on two case reports. While risk factors among the internalized pathway include attachment issues during infancy or internalizing disorders during childhood and adolescence, the externalized pathway describes difficulties among families or in school (27).

Moreover, Brand and his colleagues formulate the I-PACE-Model to combine predisposing characteristics with affective and cognitive responses as well as executive functions or inhibitory control in order to depict a broader picture of the disorder (24, 26).

Another approach is the identification of different subtypes of gamers to individually analyze risk or maintaining factors (17, 25). Lee et al. (2017) propose three different types of gamers (25). The first type is impulsive/aggressive and plays to release aggressive impulses and to alleviate boredom. The second type includes emotional vulnerable gamers, who use games as an escape or coping strategy to alleviate negative feelings and modify their mood through gaming. Finally, the third type plays due to social requirements, to fulfill the need of social interaction or to prevent a feeling of loneliness (25).

Like Lee and colleagues, authors around Marchica (2022) adapt the “Pathway Model” to PG in order to characterize three different subtypes (17). This model was originally developed among problematic gamblers (30). Behavioral conditioned gamers seem to play in the absence of preceding psychopathologies. They start gaming for recreational reasons and develop an excessive behavior due to operant and classical conditioning and habituation. On the other hand, the emotionally vulnerable type shows symptoms of anxiety or depression and uses gaming as a strategy to cope and regulate one’s emotions. The third subtype is described as an antisocial/impulsive condition. Here, trait-based vulnerabilities like impulsivity, delinquent behavior or aggression are combined with symptoms of anxiety and depression (17).

The triad model of addiction (28) defines addictive psychopathologies as a complex interaction of personal, social, and media-related factors.

In further detail, *social factors*, include the family and social environment (4, 31, 32). Especially families with high levels of conflict and poor relationships as well as low socioeconomic status seem to be at risk for PG (8, 31, 32). Moreover, PG is associated with school-related problems and can affect the graduation level (33). Yet, social isolation as well as few real-life friends encourage the development of problematic gaming behavior (8).

Furthermore, *media-related-factors* refer to advances in technology that have increased the attractiveness of games. Games nowadays create a very realistic virtual environment, which facilitates immersing yourself into the game (17). Especially so-called MMORPGs (“massively multiplayer online role-playing games”) attract adolescents. Those games are characterized through a high level of responsibility and connectivity (29).

Entertainment, virtual friendships, and escapism have been identified as important internal motives to begin playing (34). Gaming therefore can initially satisfy the need for distraction and entertainment. Often however, the initial motivation changes over time when the attraction of the new fades and habituated behavior sets in. Frequently, intensive gaming leads to a restriction of real social contacts, whereby virtual friendships become more important. Many computer games require playing together as a team which strengthens the relationship among players. The possibility of escaping into another reality though gaming is often promoted by interpersonal and intrapersonal conflicts. This escapism is facilitated by the fact that the players have to be highly concentrated and thus forget about ongoing problems. Hence, a positive emotion and a sense of relief can be associated with playing (34).

Finally, multiple *personal factors* have been identified in the current research to increase the risk for PG among adolescents and young adults (4, 8, 35, 36). Association between introversion and PG assume that introverted adolescents might use games to compensate for their low life satisfaction or insufficient face-to-face-social skills (35). Aggressive and hostile tendencies as well as higher levels of low self-esteem and more narcissistic personality traits are connected to PG (4, 8, 36). Moreover, neuroticism, associated with emotionally unstable and unconfident characteristics, might promote gaming to prevent negative feelings (35). Impulsiveness is related to neuroticism as well (37). A recent systematic review by Chung et al. (2021) suggests that individuals with PG seem to overestimate potential gains in plays and risk more (38). Interestingly, in a longitudinal observation, impulsive decision making is rather seen as a consequence of IGD due to altered reward learning but a predisposing condition (39). A diminished self-control, based on impaired inhibitory control functions as well as altered decision-making processes, might pose important risk factors for PG among adolescents and young adults as well (7, 39).

Hence, personal risk factors can further be explained by neurobiological differences. Neural evidence highlights structural and functional differences while comparing the brains of problematic gamers

with healthy controls (40). Especially frontal regions, associated with cognitive control functions and frontolimbic areas, responsible for emotional control but also temporoparietal regions accounting for attention and self-concept, are altered (8, 40). Adolescence is a period of immature neural development. While cognitive control functions are still immature, the reward system is already fully developed (41). Due to this neural imbalance, adolescents are at greater risk for developing an addictive behavior (42, 43). The concept of regulating one's own emotions needs to be learned. During these processes, the vulnerability for mental disorders is increased (43). Accordingly, adolescents report problems with internalizing disorders such as depression or anxiety as well as externalizing disorders like problematic gaming.

1.2. Emotion regulation

The individual ability to regulate one's own emotions differs considerably among adolescents. Yet, altered regulation competencies among adolescents seem to affect the experience and expression of emotions (44–46) and are therefore important personal factors that might contribute to PGs etiology. Interestingly, higher levels of emotional intelligence can have a protective effect on the development of PG (47), while emotional dysregulation is associated with psychopathologies (48). Therefore, a promising link might be the closer look on the association between emotional regulation competencies and PG among children and young adolescents over time.

