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Applying ICD-11 criteria of Gaming Disorder to identify problematic video streaming in adolescents: Conceptualization of a new clinical phenomenon

KERSTIN PASCHKE* , ANN-KATHRIN NAPP and RAINER THOMASIUS

German Center for Addiction Research in Childhood and Adolescence (DZSKJ), University Medical Center Hamburg-Eppendorf (UKE), Martinistrasse 52, D-20246, Hamburg, Germany

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FULL-LENGTH REPORT



ABSTRACT

Background and aims: Internet video streaming (VS) has become a popular leisure activity among the majority of adolescents, especially under the COVID-19 pandemic. Research on binge watching patterns in adults suggests an addictive potential of VS. To date, no unified conceptualization on problematic VS and no standardized assessment tools for adolescents exist even though they might be especially vulnerable. **Methods:** STREDIS-A is based on the ICD-11 criteria of gaming disorder. It was validated in a representative sample of 959 dyads of 10- to 17-year old adolescents with frequent VS and a respective parent using standardized questionnaires on Internet addiction, depressive and anxiety symptoms, insomnia, loneliness, and academic performance in an online survey. Item structure was investigated by factorial analyses. Cutoffs were estimated and latent profile analysis was performed. **Results:** The two-factorial structure of STREDIS-A describes cognitive-behavioral symptoms and negative consequences of VS. Internal consistency and criterion validity were good to excellent. It could excellently discriminate between affected and non-affected adolescents. **Discussion and conclusions:** The present study makes a significant contribution to the conceptualization of a new phenomenon. It provides the very first tool to assess streaming disorder in adolescents for clinical and research settings. Clinical validation is highly warranted.

KEYWORDS

problematic streaming, streaming disorder, ICD-11, adolescents, binge watching

INTRODUCTION

In the last decade, video streaming (VS) services such as Netflix, YouTube, and Twitch have experienced tremendous growth worldwide, especially since the beginning of the COVID-19 pandemic (statista, 2022). Among German adolescents, internet-based VS is taking on increasing priority over traditional television (Die medienanstalten, 2021) and about half of them are daily users (Feierabend, Rathgeb, Kheredmand, & Glöckler, 2021). VS is characterized by “the possibility for time-shifting and on-demand retrieval, access to vast libraries of content and limitless number of channels, and the use of multiple devices for retrieval [...] to choose what and when to watch” (Spilker & Colbjørnsen, 2020). The authors distinguish professional vs. user-generated streaming multipurpose platforms and live streaming service vs. on-demand videos. Streaming on multipurpose platforms like YouTube and TikTok can be separated from social media activities on these sites (Balakrishnan & Griffiths, 2017; Smith & Short, 2022) by a passive consuming pattern in contrast to active participation via direct interactions (Spilker, Ask, & Hansen, 2020).

*Corresponding author. Tel.: +49 (0) 40 7410-56265; fax: +49 (0)40 7410-56571.
E-mail: k.paschke@uke.de



To date, VS has been mainly addressed scientifically in the context of *binge watching*, i.e. watching multiple episodes of a television series online in a row (Starosta & Izydorczyk, 2020). Accordingly, motives for binge watching include enjoyment and entertainment, recreation, social aspects, information, and control but also escaping from reality and dealing with loneliness (Panda & Pandey, 2017; Shim & Kim, 2018; Starosta, Izydorczyk, & Lizińczyk, 2019, 2021). In the systematic reviews of Flayelle et al. (2020) and Starosta and Izydorczyk (2020) a specific streaming pattern is described which is characterized by multiple symptoms of behavioral addictions including loss of control, neglect of other activities and duties, feelings of guilt, lying, withdrawal symptoms, and negative social, work-related, and health consequences. Associations between problematic binge watching and loneliness as well as symptoms of depression, anxiety, and insomnia have been found in studies with (young) adults (Exelmans & Van den Bulck, 2017; Starosta, Izydorczyk, & Wontorczyk, 2021; Sun & Chang, 2021). Moreover, problematic patterns were related to more frequent and longer usage times (Flayelle, Canale, et al., 2019; Ort, Wirz, & Fahr, 2021). Assessment of binge watching mainly focused on motives and engagement or on general criteria of addictions in adults only (cf. six core components of addiction model; Griffiths, 2005) and includes the adapted Television Viewing Motivation Scale and Questionnaire of Excessive Binge-Watching Behaviors (Starosta et al., 2019), Problematic Series Watching Scale (Orosz, Bóthe, & Tóth-Király, 2016), Series Watching Engagement Scale (Tóth-Király, Bóthe, Tóth-Fáber, Hága, & Orosz, 2017), Watching TV Series Motives Questionnaire and Binge-Watching Engagement and Symptoms Questionnaire (Flayelle, Canale, et al., 2019), and Binge-Watching Addiction Questionnaire (Forte, Favieri, Tedeschi, & Casa-grande, 2021).

Although problematic users have been described with characteristics similar to established behavioral addiction concepts as specified in the ICD-11 for gaming disorder (GD; WHO, 2018), these have not yet been applied in a structured and thus reproducible manner. Accordingly, problematic users could be characterized by an impaired control over streaming, increasing priority given to streaming over other activities and the continuation or escalation of streaming despite the occurrence of negative consequences over a period of at least 12 months. Importantly, the streaming behavior need to result in clinically significant distress or impairment of personal, social, educational, work-related, and financial functions.

Flayelle et al. (2020) argue for a major need for the conceptualization of problematic forms of binge watching to ensure comparability of constructs. However, reducing VS to series binge watching seems to be artificial since the key characteristic of the user's control of content and time does apply to all streaming offers (Spilker & Colbjørnsen, 2020). Moreover, as streaming is a leisure activity for the majority of young people, a vague and inconsistent definition of streaming patterns as in "binge" does not seem to be useful. The focus should be laid on the usage pattern as suggested

by the term "problematic" (Forte et al., 2021; Orosz et al., 2016; Starosta et al., 2021; Sun & Chang, 2021) and should be preferred over the focus on the usage time as suggested by the term "excessive" (Starosta et al., 2019) to avoid over-pathologizing an everyday activity (Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015).

To the best of our knowledge, no study on problematic or even disordered VS in children and adolescents has been published and no specific assessment tool is available yet despite high public, clinical, and research concerns (Matrix, 2014; Starosta & Izydorczyk, 2020). This study aims to close this significant gap by (1) developing a screening instrument to assess streaming disorder (StrD) based on the ICD-11 criteria of GD in adolescents (Streaming Disorder Scale for Adolescents, STREDIS-A), (2) exploring the psychometric properties of the new scale, and (3) validating it in a representative sample of 10- to 17-year-old frequent VS users and a respective parent.

METHODS

Participants and procedure

1,128 households with children between 10 and 17 years and a respective parent were included in an online survey between May 19 and June 06, 2021 by the German market research and opinion polling company forsa. The sample was representative regarding residence region, age, and gender. Figure 1 shows the recruitment process. For more details on the recruitment and sampling method see Paschke, Austermann, and Thomasius (2021a).

Measures

Video streaming patterns. VS was defined as passively retrieving videos from professional and/or user-generated streaming platforms including on-demand and live streaming services as well as mono- and/or multipurpose platforms (e.g., Netflix, YouTube, Twitch, TikTok) without providing, sharing, commenting on, or liking content. Problematic VS was assessed by the Streaming Disorder Scale for Adolescents (STREDIS-A) which was developed by clinical and scientific experts in the field of behavioral addictions in adolescence. It was adapted from the ICD-11-based Gaming Disorder Scale for Adolescents (GADIS-A; Paschke, Austermann, & Thomasius, 2020; WHO, 2018) and already successfully applied to the problematic use of social media (Social Media Use Disorder Scale for Adolescents [SOMEDIS-A], Paschke, Austermann, & Thomasius, 2021b). Adolescents were asked to indicate their agreement with nine statements by choosing one out of five (Likert-scale) response options when thinking of the past 12 months (*strongly disagree*[0]—*strongly agree*[4]). Higher scores suggested more problems. Frequency of problems, conflicts, or difficulties due to VS was acquired by item 10 with four response options (*not at all*[0]—*nearly daily*[3]) with a score of ≥ 2 considered significant regarding the ICD-11-time



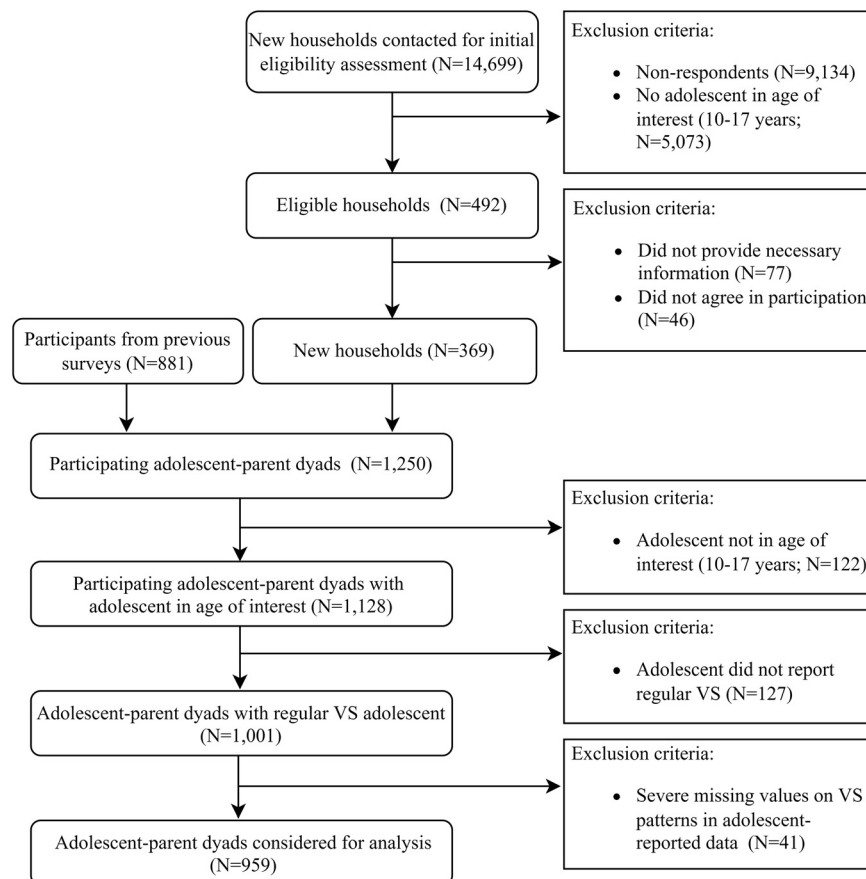


Fig. 1. Flow chart of sample recruitment. Abbreviations: VS = video streaming

criterion. Table 1 depicts STREDIS-A items matched with the ICD-11 criteria.