1.2.1. Definition

Difficulties in emotion regulation processes accompany various psychopathologies (48). Commonly, concepts of impaired emotion regulation share the idea that appropriate goal-directed behavior is impaired based on a disturbed experience or expression of emotion (49). Dimensions of emotional dysregulation include decreased awareness for emotions, inadequate emotional reactivity, intense experience and expression of emotions, emotional rigidity, and cognitive reappraisal difficulties (50). A recent differentiation of the construct into emotion regulation abilities and strategies has been proposed by Tull and Aldao (51). While the ability describes the general regulation potential of a person and is understood as a dispositional character trait or the typical behavior, strategies can actively influence the behavior and are a common target in psychotherapy (51). This differentiation captures the concept of emotion regulation on multiple dimensions and is the theoretical basis for our conducted study. In the current literature, emotional regulation strategies are typically divided into functional and dysfunctional approaches (48). While reappraisal, problem solving, and mindfulness are considered to be beneficial to competent emotional processing, suppression, avoidance, procrastination, and rumination are associated with dysfunctional emotion regulation and internalizing as well as externalizing disorders (48).

1.2.2. Development

The ability to regulate one's own emotions is a critical challenge during adolescence and its development continues into early adulthood (52). It is influenced by biological processes, including neural maturation or heritable traits as well as external aspects like the family environment (49). Current research suggests that during adolescence emotion regulation undergoes a major reorganization period (52–55). Accordingly, the use of maladaptive strategies increases among this age (53–55). In addition, neurobiological evidence highlights that especially prefrontal and limbic regions are immature during adolescence. Therefore, emotional and cognitive control functions are not yet fully developed and might be particularly affected by conflicting emotions (52).

1.2.3. Emotional dysregulation & psychopathology

Especially internalizing disorders, such as anxiety or depression are associated with maladaptive emotion regulation strategies like self-blame, rumination, avoidance, and suppression (48, 52). However, externalizing pathologies, like substance-use, eating disorders or pathological gaming are influenced by dysfunctional strategies as well, but to a lesser extent (48). A possible explanation proposes that the act of using substances, food or computer games itself serves as a dysfunctional emotion regulation strategy to alleviate negative feelings and cope with unpleasant emotions (48).

1.2.4. Problematic gaming & emotion regulation

In the current literature, the findings of emotional dysregulation and problematic gaming among adolescents mostly derive from cross-sectional studies (56–59). A few longitudinal observations indicate a predictive value of ER difficulties on PG (22, 60, 61). In a two-year follow-up study by Gentile and colleagues, poorer emotion regulation skills seem to predict problematic gaming behavior (22) while emotional awareness and improved regulation skills might prevent pathological video-gaming among adolescents after one year (60).

Yet, various limitations need to be addressed. First of all due to differing definitions of PG many studies do not include the diagnostic criteria of ICD-11 or DSM-V (56–59, 62). Moreover, the concept of emotion regulation is not consistent (58–60) and important theoretical considerations like the differentiation into a person's general ability and concrete strategies to regulate emotions by Tull and Aldao (51) are not depicted. Finally, only one investigation was conducted assessing a representative sample of adolescents (59).

1.3. Therapy approaches of PG

The therapeutic approach to target PG mostly derives from psychotherapy (7, 63). A recent review by Mestre-Bach and colleagues describes “cognitive behavioral therapy” (CBT) among family therapy or mindfulness as possible treatment strategies (7). However, cognitive behavior therapy is the

most common one. Studies indicate that the weekly gaming hours and the symptomatology of PG as well as the depressive symptomatology could be reduced once they were enrolled in a CBT program (63–65). Therapeutic strategies emphasize the role of developing a new structure in the everyday life of addicted adolescents away from online gaming and improving offline competencies like engaging in real life friends or in sport or other leisure activities. Therefore, reduced gaming time and the emergence of new purposes in life can be supported (66).

Two reviews by Zajac and colleagues evaluated the efficacy of pharmaceutical interventions among PG (63, 67). The patients were treated with drugs that are common in the treatment of ADHD like methylphenidate and substances that are used to target depression for example escitalopram. A small effect for bupropion, which is used in treating depression, and methylphenidate was found in some studies. Although it needs to be addressed that the reviews did not look exclusively at adolescents and therefore it is questionable if the pharmacological approaches can be directly transferred to younger populations.

It needs to be concluded that the current literature on the therapeutic efficacy of PG among adolescents remains small. Follow-up investigations will be necessary to estimate the impact of psychotherapy on PG. Moreover, with a better knowledge of the reasons and motives of a person to play, a targeted therapy based on the individual needs and challenges can be promising.