Since no standardized instrument to exclusively assess problematic VS in adolescents is available yet, the Young Diagnostic Questionnaire in its self- (YDQ; Wartberg et al., 2017; Young, 1998) and parental-judgement version (PYDQ; Wartberg, Kriston, Kegel, & Thomasius, 2016) was used as a comparative measure. It is based on the criteria for pathological gambling as described in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA, 1994). To distinguish the assessed VS patterns from the use of other Internet applications, the questionnaires were preceded by the instruction to think of VS only. Both one-factorial polythetic scales consist of eight items on Internet use with a dichotomous response format (*yes*[1]/*no*[0]) and a higher total score indicating more problems. Young (1998) proposed a cutoff ≥ 5 which was applied in the majority of studies (e.g., Li, Zhang, Lu, Zhang, & Wang, 2014). However, alternative approaches were suggested to allow a better differentiation and avoid overestimation of problematic patterns (e.g., Beard & Wolf, 2001). Items 3, 5 and 6 of the YDQ are related to ICD-11 GD criteria (Table 1). We therefore applied a YDQ cutoff ≥ 5 and the condition that items 3 and/or 5 and item 6 were answered with *yes*. In the current sample both scales showed acceptable

internal consistency (YDQ: Cronbach's $\alpha = 0.76$; PYDQ: $\alpha = 0.79$).

Additionally, the average number of VS days per week and the average VS time on week (school) days and weekend (leisure) days were evaluated. Out of the latter two, a mean daily VS time was computed.

Psychological measurements. Participants reported depressive symptoms on the 9-item Patient Health Questionnaire (PHQ-9) adapted for adolescents (Kroenke, Spitzer, & Williams, 2001; Paschke et al., 2021b) and anxiety symptoms by the 2-item version of the Generalized Anxiety Disorder Scale (GAD-2) with higher scores indicating more symptoms (Kroenke, Spitzer, Williams, Monahan, & Löwe, 2007; Parodi et al., 2022). Additionally, insomnia symptoms were measured with the 7-item Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001; Gerber et al., 2016) and loneliness with a 6-item version of the Revised UCLA Loneliness Scale (R-ULS; Hudiyana et al., 2021; Neto, 1992; Russell, Peplau, & Cutrona, 1980). Internal consistencies were good to acceptable in the present sample (PHQ-9: Cronbach's $\alpha = 0.89$; GAD-2: $\alpha = 0.82$; ISI: $\alpha = 0.71$; R-ULS: $\alpha = 0.87$).

Moreover, adolescents reported their past-term final grades (*very good*[1]–*failed*[6]) in the subjects German, Mathematics, and first foreign language out of which a grade

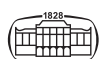


Table 1. STREDIS-A items with corresponding ICD-11 criteria and YDQ items

ICD-11 criteria (Corresponding YDQ Items)	STREDIS-A items Thinking of the last 12 months, how strongly do you agree with the following statements?
A. Impaired control over VS (e.g., onset, frequency, intensity, duration, termination, context). (Have you repeatedly made unsuccessful efforts to control, cut back, or stop Internet use? Do you stay online longer than originally intended?)	1. I often use VS services more frequently and longer than I planned to or agreed upon with my parents. ^a 2. I often cannot stop VS even though it would be sensible to do so or, for example, my parents have told me to stop. ^a
B. Increasing priority given to VS to the extent that VS takes precedence over other life interests and daily activities.	3. I often do not pursue interests outside the digital world because I prefer VS. For example, I do not meet with friends/my partner in real life, do not attend sports clubs/societies, do not read books or make music because of VS. ^a 4. I neglect daily duties because I prefer VS. Daily duties include, e.g., doing grocery shopping, cleaning, tidying up after myself, tidying up my room, fulfilling obligations for school/apprenticeship/job. ^a
C. Continuation or escalation of VS despite the occurrence of negative consequences. (Have you jeopardized or risked the loss of a significant relationship, job, educational, or career opportunity because of the Internet?)	5. I often continue using VS services even though it causes me stress with others. This means, e.g., stress with my parents, siblings, friends, partner or teachers because of VS. ^a 6. I continue VS although it harms my performance at school (or apprenticeship/job). For example, I'm late, I do not participate in class, I neglect homework and I get worse grades because of VS. ^a
D. The behavior pattern is of sufficient severity to result in significant impairment in personal, family, social, educational, occupational or other important areas of functioning.	7. Due to VS, I neglect my appearance, personal hygiene, and/or my health. For instance, I sleep less, eat unhealthy, and/or exercise less because of streaming. ^a 8. Due to VS, I risk losing important relationships or have lost them already. This includes contacts with partners, friends, acquaintances or family. ^a 9. Due to VS, I have disadvantages at school/apprenticeship/job. For example, I got bad (final) grades, I'm unable to continue to next grade or do not graduate, I have no place for training or studying, and/or I got a poor reference or a warning/dismissal as a result of VS. ^a
E. The pattern of VS behavior may be continuous or episodic and recurrent and normally evident over a period of at least 12 months.	10. In the past year, how often did you experience the conflicts or difficulties described in the statements 1 to 9 due to VS? Did this only occur on single days, during longer periods of several weeks to months, or was it almost daily? ^b

Notes: STREDIS-A = Streaming Disorder Scale for Adolescents; YDQ = Young Diagnostic Questionnaire; ICD-11 = 11th revision of the International Classification of Diseases; VS = video streaming.

^a response options: 5-point Likert-Scale: “strongly disagree” – “strongly agree”; ^b response options: “not at all”, “only on single days”, “during longer periods”, “almost daily”.

sum was calculated with lower scores indicating better performance.

Statistical analysis

All analyses were performed with the statistical program R (R Core Team, 2019).

Data management. 1,001 children and adolescents (88.74%) reported VS on a weekly basis. After exclusion of dyads with severe missing data on VS patterns, a final sample of $N = 959$ adolescent-parent dyads resulted (Fig. 1). Response patterns on standardized scales with non-severe missings were replaced by multiple imputations (mice; Buuren &

Groothuis-Oudshoorn, 2011). The data was revised for normality distribution if appropriate. Absolute values of skewness >2.0 and kurtosis >7.0 indicated substantial univariate non-normality (Kim, 2013). Multivariate normality was explored by Mardia's test (QuantPsc; Fletcher, 2012).

Factor analyses. Factor structure was investigated by exploratory factor analysis (EFA) with promax and confirmatory factor analysis (CFA) with diagonally weighted least squares on split-half samples (lavaan, psych, rsample; Kuhn, Chow, & Wickham, 2019; Revelle, 2018; Rosseel, 2012). Suitability of EFA was tested by the Kaiser-Meyer-Olkin (KMO) criterion and Bartlett's test of sphericity. Visual scree



test, parallel analysis, and the Wayne Velicer's Minimum Average Partial (MAP) criterion were calculated in order to determine the appropriate number of factors (Velicer, Eaton, & Fava, 2000). Item representation on each factor was evaluated as suggested by Howard (2016) considering a minimal factor loading of 0.4 on the primary factor, a maximum factor loading of 0.3 on alternative factors, and factor loading differences of at least 0.2. The goodness of CFA model fit was supposed as follows: χ^2/df ratio < 5, root mean square error of approximation (RMSEA) < 0.08, standardized root mean squared residual (SRMR) < 0.08, Tucker-Lewis Index (TLI) ≥ 0.95 , comparative fit index (CFI) ≥ 0.95 (Hooper, Coughlan, & Mullen, 2008). Model fits were compared by the mean adjusted χ^2 -difference statistic (Satorra & Bentler, 2001).

Internal consistency. Internal consistency coefficients were determined by Cronbach's α and McDonald's ω (Nunnally & Bernstein, 1994; Watkins, 2017).

Criterion validity. As the sum scores of the comparable scales GADIS-A and SOMEDIS-A could be shown to be a reliable measure for assessing criterion validity, STREDIS-A sum score was correlated with VS days per week and mean VS time per day, total scores of (P)YDQ, PHQ-9, GAD-2, R-ULS, ISI, and grades sum. Pearson or Spearman rank correlation tests were conducted (Cohen, 1988; Dancy & Reidy, 2011).