2. Questionnaires

2.1. Quantifying problematic gaming

Numerous instruments have been developed to assess the construct of IGD based on the DSM-V criteria as well as “gaming disorder” according to the ICD-11 diagnosis (13, 68, 69). The heterogeneity among the questionnaires leads to differing sensitivities and specificities among the administered instruments. Based on an increased body of research, the production of conceptually similar tools leads to a growing uncertainty among researchers. Therefore, the psychometric qualities of the different questionnaires should be carefully assessed and recommendations for suitable instruments to measure IGD or GD should be made in the future.

2.1.1. IGDS

The “Internet Gaming Disorder Scale” by Lemmens (2015) (70) is an instrument based on self-ratings which consists of nine questions assessing the gaming tendency according to the DSM-V criteria (9). Applying a binary question format (0 = “no”/1 = “yes”), higher scores indicate more problematic gaming. Moreover, it allows a separation into two groups of gamers, with “normal” gaming behavior and with “problematic” gaming behavior. This questionnaire has proven valuable in assessing adolescents (71).

2.1.2. GADIS-A

At the time of writing the manuscript, not many questionnaires that applied the ICD-11 criteria for Gaming Disorder were available. The “Gaming Disorder Scale for Adolescents” (GADIS-A) aims to close this gap (11).

The questionnaire is based on nine symptom statements with response options on a five-point Likert-scale and one additional item assessing the frequency of symptoms. Two factors can be identified, based on symptoms regarding negative consequences and symptoms assessing cognitive-behavioral-symptoms. Higher scores indicate more severe gaming. With this instrument a differentiation into normal gaming behavior, hazardous gaming behavior and problematic gaming behavior can be made. With this discriminatory power, it is possible to depict a broader picture of the differing nuances of gaming behavior. The psychometric qualities have proven to be excellent (11).

2.1.3. Other ratings

The majority of questionnaires are based on self-ratings. Especially during adolescence the insight into their own gaming behavior and its consequences can be limited due to cognitive immature mechanisms or symptom denial (42, 72). Therefore, external ratings through parents or other close caregivers provide important information for the diagnostic of psychopathologies among youth. The “Gaming Disorder Scale for Parents” (GADIS-P) is a newly, but well validated tool to complement the assessment of GD according to the ICD-11 criteria in clinical and research settings (73).

2.2. Quantifying emotional dysregulation

In a recent review numerous self-, parent- or other informant-reported measures of emotion regulation among children and adolescents were assessed (74). The instruments can be divided into different categories, those that measure predominantly the behavioral manifestation of emotion dysregulation and those trying to assess the specific processes or responses to actively regulate their own emotions. Additionally, several questionnaires attempt to measure the external expression and the internal processing of emotional regulation. Therefore, based on the research question (internal vs. external manifestations, adaptive vs. maladaptive responses or general vs. specific affective states), future studies should carefully choose the suitable instrument (74).

2.2.1. DERS-SF

One of the most popular instruments in the current literature is the “Difficulties in emotion regulation scale” (DERS), created Gratz and Roemer (75). It is based on measuring different subscales, an awareness and understanding of emotions, an acceptance of emotions, the ability to engage in goal-directed behavior and refrain from impulsivity, the access to effective emotion regulation strategies

and finally the clarity of emotions reflecting the extent to which individuals know which emotions they are experiencing. The DERS is widely used and has good psychometric qualities (75).

A short-form, the DERS-SF, created by Kaufmann et al. (76) has shown satisfactory to good reliability measurements as well as a good validity for adolescent samples as well (76–79).

2.2.2. PFS

Procrastination is described as the “voluntary and irrational delay of an intended course of action” (80), which often results in increased levels of stress and is seen as a dysfunctional short-term emotion regulation strategy troubling the work efficiency as well as the psychological well-being (80, 81).

The “Procrastination Questionnaire for Students” (PFS-4), created by Glöckner-Rist et al. (82), assesses this tendency of behavioral avoidance. It is a brief questionnaire based on four questions with response options on a five-point Likert-scale from “1 = (almost) never” to “5 = (almost) always”. Due to its simple structure it has also proven its suitability for high school students (83, 84).

3. Aim of the study

With this study we attempted to gain a more detailed insight into the etiology of PG among adolescents. To the best of our knowledge, a longitudinal study among adolescents investigating the role of emotional dysregulation with a clear definition of PG based on the diagnostic criteria of ICD-11 or DSM-V is missing. Moreover, we computed differentiated analyses on ER and PG among different adolescent age groups and gender as well as the time course of gaming patterns. With this approach important theoretical implications for a future tailored therapy and prevention programs among adolescents can be made.

4. Main findings

The results of this study highlight the impact of emotional regulation difficulties on PG, cross-sectionally as well as longitudinally. Emotional dysregulation in general and procrastination as one specific ER strategy are strong predictors for PG across all adolescent age groups and gender. Specific ER strategies associated with PG are separately described for children and youths as well as for girls and boys.

While children with higher PG display more problems with emotional clarity and emotional awareness, PG in youths is rather associated with the non-acceptance of emotions. Among boys over all age groups, more PG is connected to higher problems with goal-oriented behavior as well as the awareness of their emotions. Among girls with PG however, the emotional clarity and the acceptance of their emotions seem to be more problematic.

The specific analysis of different age groups as well as the distinct look on gender discrepancies are an important step to develop a tailored therapy concept targeting PG.

Moreover, due to the longitudinal approach, emotional dysregulation including procrastination can predict different gaming patterns and their stability after 14 months. This is one of the first studies differentiating between various gaming subgroups over time.

Adolescents who had developed a new problematic gaming behavior until the second assessment, display more difficulties with their emotion regulation compared to adolescents that show no PG at both measurement points. Yet, while looking at remitted gamers compared to constant problematic PG over the total time course, lower procrastination scores are more present among adolescents who stop playing games excessively.

Based on the GADIS-A, different risk factors for hazardous gaming and problematic gaming behavior can be identified. Higher procrastination scores are exclusively associated with hazardous gaming. Therefore, this factor is an important symptom to screen for in order to identify and prevent a manifest GD.

5. Bibliography

1. Feierabend S, Rathgeb T, Reutter T. JIM-Studie 2018 Jugend, Information, Medien: Basisuntersuchung zum Medienumgang 12- bis 19-Jähriger. Medienpädagogischer Forschungsverbund Südwest (mpfs) 2018. Available from: URL: <https://www.mpfs.de/de/studien/jim-studie/2018>.
2. King DL, Delfabbro PH, Billieux J, Potenza MN. Problematic online gaming and the COVID-19 pandemic. *J Behav Addict* 2020; 9(2):184–6. Available from: URL: <https://akjournals.com/view/journals/2006/9/2/article-p184.xml>.
3. Paschke K, Austermann MI, Simon-Kutscher K, Thomasius R. Adolescent gaming and social media usage before and during the COVID-19 pandemic. *SUCHT* 2021; 67(1):13–22.
4. Paulus FW, Ohmann S, Gontard A von, Popow C. Internet gaming disorder in children and adolescents: a systematic review. *Developmental Medicine & Child Neurology* 2018; 60(7):645–59.
5. Richard J, Temcheff CE, Derevensky JL. Gaming Disorder Across the Lifespan: a Scoping Review of Longitudinal Studies. *Curr Addict Rep* 2020; 7(4):561–87.
6. Mirna Macur, Halley M. Pontes. Internet Gaming Disorder in adolescence: investigating profiles and associated risk factors.
7. Mestre-Bach G, Fernandez-Aranda F, Jiménez-Murcia S. Exploring Internet gaming disorder: an updated perspective of empirical evidence (from 2016 to 2021). *Compr Psychiatry* 2022; 116:152319.
8. Sugaya N, Shirasaka T, Takahashi K, Kanda H. Bio-psychosocial factors of children and adolescents with internet gaming disorder: a systematic review. *Biopsychosoc Med* 2019 [cited 2020 Nov 24]; 13:3. Available from: URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6374886/pdf/13030_2019_Article_144.pdf.
9. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*. Arlington, VA: American Psychiatric Publishing; 2013.
10. World Health Organization, editor. *International Classification of Diseases 11th Revision ICD-11*; 2017. Available from: URL: <https://icd.who.int/dev11/l-m/en>.
11. Paschke K, Austermann MI, Thomasius R. Assessing ICD-11 Gaming Disorder in Adolescent Gamers: Development and Validation of the Gaming Disorder Scale for Adolescents (GADIS-A). *J Clin Med* 2020; 9(4).
12. Schettler LM, Thomasius R, Paschke K. Emotional dysregulation predicts problematic gaming in children and youths: a cross-sectional and longitudinal approach. *Eur Child Adolesc Psychiatry* 2023:1–12.
13. Bickham DS. Current Research and Viewpoints on Internet Addiction in Adolescents. *Curr Pediatr Rep* 2021:1–10.
14. Wartberg L, Kriston L, Thomasius R. The Prevalence and Psychosocial Correlates of Internet Gaming Disorder. *Dtsch Arztebl Int* 2017; 114(25):419–24.
15. Stevens MW, Dorstyn D, Delfabbro PH, King DL. Global prevalence of gaming disorder: A systematic review and meta-analysis. *Aust N Z J Psychiatry* 2021; 55(6):553–68.