Sensitivity and specificity. Based on the YDQ classification of problematic VS users, receiver operating characteristic (ROC) curve analyses was performed to assess sensitivity and specificity across STREDIS-A subscale scores according to EFA/CFA factors (pROC; Robin et al., 2011). 95% confidence intervals (CI) were computed with 999 bootstrapping replications. Cutoffs for StrD were estimated applying Youden's criterion. The area under curve (AUC) value was calculated as measure of goodness of differentiation (Allgaier, 2014). Adolescents were classified as with or without StrD based on cutoffs and ICD-11-time criterion. Prevalences were estimated with 95% CI. Both groups were compared according to sex proportion by χ^2 test and Cramer's V, and according to age, VS days per week, mean VS time per day, grades sum, (P)YDQ and PHQ-9, GAD-2, R-ULS, and ISI total scores by MANOVA with post-hoc Scheffé tests and Cohen's d (Cohen, 1988; Ellis, 2010).

Classification. To further investigate construct validity and allow comparisons with other ICD-11 based instruments to assess GD (GADIS-A; Paschke et al., 2020) and social media use disorder (SMUD; SOMEDIS-A; Paschke et al., 2021b), VS patterns were analyzed by latent-profile analysis (LPA) on STREDIS-A factor sum scores and STREDIS-A time criterion (mclust; Scrucca, Fop, Murphy, & Raftery, 2016). Robustness of the LPA results was checked by 999 non-parametric bootstrapping operations to account for multivariate non-normality. The ideal number of subgroup profiles k was determined by the model with lowest values on Akaike information criterion (AIC), Bayesian information criterion (BIC), and integrated completed likelihood (ICL; Jedidi,

Jagpal, & DeSarbo, 1997; Yang, 2006). Additionally, $k-1$ bootstrap likelihood ratio tests (LRT) were performed which support the model before the first non-significant test result (Nylund, Asparouhov, & Muthén, 2007).

Profile groups were investigated regarding sex proportions by χ^2 tests and Cramer's V, and regarding STREDIS-A scores, age, VS days per week, mean VS time per day, grades sum, (P)YDQ, PHQ-9, GAD-2, R-ULS, and ISI total scores by MANOVA with post-hoc Scheffé tests and Cohen's d.

Ethics

The study was conducted in accordance with the relevant national and institutional committees on human experimentation, complied with the Declaration of Helsinki, and was approved by the Local Psychological Ethics Commission at the Center for Psychosocial Medicine of the University Medical Center Hamburg-Eppendorf. Each participant gave informed consent prior to enrolment and could withdraw from the study at any time for any reason. Parental consent was sought for the adolescents.

RESULTS

Sample description

Characteristics of the final adolescent-parent dyad sample are depicted in Table 2.

Factor structure

A (very) good suitability of the data for EFA could be demonstrated by Bartlett's test ($\chi^2(36) = 2528.94, P < 0.001$) on STREDIS-A items and KMO criterion of 0.9 overall and 0.84–0.94 for individual items (Tabachnik & Fidell, 2013, p. 6). Visual scree test and MAP criterion indicated that two factors should be retained (eigenvalue_{factor1} = 5.22, eigenvalue_{factor2} = 1.1; minimum Velicer MAP of 0.05). Item communalities were 0.5–0.86. Two factors showed an intercorrelation of $r = 0.67$ and explained a cumulative variance of 0.62 (variance_{factor1} = 0.4). Factor loadings ranged from 0.53 to 0.9 (factor1) and 0.47 to 1.0 (factor2).

CFA on the 2-factorial model returned mixed results of excellent fit by CFI (0.993) and TLI (0.990), acceptable fit by SRMR (0.056), and poor fit by χ^2/df ratio (5.04; $\chi^2(26) = 131.08, P < 0.001$) and RMSEA (0.092). However, a two-factorial solution showed a significantly better fit to the data than a single-factor model (χ^2/df ratio = 40.82, $P < 0.001$; χ^2/df ratio = 7.75 [$\chi^2(27) = 209.37, P < 0.001$]; CFI = 0.988; TLI = 0.984; SRMR = 0.076; RMSEA = 0.119). The two factors correlated by $r = 0.84$. All standardized coefficients were significantly positive ranging from 0.74 to 0.93.

STREDIS-A items 3, 4, and 7 to 9 loaded highest on factor1 mirroring impending or manifest consequences due to VS. STREDIS-A items 1, 2, and 5 loaded highest on factor2 resembling cognitive-behavioral symptoms of StrD (Fig. 2, Table 3). However, item 5 also loaded substantially on factor1 and thus was no clearly representative for factor2.



Table 2. Sociodemographic characteristics of final sample^a

Variables/categories	Adolescents <i>N</i> [% (95% CI)]/mean (SD; range)	Parents <i>N</i> [% (95% CI)]/mean (SD; range)
Absolute frequency	959	959
Gender		
Male	509 [53.08 (49.91–56.22)]	465 [48.54 (45.37–51.65)]
Female	450 [46.92 (43.78–50.09)]	494 [51.51 (48.35–54.66)]
Age in years	13.55 (2.16; 10–17)	45.53 (7.27; 28–72)
Relationship status		
Biological child	886 [92.39 (90.54–93.90)]	
Adoptive child	6 [0.63 (0.29–1.36)]	
Stepchild	43 [4.48 (3.35–5.99)]	
Other ^b	24 [2.50 (1.69–3.70)]	
Education level ^{c,d}		
High	504 [56.12 (52.86–59.34)]	234 [24.87 (22.21–27.73)]
Medium	325 [36.19 (33.11–39.39)]	641 [68.12 (65.07–71.02)]
Low	69 [7.68 (6.12–9.61)]	66 [7.01 (5.55–8.83)]
Occupation ^e		
Full time employment/school attendance	910 [95.49 (93.98–96.63)]	581 [60.58 (57.45–63.63)]
Part time employment/apprenticeship	32 [3.36 (2.39–4.70)]	289 [30.14(27.32–33.11)]
Other ^f	11 [1.15 (0.65–2.05)]	89 [9.28 (7.60–11.28)]
Psychological measures		
GAD-2 sum score	0.92 (1.34; 0–6)	
ISI sum score	8.54 (6.45; 0–28)	
PHQ-9 sum score	4.69 (4.94; 0–27)	
R-ULS sum score	11.54 (4.37; 6–24)	
YDQ sum score	1.8 (1.87; 0–8)	

Notes: *N* = absolute frequency; CI = confidence interval; SD = standard deviation; GAD = Generalized Anxiety Disorder Scale; ISI = Insomnia Severity Index; PHQ = Patient Health Questionnaire; R-ULS = Revised UCLA Loneliness Scale; YDQ = Young Diagnostic Questionnaire; VS = video streaming.

^a dyads with frequently VS adolescents, i.e. adolescents use VS at least once a week; ^b not specified; ^c for parents: highest level achieved - high = bachelor/master's degree to doctorate (Ph.D); medium = secondary school leaving certificate (Realschulabschluss)/university entry qualification (Abitur)/completed apprenticeship; low = no or lower school-leaving certificate (Hauptschulabschluss); for adolescents: (prospective) school leaving certificate (based on the current school performance) - high = university entry qualification (Abitur), medium = secondary school certificate (Realschulabschluss), low = no/special-school (Förderschulabschluss)/lower school certificate (Hauptschulabschluss); ^d no response adolescents *n* = 61, no response parents *n* = 1, not specified parents *n* = 17; ^e Item not presented to adolescents younger than 14 years, no response adolescents *n* = 6; ^f for adolescents: university students, in voluntary service, military service, other occupation, or unemployed; for parents: unemployed, job seeking, welfare recipient, pensioners, disabled, trainee, student, no specification.

Moderate correlations were found between items and time criterion ($0.42 \leq r \leq 0.57$, Table 4). Time criterion strongly correlated with total STREDIS-A ($r = 0.66$) and factor2-based subscale score ($r = 0.66$). Its correlation with subscale 1 was moderate ($r = 0.58$). Relative item-response frequencies are shown in Table 5.

Internal consistency

Total STREDIS-A showed excellent (Cronbach's $\alpha = 0.9$, McDonald's $\omega = 0.93$) and factor-based subscales good internal consistency (subscale 1: $\alpha = 0.89$, $\omega = 0.91$; subscale 2: $\alpha = 0.82$, $\omega = 0.83$).

Criterion validity

Strong positive correlations were found between STREDIS-A and (P)YDQ as well as PHQ-9 total scores. STREDIS-A

total score correlated with mean daily VS time, GAD-2, and R-ULS total score in a moderate positive manner. Between STREDIS-A total score and weekly VS days, ISI total score, and grades sum, weak positive correlations were calculated. All correlations were significant with $P < 0.001$ (Fig. 2; right column).