16. Fam JY. Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades. *Scand J Psychol* 2018; 59(5):524–31.
17. Marchica LA, Richard J, Nower L, Ivoska W, Derevensky JL. Problem video gaming in adolescents: An examination of the Pathways Model. *International Gambling Studies* 2022; 22(2):282–99.
18. Dufour M, Brunelle N, Khazaal Y, Tremblay J, Leclerc D, Cousineau M-M et al. Gender difference in online activities that determine problematic internet use. *Journal de Thérapie Comportementale et Cognitive* 2017; 27(3):90–8. Available from: URL: <https://www.sciencedirect.com/science/article/pii/S1155170417300496>.
19. Király O, Griffiths MD, Demetrovics Z. Internet Gaming Disorder and the DSM-5: Conceptualization, Debates, and Controversies. *Curr Addict Rep* 2015; 2(3):254–62.
20. Unsel Bolat G, Celik D, Ozgul S, Ercan ES. Psychiatric Correlates of Internet Gaming Disorder in Children. *ADDICTA: The Turkish Journal on Addictions* 2021; 8(1):45–50.
21. González-Bueso V, Santamaría JJ, Fernández D, Merino L, Montero E, Ribas J. Association between Internet Gaming Disorder or Pathological Video-Game Use and Comorbid Psychopathology: A Comprehensive Review. *Int J Environ Res Public Health* 2018; 15(4):668. Available from: URL: <https://www.mdpi.com/1660-4601/15/4/668>.
22. Gentile DA, Choo H, Liau A, Sim T, Li D, Fung D et al. Pathological video game use among youths: a two-year longitudinal study. *Pediatrics* 2011; 127(2):e319–29.
23. Brunborg GS, Mentzoni RA, Frøyland LR. Is video gaming, or video game addiction, associated with depression, academic achievement, heavy episodic drinking, or conduct problems? *J Behav Addict* 2014; 3(1):27–32.
24. Brand M, Young KS, Laier C, Wölfling K, Potenza MN. Integrating psychological and neurobiological considerations regarding the development and maintenance of specific Internet-use disorders: An Interaction of Person-Affect-Cognition-Execution (I-PACE) model. *Neurosci Biobehav Rev* 2016; 71:252–66.
25. Lee S-Y, Lee HK, Choo H. Typology of Internet gaming disorder and its clinical implications. *Psychiatry Clin Neurosci* 2017; 71(7):479–91.
26. Brand M, Wegmann E, Stark R, Müller A, Wölfling K, Robbins TW et al. The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neurosci Biobehav Rev* 2019; 104:1–10.
27. Benarous X, Morales P, Mayer H, Iancu C, Edel Y, Cohen D. Internet Gaming Disorder in Adolescents With Psychiatric Disorder: Two Case Reports Using a Developmental Framework. *Front. Psychiatry* 2019; 10:336.
28. Kielholz, P., & Ladewig, D. *Die Abhängigkeit von Drogen*. Dt. Taschenbuch-Verlag; 1973.
29. Popow C, Ohmann S, Gontard A von, Paulus F. Computerspielabhängigkeit bei Kindern und Jugendlichen – ein Überblick. *Monatsschr Kinderheilkd* 2018; 2(3):252.
30. Blaszczynski A, Nower L. A pathways model of problem and pathological gambling. *Addiction* 2002; 97(5):487–99.

31. Nielsen P, Favez N, Rigter H. Parental and Family Factors Associated with Problematic Gaming and Problematic Internet Use in Adolescents: a Systematic Literature Review. *Curr Addict Rep* 2020; 7(3):365–86.
32. Schneider LA, King DL, Delfabbro PH. Family factors in adolescent problematic Internet gaming: A systematic review. *J Behav Addict* 2017; 6(3):321–33.
33. Rehbein F, Kleimann M, Mössle T. Prevalence and risk factors of video game dependency in adolescence: results of a German nationwide survey. *Cyberpsychol Behav Soc Netw* 2010; 13(3):269–77.
34. Beranuy M, Carbonell X, Griffiths MD. A Qualitative Analysis of Online Gaming Addicts in Treatment. *Int J Ment Health Addiction* 2013; 11(2):149–61.
35. Şalvarlı Şİ, Griffiths MD. Internet Gaming Disorder and Its Associated Personality Traits: A Systematic Review Using PRISMA Guidelines. *Int J Ment Health Addiction* 2021; 19(5):1420–42.
36. Griffiths MD, Kuss DJ, King DL. Video game addiction: past, present and future. *Curr Psychiatry Rev* 2012; (8(4)):308–18. Available from: URL: <https://doi.org/10.2174/157340012803520414>.
37. Costa PT, McCrae RR. Four ways five factors are basic. *Personality and Individual Differences* 1992; 13(6):653–65. Available from: URL: <https://www.sciencedirect.com/science/article/pii/019188699290236i>.
38. Chung W, Sun C-K, Tsai I-T, Hung K-C, Chiu H-J, Tzang R-F et al. A systematic review and meta-analysis on the clinical implications of probability discounting among individuals with Internet gaming disorder. *Sci Rep* 2021; 11(1):3177. Available from: URL: <https://www.nature.com/articles/s41598-021-82822-z>.
39. Kräplin A, Scherbaum S, Kraft E-M, Rehbein F, Bühringer G, Goschke T et al. The role of inhibitory control and decision-making in the course of Internet gaming disorder. *J Behav Addict* 2020.
40. Schettler L, Thomasius R, Paschke K. Neural correlates of problematic gaming in adolescents: A systematic review of structural and functional magnetic resonance imaging studies. *Addict Biol* 2021:e13093.
41. Casey BJ, Jones RM. Neurobiology of the adolescent brain and behavior: implications for substance use disorders. *Journal of the American Academy of Child and Adolescent Psychiatry* 2010; 49(12):1189-201; quiz 1285.
42. Konrad K, Firk C, Uhlhaas PJ. Brain development during adolescence: neuroscientific insights into this developmental period. *Dtsch Arztebl Int* 2013; 110(25):425–31.
43. Powers A, Casey BJ. The Adolescent Brain and the Emergence and Peak of Psychopathology. *Journal of Infant, Child, and Adolescent Psychotherapy* 2015; 14(1):3–15.
44. Yen J-Y, Yeh Y-C, Wang P-W, Liu T-L, Chen Y-Y, Ko C-H. Emotional Regulation in Young Adults with Internet Gaming Disorder. *Int J Environ Res Public Health* 2017; 15(1).
45. Lin P-Y, Lin H-C, Lin P-C, Yen J-Y, Ko C-H. The association between Emotional Regulation and Internet Gaming Disorder. *Psychiatry Res* 2020; 289:113060.