Sensitivity and specificity

According to ROC curve analyses results on the two STREDIS-A subscales, the optimal cutoff for subscale 1 was 11.5 (95% CI 6.5–11.5) with a specificity of 90.7% (95% CI 73.85–93.17), sensitivity of 86.36% (95% CI 72.73–100.0), and AUC value of 92.1% (95% CI 87.3–96.9). Accuracy was 91.35%. For subscale 2 a cut-off value of 5.5 (95% CI 5.5–8.5) with a specificity of 64.03% (95% CI 59.02–90.39), sensitivity of 90.91% (95% CI 68.18–100.0), and AUC value of 84.8% (95% CI 75.8–93.8) was estimated based on



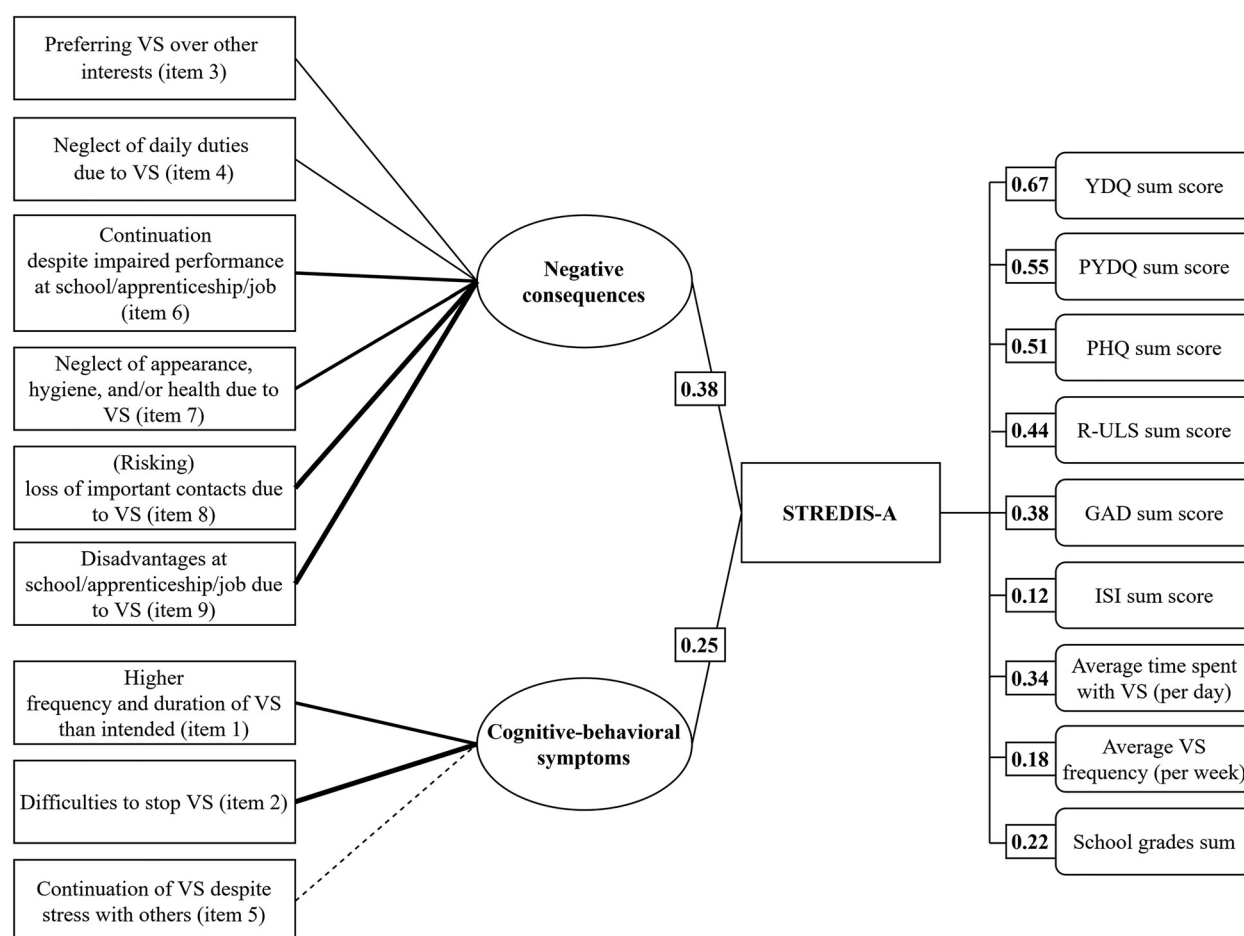


Fig. 2. Two-factorial structure of STREDIS-A and criterion validity

Individual STREDIS-A items are depicted on the left. Their EFA factor loadings with STREDIS-A factor 1 (negative consequences) and factor 2 (cognitive-behavioral symptoms of VS) are represented by different line types (thickest line: factor loading >0.9 ; medium line: factor loading >0.7 ; thinnest line: factor loading >0.5 ; dashed line: equivocal factor loading; for exact values see Table 3). The proportions of explained variance of both factors based on the EFA are given in the center. All EFA calculations are based on half of the sample. Significant Pearson correlation coefficients of the STREDIS-A sum score with all criteria except for Average VS frequency (per week) are shown on the right. For the frequency criterion, the Spearman rank correlation coefficient is presented. Correlation calculations were performed on the complete sample. All factor loadings and correlations were significant ($P < 0.001$).

Abbreviations: VS = video streaming; STREDIS-A = Streaming Disorder Scale for Adolescents; (P)YDQ = (Parental) Young Diagnostic Questionnaire; PHQ = Patient Health Questionnaire; GAD = Generalized Anxiety Disorder Scale; R-ULS = Revised UCLA Loneliness Scale; ISI = Insomnia Severity Index; EFA = Exploratory Factor Analysis

Youden's criterion. However, due to low specificity and accuracy of only 62.25%, the more conservative cutoff of 6.5 was chosen with a specificity of 72.79%, sensitivity of 81.82%, and accuracy of 80.0% to avoid overestimation. AUC values indicated good to excellent differentiation.

Classification by cutoff values

4.7% (95% CI 3.4–6.0; $N = 45$) of the adolescent VS users were classified with StrD based on estimated cutoffs and ICD-11-time criterion. As expected per definition, adolescents with StrD differed from those without regarding their scores on STREDIS-A subscale 1 and 2 as well as the time criterion with large effect sizes. Except for age and number of VS days per week, all dependent variables ((P)YDQ, PHQ-9, GAD-2, ISI, R-ULS total scores and grades sum)

were significant in the MANOVA on the two classified VS groups (Pillai score(1,782) = 0.24, $F(10,773) = 24.65$, $P < 0.001$; Table 6). Post-hoc Scheffé tests revealed large differences between both groups according to the mean VS time per day and the total scores of (P)YDQ, PHQ-9, GAD-2, and R-ULS with significantly higher values in the StrD group. Medium effect sizes were found for the significantly larger ISI total score and for grades sum in the StrD group.

Classification by LPA

LPA on STREDIS-A-based VS patterns with an ellipsoidal, equal volume and shape model preferred a model with three mutually exclusive and exhaustive latent profiles with lowest AIC, absolute BIC, and ICL values (Table 7). Moreover, a four-profile model did not fit the data significantly better

Table 3. Factorial analyses of STREDIS-A items

STREDIS-A item ^a	Factor 1 ^b	Factor 2 ^b	Communalities
Item 1 EFA	0.23	0.73	0.50
CFA	-	0.74	-
Item 2 EFA	-0.15	1.0	0.86
CFA	-	0.81	-
Item 3 EFA	0.53	0.18	0.44
CFA	0.79	-	-
Item 4 EFA	0.56	0.28	0.61
CFA	0.81	-	-
Item 5 EFA	0.40	0.47	0.63
CFA	-	0.93	-
Item 6 EFA	0.73	0.1	0.65
CFA	0.83	-	-
Item 7 EFA	0.82	0.23	0.60
CFA	0.76	-	-
Item 8 EFA	0.9	-0.11	0.68
CFA	0.85	-	-
Item 9 EFA	0.9	-0.13	0.67
CFA	0.86	-	-

Notes: STREDIS-A = Streaming Disorder Scale for Adolescents; EFA = Explanatory Factor Analysis with promax rotation (based on split-half sub-sample of $n_1 = 479$ dyads); CFA = Confirmatory Factor Analysis (based on split-half sub-sample of $n_2 = 480$ dyads); factor 1 = negative consequences; factor 2 = cognitive-behavioral symptoms.

^a for the description of the items, refer to Table 1; ^b (standardized) factor loadings are depicted.

than the three-profile one based on LRT. Both log likelihood values were identical. Thus, the null hypothesis stating that the smaller model was the best model, was not rejected.

Accordingly, the majority of frequent VS users was classified in profile 2 ($N_{\text{profile2}} = 594$; 61.9%), about one quarter in profile 3 ($N_{\text{profile3}} = 258$; 26.9%), and the smallest proportion in profile 1 ($N_{\text{profile1}} = 59$; 11.2%).

Except for age, the three profiles significantly differed regarding their VS patterns (as assessed by STREDIS-A and (P)YDQ) and VS time, their grades sum, as well as their total scores on PHQ-9, GAD-2, ISI, and R-ULS (MANOVA: Pillai score(2,781) = 1.09, $F_{\text{approx}}(26,1540) = 71.57$, $P < 0.001$; Table 8). Moreover, profile1 showed a significantly lower proportion of girls compared to profile 3 with weak effect size whereas no significant difference was found for the other profile comparisons.

Of all profiles, profile1 had the highest scores on the STREDIS-A subscales which on average were both above the estimated cutoffs for StrD and reported problems with their VS patterns for longer periods or daily. All StrD values were significantly higher in profile1 compared to profile2 and 3. Profile3 showed significantly lower values than profile2 with large effect sizes. The same pattern could be found for (P)YDQ and the time of daily VS as well as for PHQ-9, GAD-2, and R-ULS total scores with medium to large effect sizes. On average, adolescents of profile3 significantly used VS services one day less than those of

Table 4. Inter-item Pearson correlation of STREDIS-A items^a

STREDIS-A	1	2	3	4	5	6	7	8	9	Time
Items ^b	criterion									
1	1.00									
2	0.66	1.00								
3	0.37	0.47	1.00							
4	0.44	0.54	0.54	1.00						
5	0.53	0.62	0.57	0.64	1.00					
6	0.41	0.47	0.50	0.60	0.59	1.00				
7	0.30	0.35	0.51	0.52	0.49	0.57	1.00			
8	0.35	0.37	0.57	0.52	0.56	0.56	0.61	1.00		
9	0.36	0.40	0.48	0.55	0.53	0.69	0.60	0.66	1.00	
Time criterion	0.57	0.56	0.43	0.51	0.57	0.48	0.45	0.42	0.45	1.00

Notes: STREDIS-A = Streaming Disorder Scale for Adolescents.