46. Liu S, Yu C, Conner BT, Wang S, Lai W, Zhang W. Autistic traits and internet gaming addiction in Chinese children: The mediating effect of emotion regulation and school connectedness. *Res Dev Disabil* 2017; 68:122–30.
47. Della Dang L, Zhang MX, Leong KK, Wu AMS. The Predictive Value of Emotional Intelligence for Internet Gaming Disorder: A 1-Year Longitudinal Study. *Int J Environ Res Public Health* 2019; 16(15):2762. Available from: URL: <https://www.mdpi.com/1660-4601/16/15/2762>.
48. Aldao A, Nolen-Hoeksema S, Schweizer S. Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clin Psychol Rev* 2010; 30(2):217–37.
49. Thompson RA. Emotion dysregulation: A theme in search of definition. *Dev Psychopathol* 2019; 31(3):805–15.
50. D'Agostino A, Covanti S, Rossi Monti M, Starcevic V. Reconsidering Emotion Dysregulation. *Psychiatr Q* 2017; 88(4):807–25.
51. Tull MT, Aldao A. Editorial overview: New directions in the science of emotion regulation. *Current Opinion in Psychology* 2015; 3:iv–x.
52. Ahmed SP, Bittencourt-Hewitt A, Sebastian CL. Neurocognitive bases of emotion regulation development in adolescence. *Dev Cogn Neurosci* 2015; 15:11–25.
53. Cracco E, Goossens L, Braet C. Emotion regulation across childhood and adolescence: evidence for a maladaptive shift in adolescence. *Eur Child Adolesc Psychiatry* 2017; 26(8):909–21.
54. Zimmermann P, Iwanski A. Emotion regulation from early adolescence to emerging adulthood and middle adulthood. *International Journal of Behavioral Development* 2014; 38(2):182–94.
55. Lange S, Tröster H. Adaptive und maladaptive Emotionsregulationsstrategien im Jugendalter. *Zeitschrift für Gesundheitspsychologie* 2015; 23(3):101–11.
56. Estévez A, Jáuregui P, Sánchez-Marcos I, López-González H, Griffiths MD. Attachment and emotion regulation in substance addictions and behavioral addictions. *J Behav Addict* 2017; 6(4):534–44.
57. Uçur Ö, Dönmez YE. Problematic internet gaming in adolescents, and its relationship with emotional regulation and perceived social support. *Psychiatry Res* 2020; 296:113678.
58. Schneider LA, King DL, Delfabbro PH. Maladaptive Coping Styles in Adolescents with Internet Gaming Disorder Symptoms. *Int J Ment Health Addiction* 2018; 16(4):905–16.
59. Kökönyei G, Kocsel N, Király O, Griffiths MD, Galambos A, Magi A et al. The Role of Cognitive Emotion Regulation Strategies in Problem Gaming Among Adolescents: A Nationally Representative Survey Study. *Front Psychiatry* 2019; 10:273.
60. Liao AK, Choo H, Li D, Gentile DA, Sim T, Khoo A. Pathological video-gaming among youth: A prospective study examining dynamic protective factors. *Addiction Research & Theory* 2015; 23(4):301–8.
61. Wichstrøm L, Stenseng F, Belsky J, Soest T von, Hygen BW. Symptoms of Internet Gaming Disorder in Youth: Predictors and Comorbidity. *J Abnorm Child Psychol* 2019 [cited 2022 Jan 16]; 47(1):71–83. Available from: URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6329732/pdf/10802_2018_Article_422.pdf.
62. Amendola S, Spensieri V, Guidetti V, Cerutti R. The relationship between difficulties in emotion regulation and dysfunctional technology use among adolescents. *Journal of psychopathology*