^a based on total sample of $N = 959$ adolescents; ^b for the description of items, refer to Table 1. The items of factor 2 are highlighted in gray.



Table 5. Relative item-response frequency of STREDIS-A items (in %)^a

STREDIS-A Items ^b	Response options				
	strongly disagree	somewhat disagree	partially agree/ partially disagree	somewhat agree	strongly agree
Item 1	12.93	21.27	32.33	25.86	7.61
Item 2	20.33	26.59	25.03	21.38	6.67
Item 3	47.49	28.88	13.66	6.99	2.82
Item 4	31.28	31.60	22.63	11.99	2.50
Item 5	37.12	30.03	17.94	11.47	3.44
Item 6	49.01	28.99	13.87	6.47	1.67
Item 7	62.36	21.38	10.32	5.11	0.83
Item 8	64.65	24.92	7.30	2.40	0.73
Item 9	59.75	26.28	9.28	3.96	0.73
	not at all	only on single days	for longer periods	nearly daily	
Time criterion	26.90	61.94	9.07	2.09	

Notes: STREDIS-A = Streaming Disorder Scale for Adolescents.

^a based on the total sample of $N = 959$ adolescents; ^b for the description of items, refer to Table 1. The items of factor 2 are highlighted in gray.

profiles1 and 2 with small effect sizes while no difference was found between profiles1 and 2. Significantly higher ISI total scores were revealed for adolescents of profile1 compared to profile2 and 3 with small to medium effect sizes while no difference was found between profiles2 and 3. Adolescents of profile1 showed the worst school performance compared to profile2 (small effect size) and profile3 (medium effect size) whereas profiles2 and 3 did not differ.

DISCUSSION

The present study is the first to provide conceptualization for problematic streaming patterns in adolescents by applying the ICD-11 criteria of GD. As the first available tool for the assessment of StrD, the 10-item STREDIS-A was successfully validated in a representative adolescent-parent

sample. It showed good to excellent internal consistency, criterion validity, and discriminatory power.

As in the original GADIS-A (Paschke et al., 2020) for the assessment of GD and the adapted SOMEDIS-A (Paschke et al., 2021b) for SMUD, the two-factorial structure of negative consequences (factor1) and cognitive-behavioral symptoms (factor2) could be replicated. Yet, item four (neglect of daily duties) did no longer load highest on factor2 but was assigned factor1. Moreover, although loading highest on factor2, item5 could not be unequivocally assigned to it. This suggests the loss of control over VS to be the main cognitive-behavioral symptom of StrD, while the increased priority given to VS, the acceptance of associated problems and the occurrence of impairments is rather a consequence covered by factor1. However, the lack of separation between attitudes towards VS and resulting impairments might be also due to item wording which does not distinguish between current and long-term perspectives.



Table 6. Frequencies and statistical comparisons of adolescents with and without StrD

Variables	Frequency [95% CI]		F-value	χ^2 /post-hoc	Effect
Mean (SE)	No StrD	StrD	(MANOVA)	Scheffé tests	size ^a
absolute frequency	914	45	-	-	-
relative frequency	95.31 [93.97; 96.65]	4.69 [3.35; 6.03]	-	-	-
female sex in %	47.59 [44.36; 50.83]	33.33 [19.56; 47.11]	-	0.02 NS ($P = 0.89$)	0.06
STREDIS-A subscale 1 sum score	4.1 (0.13)	15.6 (0.46)	-	11.5***	2.96
STREDIS-A subscale 2 sum score	4.51 (0.09)	9.64 (0.27)	-	5.13***	1.84
STREDIS-A time criterion score	0.8 (0.02)	2.24 (0.06)	-	1.45***	2.52
age	13.55 (0.07)	13.53 (0.3)	0.0 NS ($P = 0.99$)	-	0.01
YDQ sum score	1.65 (0.06)	5.12 (0.31)	158.65***	3.47***	2.01
PYDQ sum score	1.78 (0.06)	5.38 (0.31)	128.04***	3.59***	1.89
average number of VS days per week	5.49 (0.06)	5.87 (0.23)	1.96 NS ($P = 0.16$)	-	0.21
average VS time per day [in minutes] ^b	198.95 (18.84)	337.67 (23.29)	38.37***	138.71***	1.08
PHQ-9 sum score	4.3 (0.15)	12.44 (0.99)	127.06***	8.14***	1.76
GAD-2 sum score	0.83 (0.04)	2.79 (0.31)	96.02***	1.96***	1.53
R-ULS sum score	11.34 (0.14)	15.53 (0.62)	37.16***	4.19***	0.98
ISI sum score	8.32 (0.21)	13.05 (1.02)	17.91***	4.73***	0.74
grades sum ^{cd}	6.34 (0.36)	7.92 (0.47)	16.26***	1.58***	0.65

Notes: StrD = Streaming Disorder; MANOVA = Multivariate Analysis of Variance; χ^2 = chi-square; CI = confidence interval; NS = not significant; SE = standard error of means; VS = video streaming; STREDIS-A = Streaming Disorder Scale for Adolescents; subscale 1 = negative consequences; subscale 2 = cognitive-behavioral symptoms; (P)YDQ = (Parental) Young Diagnostic Questionnaire; PHQ = Patient Health Questionnaire; GAD = Generalized Anxiety Disorder Scale; R-ULS = Revised UCLA Loneliness Scale; ISI = Insomnia Severity Index.

^a based on Cramer's V for female sex and Cohen's d for all other variables; ^b Mean of VS per week (school) day and weekend (leisure) day [in minutes]; ^c Sum of school grades in mathematics, German, and first foreign language (each ranging 1–6, with higher scores indicating worse performance); ^d during past school term.

*** $P \leq 0.001$.

In line with the altered factor definition, cutoff values changed towards higher thresholds for factor1 compared to factor2. Diverging cutoffs between instruments assessing usage patterns of different digital media are expected according to the concept of separate entities of behavioral addictions (Király et al., 2014). Since frequent VS is a leisure activity of almost 90% of 10- to 17-year-old adolescents, aspects on the control of usage alone are of limited use when trying to identify problematic VS patterns. As it is known from binge watching research, watching multiple series in a row (i.e., to the cost of control) is a typical viewing

habit in the majority of users and, thus, not necessarily dysfunctional or an indicator of addictive viewing behavior (Flayelle, Maurage, Karila, Vögele, & Billieux, 2019; Tóth-Király et al., 2017). Noteworthy, the intensity of VS has even increased during the on-going COVID-19 pandemic (Dixit, Marthoenis, Arafat, Sharma, & Kar, 2020). Therefore, more emphasis needs to be laid on the occurrence of negative consequences to identify potential StrD. The two-factorial solution is in line with the biaxial model of addiction and the ICD-11 approach (Reed et al., 2019; Wartberg et al., 2017). Accordingly, a disordered usage

Table 7. Comparison of latent profile models

Latent profiles k	Log likelihood	AIC	BIC	ICL	LRTS
1	-3487.88	6993.76	-7037.55	-7037.55	-
2	-3464.96	6961.93	-7039.78	-7065.75	45.83***
3	-2680.61	5407.22	-5519.14	-5519.14	1568.7***
4	-2680.61	5421.22	-5567.2	-5835.33	0.00

Notes: AIC = Akaike information criterion; BIC = Bayesian information criterion; ICL = Integrated Completed Likelihood; LRTS = likelihood ratio test score.

*** $P \leq 0.001$ (based on bootstrapping with 999 replications).



Table 8. MANOVA and post-hoc tests on the three VS profiles based on LPA^a

Variables Frequency [95% CI] Mean (SE)	Problematic streamers (PS)	Intensive streamers (IS)	Light streamers (LS)	F-value	χ^2 /post-hoc Scheffé tests ^a	Effect size ^b
absolute frequency	107	594	258	-	-	-
relative frequency in %	11.16 [9.16; 13.15]	61.94 [58.87; 65.01]	26.9 [24.1; 29.71]	-	-	-
female sex in %	36.45 [27.33; 45.57]	46.63 [42.62; 50.64]	51.94 [45.84; 58.03]	-	3.4 NS ($P = 0.07$) 6.67** 1.82 NS ($P = 0.18$) -6.27*** -9.58*** -3.31*** -2.9*** -6.47*** -3.57*** -1.19*** -2.19*** -1***	0.07 0.14 0.05 1.52 2.95 0.94 1.25 3.08 1.62 7.78 10.33 Inf
STREDIS-A subscale 1 sum score	11.1 (0.48)	4.83 (0.16)	1.52 (0.13)	222.44***	-	0.13 0.25 0.12
STREDIS-A subscale 2 sum score	8.29 (0.23)	5.39 (0.09)	1.82 (0.12)	345.09***	-2.29*** -3.55*** -1.25*** -2.15*** -3.19*** -1.03***	1.33- 2.36 0.83 1.11 1.74 0.59
STREDIS-A time criterion score	2.19 (0.04)	1 (0)	0 (0)	9827.96***	-0.06 NS ($P = 0.96$) -0.83*** -0.77*** -76.4*** -120.8*** -44.4*** -5*** -7.09*** -2.09*** -1.29*** -1.66*** -0.37*** -2.56*** -4.51*** -1.94*** -3.39*** -2.63**	0.03 0.43 0.43 0.58 0.98 0.36 1.02 1.64 0.49 0.97 1.3 0.32 0.59 1.14 0.47 0.54 0.39
age	13.22 (0.19)	13.51 (0.09)	13.77 (0.14)	0.82 NS ($P = 0.44$)	-	0.12
YDQ sum score	4.18 (0.21)	1.89 (0.07)	0.64 (0.07)	180.79***	-	0.12
PYDQ sum score	4.14 (0.24)	1.99 (0.08)	0.96 (0.09)	99.87***	-	0.12
number of VS days per week	5.77 (0.15)	5.71 (0.07)	4.94 (0.13)	14.89***	-	0.12
mean VS time per day [in minutes] ^c	285.61 (14.16)	209.21 (5.31)	164.81 (6.95)	34.81***	-	0.12
PHQ-9 sum score	9.69 (0.59)	4.69 (0.19)	2.6 (0.2)	84.22***	-	0.12
GAD-2 sum score	2.17 (0.17)	0.87 (0.05)	0.5 (0.06)	55.5***	-	0.12
R-ULS sum score	14.34 (0.44)	11.77 (0.18)	9.83 (0.23)	46.14***	-	0.12
ISI sum score	11.34 (0.62)	7.95 (0.25)	8.71 (0.42)	8.01***	-	0.12
grades sum ^{de}	7.23 (0.29)	6.45 (0.1)	6 (0.14)	8.67***	-	0.12
					0.76 NS ($P = 0.28$) -0.78* -1.23*** -0.45 NS ($P = 0.07$)	0.12 0.31 0.5 0.19

Notes: MANOVA = Multivariate Analysis of Variance; VS = video streaming; LPA = Latent Profile Analysis; CI = confidence interval; NS = not significant; SE = standard error of the means; STREDIS-A=Streaming Disorder Scale for Adolescents; STREDIS-A subscale 1 = negative consequences; STREDIS-A subscale 2 = cognitive-behavioral symptoms; (P)YDQ = (Parental) Young Diagnostic Questionnaire; PHQ = Patient Health Questionnaire; GAD = Generalized Anxiety Disorder Scale; R-ULS = Revised UCLA Loneliness Scale; ISI = Insomnia Severity Index.

^a post-hoc tests reported in the following sequence: PS- IS, PS – LS, IS – LS; ^b based on Cramer's V for female sex and Cohen's d for all other variables; ^c Mean of VS per week (school) day and weekend (leisure) day [in minutes]; ^d Sum of grades in mathematics, German, and first foreign language (each ranging 1–6, with higher scores indicating worse performance); ^e during past school term.

*** $P \leq 0.001$, ** $P \leq 0.01$, * $P \leq 0.05$.



pattern is characterized by “an impaired-control motivational dysfunction and a harmful consequence component involving negative social, psychological, and physical consequences of excessive use” (Wakefield, 2015). However, despite the strong clinical plausibility and the factorial results, the two factors are strongly correlated and therefore only limitedly distinct from a psychometric point of view. This favors the use of the total STREDIS-A score in multivariate analyses.

Based on the two-factorial concept, 4.69% (95% CI 3.35–6.03%) of adolescents with regular VS were classified with StrD. This prevalence is comparable to GD (3.7%, 95% CI 2.4–5.0%; Paschke et al., 2020) and SMUD (3.33%, 95% CI 2.18–4.48%; Paschke et al., 2021b) but also common adolescent mental disorders like anxieties (6.5%, 95% CI 4.7–9.1%), depression (2.6%, 95% CI 1.7–3.9%), attention deficit hyperactivity disorder (3.4%, 95% CI 2.6–4.5%), and disruptive disorders (5.7%, 95% CI 4.0–8.1%; Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015). The StrD group streamed more than two hours longer per day than nonaffected regular users. Higher VS intensities have been reported for adult problematic binge-watchers (Flayelle, Canale, et al., 2019). Adolescents with StrD showed a moderate depressive symptom expression (Richardson et al., 2010), more symptoms of anxiety and insomnia and reported more loneliness and worse school performance compared to those without StrD. This is line with studies with (problematic) binge watchers (Anghelcev, Sar, Martin, & Moultrie, 2020; Flayelle et al., 2020; Raza et al., 2021; Starosta & Izydorczyk, 2020; Steins-Loeber, Reiter, Averbek, Harbarth, & Brand, 2020) and studies with adolescents with problematic social media and Internet use (Barry, Sidoti, Briggs, Reiter, & Lindsey, 2017; Marttila, Koivula, & Räsänen, 2021; Pontes et al., 2021; Tsitsika et al., 2014) as well as higher screen times (Adelantado-Renau et al., 2019; Hale & Guan, 2015; Sheno et al., 2022; Tremblay et al., 2011). Comparable results, although to a smaller extent, were found for problematic streamers according to the LPA results. This group made up 11.16% (95% CI 9.16–13.15%) of all regular streamers and included at-risk and disordered usage patterns. It showed lower scores on the negative-consequences subscale 1 suggesting at-risk VS to be a potential precursor to StrD.

Adolescents seem to be especially vulnerable to developing StrD due to immature cognitive-control abilities (Casey & Jones, 2010). Adolescent gamers with GD show a larger cognitive-affective imbalance than unaffected gamers (Schettler, Thomasius, & Paschke, 2021). This might be also the case in adolescents with StrD although further studies, including neuroimaging are highly warranted.

STREDIS-A is the first tool to reliably and validly screen for StrD to support standardized approaches in epidemiological, clinical, and neuroscientific research fields. It can be easily and cost-effectively used, e.g., prior to clinical appointments to induce proper treatments with the goal of reducing symptoms and preventing severe secondary impairments, comorbidities, or even chronicity.

Limitations

One major strength of this study is the large representative adolescent-parent sample. However, only households with Internet access (92%, of German households, Statista, 2022) and sufficient knowledge of the German language were included. Furthermore, missing data is a common problem in large online surveys, especially with younger adolescents, that might have affected representativity. No objective markers such as logged streaming times could be considered in the validation process. Since no standardized questionnaire to assess StrD in adolescents as a comparative measure of the new scale has been available yet, one of the most established instruments on the general concept of Internet addiction was applied: (P)YDQ has been broadly used in adolescents to also assess specific use patterns like problematic gaming and shows large similarities to DSM-5 internet gaming disorder criteria (Strittmatter et al., 2015). However, verification by a specialized clinician as the gold standard for concordant validity would have been desirable. Yet, bearing in mind, that this study is the first attempt to conceptualize problematic streaming patterns in adolescents, the newly introduced questionnaire provides a good starting point for further research. Future studies should enhance validation and add the evaluation of re-test reliability and potential cause-and-effect relationships by a longitudinal design. Moreover, they should further investigate the influence of different VS patterns (i.e., purely passive vs. mixed passive-interactive) and the use of different VS services (i.e., mono- vs. multipurpose, professional vs. user generated, live vs. on-demand).

CONCLUSIONS

The current study has the potential to make significant contributions to the conceptualization of addictive VS among adolescents. Based on the ICD-11 criteria of GD and the two-factorial approach of cognitive-behavioral symptoms and their negative consequences, STREDIS-A provides the first standardized measure to excellently distinguish StrD from unproblematic VS patterns with good to excellent internal consistency, reliability and criterion validity. This is of particular importance, on the one hand, to avoid the pathologization of a regular leisure activity in the majority of adolescents, and, on the other hand, to identify suffering adolescents in need of treatment at a stage of life that is particularly prone to negative consequences, mental disorders, and chronification.

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data. KP drafted the manuscript. AKN performed literature review and prepared tables and figures, and formatting. All authors critically revised the draft for important intellectual content. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors gave final approval for the article to be published.