- 2019; (25):10–7. Available from: URL: https://www.jpsychopathol.it/wp-content/uploads/2018/12/xx_cerutti_epub.pdf.
63. Zajac K, Ginley MK, Chang R. Treatments of internet gaming disorder: a systematic review of the evidence. *Expert Rev Neurother* 2020 [cited 2022 Sep 30]; 20(1):85–93. Available from: URL: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6930980/pdf/nihms-1540688.pdf>.
 64. Stevens MWR, King DL, Dorstyn D, Delfabbro PH. Cognitive-behavioral therapy for Internet gaming disorder: A systematic review and meta-analysis. *Clin Psychol Psychother* 2019; 26(2):191–203.
 65. Torres-Rodríguez A, Griffiths MD, Carbonell X, Oberst U. Treatment efficacy of a specialized psychotherapy program for Internet Gaming Disorder. *J Behav Addict* 2018; 7(4):939–52.
 66. King DL, Delfabbro PH, Doh YY, Wu AMS, Kuss DJ, Pallesen S et al. Policy and Prevention Approaches for Disordered and Hazardous Gaming and Internet Use: an International Perspective. *Prev Sci* 2018 [cited 2022 Sep 30]; 19(2):233–49. Available from: URL: <https://link.springer.com/content/pdf/10.1007/s11121-017-0813-1.pdf>.
 67. Zajac K, Ginley MK, Chang R, Petry NM. Treatments for Internet gaming disorder and Internet addiction: A systematic review. *Psychol Addict Behav* 2017; 31(8):979–94.
 68. King DL, Chamberlain SR, Carragher N, Billieux J, Stein D, Mueller K et al. Screening and assessment tools for gaming disorder: A comprehensive systematic review. *Clin Psychol Rev* 2020; 77:101831. Available from: URL: <https://www.sciencedirect.com/science/article/pii/S0272735820300192>.
 69. Karhulahti V-M, Martončík M, Adamkovič M. Measuring Internet Gaming Disorder and Gaming Disorder: A Qualitative Content Validity Analysis of Validated Scales. *Assessment* 2023; 30(2):402–13.
 70. Lemmens JS, Valkenburg PM, Gentile DA. The Internet Gaming Disorder Scale. *Psychol Assess* 2015; 27(2):567–82.
 71. Paschke K, Sack P-M, Thomasius R. Validity and Psychometric Properties of the Internet Gaming Disorder Scale in Three Large Independent Samples of Children and Adolescents. *Int J Environ Res Public Health* 2021; 18(3).
 72. Aebi M, Kuhn C, Banaschewski T, Grimmer Y, Poustka L, Steinhausen H-C et al. The contribution of parent and youth information to identify mental health disorders or problems in adolescents. *Child Adolesc Psychiatry Ment Health* 2017; 11(1):23. Available from: URL: <https://link.springer.com/article/10.1186/s13034-017-0160-9>.
 73. Paschke K, Austermann MI, Thomasius R. Assessing ICD-11 gaming disorder in adolescent gamers by parental ratings: Development and validation of the Gaming Disorder Scale for Parents (GADIS-P). *J Behav Addict* 2021.
 74. Freitag GF, Grassie HL, Jeong A, Mallidi A, Comer JS, Ehrenreich-May J et al. Systematic Review: Questionnaire-Based Measurement of Emotion Dysregulation in Children and Adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry* 2022. Available from: URL: <https://www.sciencedirect.com/science/article/pii/S0890856722019785>.
 75. Gratz KL, Roemer L. Multidimensional Assessment of Emotion Regulation and Dysregulation: Development, Factor Structure, and Initial Validation of the Difficulties in Emotion Regulation Scale. *Journal of Psychopathology and Behavioral Assessment* 2004; 26(1):41–54.

76. Kaufman EA, Xia M, Fosco G, Yaptangco M, Skidmore CR, Crowell SE. The Difficulties in Emotion Regulation Scale Short Form (DERS-SF): Validation and Replication in Adolescent and Adult Samples. *J Psychopathol Behav Assess* 2016; 38(3):443–55.
77. Neumann A, van Lier PAC, Gratz KL, Koot HM. Multidimensional assessment of emotion regulation difficulties in adolescents using the Difficulties in Emotion Regulation Scale. *Assessment* 2010; 17(1):138–49.
78. Weinberg A, Klonsky ED. Measurement of emotion dysregulation in adolescents. *Psychol Assess* 2009; 21(4):616–21.
79. Gutzweiler R, In-Albon T. Überprüfung der Gütekriterien der deutschen Version der Difficulties in Emotion Regulation Scale in einer klinischen und einer Schülerstichprobe Jugendlicher. *Zeitschrift für Klinische Psychologie und Psychotherapie* 2018; 47(4):274–86.
80. Zhang S, Liu P, Feng T. To do it now or later: The cognitive mechanisms and neural substrates underlying procrastination. *Wiley Interdiscip Rev Cogn Sci* 2019; 10(4):e1492.
81. Klingsieck KB. Procrastination. *European Psychologist* 2013; 18(1):24–34. Available from: URL: <https://econtent.hogrefe.com/doi/full/10.1027/1016-9040/a000138>.
82. Glöckner-Rist A, Engberding M, Höcker A et al. Prokrastinationsfragebogen für Studierende (PFS) [Procrastination questionnaire for students]. In: *Zusammenstellung sozialwissenschaftlicher Items und Skalen [Collection of Items and Scales for the Social Science] (ZIS) - GESIS Leibniz Institut for the Social Science*.
83. Paschke K, Arnaud N, Austermann MI, Thomasius R. Risk factors for prospective increase in psychological stress during COVID-19 lockdown in a representative sample of adolescents and their parents. *BJPsych Open* 2021; 7(3):e94.
84. Wartberg L, Thomasius R, Paschke K. The relevance of emotion regulation, procrastination, and perceived stress for problematic social media use in a representative sample of children and adolescents. *Computers in Human Behavior* 2021; 121:106788.