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REFERENCES

- Adelantado-Renau, M., Moliner-Urdiales, D., Cavero-Redondo, I., Beltran-Valls, M. R., Martínez-Vizcaíno, V., & Álvarez-Bueno, C. (2019). Association between screen media use and academic performance among children and adolescents: A systematic review and meta-analysis. *JAMA Pediatrics*, 173(11), 1058. <https://doi.org/10.1001/jamapediatrics.2019.3176>.
- Allgaier, A.-K. (2014). Diagnostische Güte von Testverfahren [Accuracy of diagnostic tests]. *PPmP - Psychotherapie · Psychosomatik · Medizinische Psychologie*, 64(02), 86–87. <https://doi.org/10.1055/s-0033-1360057>.
- Anghelcev, G., Sar, S., Martin, J., & Moultrie, J. L. (2020). Is heavy binge-watching a socially driven behaviour? Exploring differences between heavy, regular and non-binge-watchers. *Journal of Digital Media & Policy*, 1–21. https://doi.org/10.1386/jdmp_00035_1.
- APA (1994). *Diagnostic and statistical Manual of mental disorders (DSM-IV)* (5. Aufl.). American Psychiatric Association.
- Balakrishnan, J., & Griffiths, M. D. (2017). Social media addiction: What is the role of content in YouTube? *Journal of Behavioral Addictions*, 6(3), 364–377. <https://doi.org/10.1556/2006.6.2017.058>.
- Barry, C. T., Sidoti, C. L., Briggs, S. M., Reiter, S. R., & Lindsey, R. A. (2017). Adolescent social media use and mental health from adolescent and parent perspectives. *Journal of Adolescence*, 61, 1–11. <https://doi.org/10.1016/j.adolescence.2017.08.005>.
- Bastien, C., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine*, 2(4), 297–307. [https://doi.org/10.1016/S1389-9457\(00\)00065-4](https://doi.org/10.1016/S1389-9457(00)00065-4).
- Beard, K. W., & Wolf, E. M. (2001). Modification in the proposed diagnostic criteria for internet addiction. *CyberPsychology & Behavior*, 4(3), 377–383. <https://doi.org/10.1089/109493101300210286>.
- Billieux, J., Schimmenti, A., Khazaal, Y., Maurage, P., & Heeren, A. (2015). Are we overpathologizing everyday life? A tenable blueprint for behavioral addiction research. *Journal of Behavioral Addictions*, 4(3), 119–123. <https://doi.org/10.1556/2006.4.2015.009>.
- Buuren, S. van., & Groothuis-Oudshoorn, K. (2011). mice: Multi-variate imputation by chained equations in R. *Journal of Statistical Software*, 45(3), 1–67. <https://doi.org/10.18637/jss.v045.i03>.
- Casey, B. J., & Jones, R. M. (2010). Neurobiology of the adolescent brain and behavior: Implications for substance use disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, 49(12), 1189–1201. <https://doi.org/10.1016/j.jaac.2010.08.017>.
- Cohen, J. (1988). The effect size index: D. *Statistical power analysis for the behavioral sciences (Second Edition)*, S. 284–288. Lawrence Erlbaum Associates.
- Dancey, P. C., & Reidy, J. (2011). *Statistics without maths for psychology* (5 edition). Prentice Hall.
- Die medienanstalten (Hrsg.). (2021). *Digitalisierungsbericht 2021: Video. die medienanstalten - ALM GbR*. https://www.die-medienanstalten.de/publikationen/digitalisierungsbericht-video?tx_news_pi1%5Bnews%5D=4966&cHash=d01bfb9aa8a91d2e71be1683396db46.
- Dixit, A., Marthoenis, M., Arafat, S. M. Y., Sharma, P., & Kar, S. K. (2020). Binge watching behavior during COVID 19 pandemic: A cross-sectional, cross-national online survey. *Psychiatry Research*, 289, 113089. <https://doi.org/10.1016/j.psychres.2020.113089>.
- Ellis, P. D. (2010). *The essential guide to effect sizes: Statistical power, meta-analysis, and the interpretation of research results*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511761676>.
- Exelmans, L., & Van den Bulck, J. (2017). Binge viewing, sleep, and the role of Pre-sleep arousal. *Journal of Clinical Sleep Medicine*, 13(08), 1001–1008. <https://doi.org/10.5664/jcsm.6704>.
- Feierabend, S., Rathgeb, T., Kheredmand, H., & Glöckler, S. (2021). *JIM-Studie 2021 Medien—Basisstudie zum Medienumgang 12-bis 19-Jähriger in Deutschland*. Medienpädagogischer Forschungsverbund Südwest. https://www.mpfs.de/fileadmin/files/Studien/JIM/2021/JIM-Studie_2021_barrierefrei.pdf.
- Flayelle, M., Canale, N., Vögele, C., Karila, L., Maurage, P., & Billieux, J. (2019). Assessing binge-watching behaviors: Development and validation of the “Watching TV series motives” and “Binge-watching engagement and symptoms” questionnaires. *Computers in Human Behavior*, 90, 26–36. <https://doi.org/10.1016/j.chb.2018.08.022>.
- Flayelle, M., Maurage, P., Di Lorenzo, K. R., Vögele, C., Gainsbury, S. M., & Billieux, J. (2020). Binge-Watching: What do we know so far? A first systematic review of the evidence. *Current Addiction Reports*, 7(1), 44–60. <https://doi.org/10.1007/s40429-020-00299-8>.
- Flayelle, M., Maurage, P., Karila, L., Vögele, C., & Billieux, J. (2019). Overcoming the unitary exploration of binge-watching: A cluster analytical approach. *Journal of Behavioral Addictions*, 8(3), 586–602. <https://doi.org/10.1556/2006.8.2019.53>.
- Fletcher, T. D. (2012). *QuantPsc: Quantitative psychology tools. R package version 1.5*. <https://CRAN.R-project.org/package=QuantPsc>.
- Forte, G., Favieri, F., Tedeschi, D., & Casagrande, M. (2021). Binge-Watching: Development and validation of the binge-watching addiction questionnaire. *Behavioral Sciences*, 11(2), 27. <https://doi.org/10.3390/bs11020027>.



- Gerber, M., Lang, C., Lemola, S., Colledge, F., Kalak, N., Holsboer-Trachsler, E., ... Brand, S. (2016). Validation of the German version of the insomnia severity index in adolescents, young adults and adult workers: Results from three cross-sectional studies. *BMC Psychiatry*, 16(1), 174. <https://doi.org/10.1186/s12888-016-0876-8>.
- Griffiths, M. (2005). A 'components' model of addiction within a biopsychosocial framework. *Journal of Substance Use*, 10(4), 191–197. <https://doi.org/10.1080/14659890500114359>.
- Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Reviews*, 21, 50–58. <https://doi.org/10.1016/j.smrv.2014.07.007>.
- Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, 6(1), 53–60.
- Howard, M. C. (2016). A review of exploratory factor Analysis decisions and overview of current practices: What we are doing and how can we improve? *International Journal of Human-Computer Interaction*, 32(1), 51–62. <https://doi.org/10.1080/10447318.2015.1087664>.
- Hudiyana, J., Lincoln, T. M., Hartanto, S., Shadiqi, M. A., Milla, M. N., Muluk, H., & Jaya, E. S. (2021). How Universal Is a Construct of Loneliness? Measurement Invariance of the UCLA Loneliness Scale in Indonesia, Germany, and the United States. *Assessment*. <https://doi.org/10.1177/10731911211034564>.
- Jedidi, K., Jagpal, H. S., & DeSarbo, W. S. (1997). Finite-Mixture structural equation models for response-based segmentation and unobserved heterogeneity. *Marketing Science*, 16(1), 39–59. <https://doi.org/10.1287/mksc.16.1.39>.
- Kim, H.-Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics*, 38(1), 52. <https://doi.org/10.5395/rde.2013.38.1.52>.
- Király, O., Griffiths, M. D., Urban, R., Farkas, J., Kokonyei, G., Elekes, Z., & Demetrovics, Z. (2014). Problematic internet use and problematic online gaming are not the same: Findings from a large nationally representative adolescent sample. *Cyberpsychology, Behavior and Social Networking*, 17(12), 749–754. <https://doi.org/10.1089/cyber.2014.0475>.
- Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>.
- Kroenke, K., Spitzer, R. L., Williams, J. B. W., Monahan, P. O., & Löwe, B. (2007). Anxiety disorders in primary care: Prevalence, impairment, comorbidity, and detection. *Annals of Internal Medicine*, 146(5), 317. <https://doi.org/10.7326/0003-4819-146-5-200703060-00004>.
- Kuhn, M., Chow, F., & Wickham, H. (2019). *rsample: General resampling infrastructure*. <https://CRAN.R-project.org/package=rsample>.
- Li, Y., Zhang, X., Lu, F., Zhang, Q., & Wang, Y. (2014). Internet addiction among elementary and middle school students in China: A nationally representative sample study. *Cyberpsychology, Behavior, and Social Networking*, 17(2), 111–116. <https://doi.org/10.1089/cyber.2012.0482>.
- Marttila, E., Koivula, A., & Räsänen, P. (2021). Does excessive social media use decrease subjective well-being? A longitudinal analysis of the relationship between problematic use, loneliness and life satisfaction. *Telematics and Informatics*, 59, 101556. <https://doi.org/10.1016/j.tele.2020.101556>.
- Matrix, S. (2014). The Netflix effect: Teens, binge watching, and on-demand digital media trends. *Jeunesse: Young People, Texts, Cultures*, 6(1), 119–138. <https://doi.org/10.1353/jeu.2014.0002>.
- Neto, F. (1992). Loneliness among Portuguese adolescents. *Social Behavior and Personality*, 20(1), 15–21. <https://doi.org/10.2224/sbp.1992.20.1.15>.
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. McGraw-Hill.
- Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class Analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling: A Multidisciplinary Journal*, 14(4), 535–569. <https://doi.org/10.1080/10705510701575396>.
- Orosz, G., Bőthe, B., & Tóth-Király, I. (2016). The development of the problematic series WatchingScale (PSWS). *Journal of Behavioral Addictions*, 5(1), 144–150. <https://doi.org/10.1556/2006.5.2016.011>.
- Ort, A., Wirz, D. S., & Fahr, A. (2021). Is binge-watching addictive? Effects of motives for TV series use on the relationship between excessive media consumption and problematic viewing habits. *Addictive Behaviors Reports*, 13, 100325. <https://doi.org/10.1016/j.abrep.2020.100325>.
- Panda, S., & Pandey, S. C. (2017). Binge watching and college students: Motivations and outcomes. *Young Consumers*, 18(4), 425–438. <https://doi.org/10.1108/YC-07-2017-00707>.
- Parodi, K. B., Holt, M. K., Green, J. G., Porche, M. V., Koenig, B., & Xuan, Z. (2022). Time trends and disparities in anxiety among adolescents, 2012–2018. *Social Psychiatry and Psychiatric Epidemiology*, 57(1), 127–137. <https://doi.org/10.1007/s00127-021-02122-9>.
- Paschke, K., Austermann, M. I., & Thomasius, R. (2020). Assessing ICD-11 gaming disorder in adolescent gamers: Development and validation of the gaming disorder scale for adolescents (GADIS-A). *Journal of Clinical Medicine*, 9(4), 993. <https://doi.org/10.3390/jcm9040993>.
- Paschke, K., Austermann, M. I., & Thomasius, R. (2021a). Assessing ICD-11 gaming disorder in adolescent gamers by parental ratings: Development and validation of the Gaming Disorder Scale for Parents (GADIS-P). *Journal of Behavioral Addictions*, 10(1), 159–168. <https://doi.org/10.1556/2006.2020.00105>.
- Paschke, K., Austermann, M. I., & Thomasius, R. (2021b). ICD-11-Based assessment of social media use disorder in adolescents: Development and validation of the social media use disorder scale for adolescents. *Frontiers in Psychiatry*, 12, 661483. <https://doi.org/10.3389/fpsy.2021.661483>.
- Polanczyk, G. V., Salum, G. A., Sugaya, L. S., Caye, A., & Rohde, L. A. (2015). Annual research review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. *Journal of Child Psychology and Psychiatry*, 56(3), 345–365. <https://doi.org/10.1111/jcpp.12381>.