Zusammenfassung

Die Ergebnisse der oben genannten Studie lieferten einen wichtigen Baustein für ein besseres Verständnis der Computerspielabhängigkeit im Kinder- und Jugendalter sowie wichtige Ansatzpunkte auf dem Weg zu einer individualisierten Diagnostik und Therapie. Die querschnittlichen Daten konnten den in der bisherigen Literatur bereits vermuteten Zusammenhang zwischen problematischen Computerspielen und Schwierigkeiten in der Emotionsregulation unterstützen. Neu war jedoch die differenzierte Betrachtung der Emotionsregulationsschwierigkeiten bei Kindern und Jugendlichen sowie Mädchen und Jungen getrennt. Während Jungen mit einer Computerspielabhängigkeit mehr Probleme im zielgerichtetem Verhalten sowie der Wahrnehmung ihrer Emotionen aufwiesen, zeigten sich bei Mädchen mit höheren Werten im Abhängigkeitsfragebogen Auffälligkeiten in der Akzeptanz der eigenen Emotionen. Darüber hinaus waren für Kinder mit problematischem Computerspielverhalten ähnlich wie bei Jungen das Bewusstmachen ihrer eigenen Gefühle herausfordernd, während Jugendliche ähnlich der Mädchen, vielmehr mit der Akzeptanz ihrer Emotionen haderten. Die längsschnittlichen Analysen machten zudem den Einfluss von Emotionsregulationsschwierigkeiten auf spätere Probleme mit Computerspielen deutlich. Dies war eine der ersten Studien, die auf den Zusammenhang zwischen der dysfunktionalen Emotionsregulationsstrategie Prokrastination und Computerspielabhängigkeit bei Jugendlichen aufmerksam gemacht hat. Die Stratifizierung in unterschiedliche Gaming-Gruppen über die Zeit wies der Prokrastination zudem eine wichtige Bedeutung als aufrechterhaltenden Faktor zu. Insbesondere für Jugendliche mit einem riskanten Konsum scheint die Prokrastination ein früher Marker zu sein, um problematisches Spielen zu entdecken.

Summary

These results provided important knowledge for a better understanding of problematic gaming in children and adolescents as well as interesting thoughts on the pathway to an individualized diagnostic and therapy. Cross-sectional data supported the assumed association between problematic gaming and emotion regulation difficulties. However, the differentiated examination of emotion regulation in various age groups and among the sexes was new. While boys with higher scores on the internet gaming scale displayed more problems in goal-directed behavior and their emotional awareness, girls with problematic gaming behavior showed difficulties in the acceptance of their emotions. Children with problematic gaming, similar to boys, struggled with the awareness of their emotions as well as emotional clarity. Youths on the other hand, were similar to girls challenged by the acceptance of their emotions. Longitudinal analyses highlighted the influence of emotion regulation difficulties on problematic gaming behavior in the future. This was one of the first studies to draw attention to the link between the dysfunctional regulation strategy procrastination and addictive computer gaming in adolescents. Furthermore, the stratification into different gaming groups over time indicated that procrastination seemed to be an important maintaining factor. Particularly for adolescents with hazardous gaming, procrastination could be seen as an early marker for problematic gaming.

Author contribution

PD Dr. Kerstin Paschke initially developed the design and concept of the study “Emotional dysregulation and problematic gaming in children and youth: A cross-sectional and longitudinal approach”. The data acquisition was conducted with the support of the German opinion research institute “forsa” as part of a comprehensive survey on the use of digital media among children and adolescents. The participants, aged 10-17 years, of this study were asked to fill in two online questionnaires, first in September 2019 and later in November 2020. The initial processing of the data was carried out by PD Dr. Kerstin Paschke. The subsequent analyses and statistical considerations were carried out and critically evaluated by both Ms. Leonie Marie Schettler and PD Dr. Kerstin Paschke. Ms. Leonie Marie Schettler wrote the first draft of the manuscript and was responsible for all visualizations. PD Dr. Kerstin Paschke and Prof. Dr. Rainer Thomasius critically reviewed the manuscript and gave important contextual advice.

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Eidesstaatliche Erklärung

Ich versichere ausdrücklich, dass ich die Arbeit selbständig und ohne fremde Hilfe verfasst, andere als die von mir angegebenen Quellen und Hilfsmittel nicht benutzt und die aus den benutzten Werken wörtlich oder inhaltlich entnommenen Stellen einzeln nach Ausgabe (Auflage und Jahr des Erscheinens), Band und Seite des benutzten Werkes kenntlich gemacht habe.

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