- Pontes, H. M., Schivinski, B., Sindermann, C., Li, M., Becker, B., Zhou, M., & Montag, C. (2021). Measurement and conceptualization of gaming disorder according to the world health organization framework: The development of the gaming disorder test. *International Journal of Mental Health and Addiction*, 19, 508–528. <https://doi.org/10.1007/s11469-019-00088-z>.
- R Core Team (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>.
- Raza, S. H., Yousaf, M., Sohail, F., Munawar, R., Ogadimma, E. C., & Marisa Lim Dao Siang, J. (2021). Investigating binge-watching adverse mental health outcomes during covid-19 pandemic: Moderating role of screen time for web series using online streaming. *Psychology Research and Behavior Management*, 14, 1615–1629. <https://doi.org/10.2147/PRBM.S328416>.
- Reed, G. M., First, M. B., Kogan, C. S., Hyman, S. E., Gureje, O., Gaebel, W., ..., Saxena, S. (2019). Innovations and changes in the ICD-11 classification of mental, behavioural and neurodevelopmental disorders. *World Psychiatry*, 18(1), 3–19. <https://doi.org/10.1002/wps.20611>.
- Revelle, W. (2018). *psych: Procedures for psychological, psychometric, and personality research*. Northwestern University. <https://CRAN.R-project.org/package=psych>.
- Richardson, L. P., McCauley, E., Grossman, D. C., McCarty, C. A., Richards, J., Russo, J. E., ... Katon, W. (2010). Evaluation of the Patient health questionnaire-9 item for detecting major depression among adolescents. *Pediatrics*, 126(6), 1117–1123. <https://doi.org/10.1542/peds.2010-0852>.
- Robin, X., Turck, N., Hainard, A., Tiberti, N., Lisacek, F., Sanchez, J.-C., & Müller, M. (2011). PROC: An open-source package for R and S+ to analyze and compare ROC curves. *BMC Bioinformatics*, 12, 77. <https://doi.org/10.1186/1471-2105-12-77>.
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48(2), 1–36.
- Russell, D., Peplau, L. A., & Cutrona, C. E. (1980). The revised UCLA Loneliness Scale: Concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology*, 39(3), 472–480. <https://doi.org/10.1037/0022-3514.39.3.472>.
- Satorra, A., & Bentler, P. M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika*, 66(4), 507–514. <https://doi.org/10.1007/BF02296192>.
- 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. *Addiction Biology*. <https://doi.org/10.1111/adb.13093>.
- Scrucca, L., Fop, M., Murphy, T. B., & Raftery, A. E. (2016). Mclust 5: Clustering, classification and density estimation using Gaussian finite mixture models. *The R Journal*, 8(1), 205–233.
- Shenoi, R. P., Linakis, J. G., Bromberg, J. R., Casper, T. C., Richards, R., Chun, T. H., & Spirito, A. (2022). Association of physical activity, sports, and screen time with adolescent behaviors in youth who visit the Pediatric emergency department. *Clinical Pediatrics*. <https://doi.org/10.1177/000992282211075094>.
- Shim, H., & Kim, K. J. (2018). An exploration of the motivations for binge-watching and the role of individual differences. *Computers in Human Behavior*, 82, 94–100. <https://doi.org/10.1016/j.chb.2017.12.032>.
- Smith, T., & Short, A. (2022). Needs affordance as a key factor in likelihood of problematic social media use: Validation, latent Profile analysis and comparison of TikTok and Facebook problematic use measures. *Addictive Behaviors*, 129, 107259. <https://doi.org/10.1016/j.addbeh.2022.107259>.
- Spilker, H. S., Ask, K., & Hansen, M. (2020). The new practices and infrastructures of participation: How the popularity of Twitch.tv challenges old and new ideas about television viewing. *Information, Communication & Society*, 23(4), 605–620. <https://doi.org/10.1080/1369118X.2018.1529193>.
- Spilker, H. S., & Colbjørnsen, T. (2020). The dimensions of streaming: Toward a typology of an evolving concept. *Media, Culture & Society*, 42(7–8), 1210–1225. <https://doi.org/10.1177/0163443720904587>.
- Starosta, J., & Izydorczyk, B. (2020). Understanding the phenomenon of binge-watching—a systematic review. *International Journal of Environmental Research and Public Health*, 17(12), 4469. <https://doi.org/10.3390/ijerph17124469>.
- Starosta, J., Izydorczyk, B., & Lizińczyk, S. (2019). Characteristics of people's binge-watching behavior in the “entering into early adulthood” period of life. *Health Psychology Report*, 7(2), 149–164. <https://doi.org/10.5114/hpr.2019.83025>.
- Starosta, J., Izydorczyk, B., & Wontorczyk, A. (2021). Anxiety-depressive syndrome and binge-watching among young adults. *Frontiers in Psychology*, 12, 689944. <https://doi.org/10.3389/fpsyg.2021.689944>.
- statista (2022, Januar 24). *Internetzugang in deutschen Haushalten [Internet Access in German households]. Anteil der Haushalte in Deutschland mit Internetzugang von 2002 bis 2021*. <https://de.statista.com/statistik/daten/studie/153257/umfrage/haushalte-mit-internetzugang-in-deutschland-seit-2002/>.
- Statista (2022, Januar). *Anzahl der zahlenden Streaming-Abonnenten von Netflix weltweit vom 3. Quartal 2011 bis zum 4. Quartal 2021*. <https://de.statista.com/statistik/daten/studie/196642/umfrage/abonnenten-von-netflix-quartalszahlen/>.
- Steins-Loeber, S., Reiter, T., Averbach, H., Harbarth, L., & Brand, M. (2020). Binge-watching behaviour: The role of impulsivity and depressive symptoms. *European Addiction Research*, 26(3), 141–150. <https://doi.org/10.1159/000506307>.
- Sun, J.-J., & Chang, Y.-J. (2021). Associations of problematic binge-watching with depression, social interaction anxiety, and loneliness. *International Journal of Environmental Research and Public Health*, 18(3), 1168. <https://doi.org/10.3390/ijerph18031168>.
- Tabachnik, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Harlow: Pearson Education Limited, 6.
- Tóth-Király, I., Bóthe, B., Tóth-Fáber, E., Hága, G., & Orosz, G. (2017). Connected to TV series: Quantifying series watching engagement. *Journal of Behavioral Addictions*, 6(4), 472–489. <https://doi.org/10.1556/2006.6.2017.083>.
- Tremblay, M. S., LeBlanc, A. G., Kho, M. E., Saunders, T. J., Larouche, R., Colley, R. C., ... Gorbey, S. (2011). Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 98. <https://doi.org/10.1186/1479-5868-8-98>.
- Tsitsika, A. K., Tzavela, E. C., Janikian, M., Ólafsson, K., Iordache, A., Schoenmakers, T. M., ... Richardson, C. (2014). Online social networking in adolescence: Patterns of use in six



- European countries and links with Psychosocial functioning. *Journal of Adolescent Health*, 55(1), 141–147. <https://doi.org/10.1016/j.jadohealth.2013.11.010>.
- Velicer, W. F., Eaton, C. A., & Fava, J. L. (2000). Construct explication through factor or component analysis: A review and evaluation of alternative Procedures for determining the number of factors or components. In R. D. Goffin, & E. Helmes (Hrsg.), (Eds.), *Problems and Solutions in human assessment: Honoring Douglas N. Jackson at Seventy* (S. 41–71). Springer US. https://doi.org/10.1007/978-1-4615-4397-8_3.
- Wakefield, J. C. (2015). DSM-5 substance use disorder: How conceptual missteps weakened the foundations of the addictive disorders field. *Acta Psychiatrica Scandinavica*, 132(5), 327–334. <https://doi.org/10.1111/acps.12446>.
- Wartberg, L., Durkee, T., Kriston, L., Parzer, P., Fischer-Waldschmidt, G., Resch, F., ... Kaess, M. (2017). Psychometric properties of a German version of the young diagnostic questionnaire (YDQ) in two independent samples of adolescents. *International Journal of Mental Health*, 15(1), 182–190. <https://doi.org/10.1007/s11469-016-9654-6>.
- Wartberg, L., Kriston, L., Kegel, K., & Thomasius, R. (2016). Adaptation and psychometric evaluation of the young diagnostic questionnaire (YDQ) for parental assessment of adolescent problematic internet use. *Journal of Behavioral Addictions*, 5(2), 311–317. <https://doi.org/10.1556/2006.5.2016.049>.
- Watkins, M. W. (2017). The reliability of multidimensional neuropsychological measures: From alpha to omega. *The Clinical Neuropsychologist*, 31(6–7), 1113–1126. <https://doi.org/10.1080/13854046.2017.1317364>.
- World Health Organization (2018). *International classification of diseases for mortality and morbidity statistics (11th Revision)*. <https://icd.who.int/browse11/l-m/en>.
- Yang, C.-C. (2006). Evaluating latent class analysis models in qualitative phenotype identification. *Computational Statistics & Data Analysis*, 50(4), 1090–1104. <https://doi.org/10.1016/j.csda.2004.11.004>.
- Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior*, 1(3), 237–244. <https://doi.org/10.1089/cpb.1998.1.237>.

