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Validation of the ACSID-11 for consistent screening of specific Internet-use disorders based on ICD-11 criteria for gaming disorder: A multitrait-multimethod approach

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ABSTRACT

Introduction: With the inclusion of gaming disorder in the ICD-11, diagnostic criteria were introduced for this relatively new disorder. These criteria may be applied to other potential specific Internet-use disorders. The 11-item Assessment of Criteria for Specific Internet-use Disorders (ACSID-11) was developed for consistent screening of gaming disorder, online buying-shopping disorder, online pornography-use disorder, social networks-use disorder, and online gambling disorder. This study tested the construct validity of the ACSID-11, including convergent and divergent measures.

Methods: The ACSID-11 measures five behavioral addictions with the same set of items by following the principles of the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). The ACSID-11 was administered to a convenience sample of active Internet users ($N = 1597$) together with validated and established measures of each specific Internet-use disorder along with screeners for mental health. Included are the Ten-Item Internet Gaming Disorder Test (IGDT-10), the Bergen Shopping Addiction Scale (BSAS), the Problematic Pornography Consumption Scale (PPCS), the Bergen Social Media Addiction Scale (BSMAS) and the Berlin Inventory of Gambling behavior – Screening (BIG-S). The ACSID-11 was compared convergently and divergently through a multitrait-multimethod approach along with contingency tables with the other Internet-use disorder screeners.

Results: The multitrait-multimethod results shows that each behavior assessed with the ACSID-11 has moderate to strong correlations (*r's* from 0.462 to 0.609) with the scores of the corresponding established measures and, furthermore, positive correlations (*r's* from 0.122 to 0.434) with measures of psychological distress and further shows that the ACSID-11 can be used for a comprehensive assessment of different behaviors. The contingency tables reveal large divergences between the ACSID-11 and other screening instruments concerning the classification of problematic specific Internet use based on the given cut-off values.

Conclusion: The current work provides additional validation for the ACSID-11. Accordingly, this tool can be considered as reliable and valid for the simultaneous assessment of different Internet-use disorders: gaming disorder, online buying-shopping disorder, online pornography use disorder, social networks use disorder, and online gambling disorder. With a subsequent clinical validation of the scale and the proposed cut-off score, the ACSID-11 will be a thoroughly validated useful screening tool for clinical practice.

1. Introduction

With the inclusion of gaming disorder (coding 6C51) in the eleventh edition of the International Classification of Diseases (ICD-11; [1]), new diagnostic requirements were captured for this disorder in contrast to those contained in the fifth edition of the Diagnostic and Statistical

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Manual of Mental Disorders (DSM-5; [2]). The ICD-11 criteria are impaired control (IC) over the behavior, increasing priority (IP) given to the behavior, continuation or escalation (CE) of the behavior over an extended period of time, leading to significant distress or functional impairment (FI) in life. The same requirements of IC, IP, CE and FI have been established for gambling disorder (coding 6C50). The additional ICD-11 categories "other specified disorders due to addictive behaviours" (coding 6C5Y) and "disorders due to addictive behaviours, unspecified" (coding 6C5Z) imply there might be further addictive behaviors with similar diagnostic requirements [1].

Given that it is important not to overpathologize everyday-life behavior [3], meta-level criteria for classifying potential addictive behaviors within the category 6C5Y "other specified disorders due to addictive behaviors" were suggested by Brand and colleagues [4]. These meta-criteria are: 1) sufficient empirical evidence for the clinical relevance of the disorder, especially studies that include treatment-seeking individuals demonstrating functional impairment in daily life due to the disorder, 2) embedding in current theories and theoretical models in the field of behavioral addiction research, 3) empirical evidence for underlying mechanisms including different kinds of data collection like self-reports, clinical interviews, neurobiological studies and behavioral experiments [4]. These meta-criteria may be found in varying degrees of support for pornography use disorder [5–7], buying-shopping disorder [8–10], and social networks use disorder [11,12], although empirical evidence should be strengthened, these three Internet-use disorders (IUDs) could fit into the 6C5Y section of the ICD-11 [4]. But there is an ongoing debate whether some of these disorders should rather be classified as impulse control disorder and not as disorder due to addictive behavior, in particular problematic pornography use is listed as impulse control disorder in the ICD-11 although the diagnostic criteria to the gaming disorder are essentially very similar.

According to the ICD-11, gaming disorder and gambling disorder can be specified as occurring predominantly online or offline [1]. Similar specification can be used for the coding of 6C5Y. In the following, we will focus on five potential types of specific IUDs: gaming disorder, online buying-shopping disorder, online pornography use disorder, social network use disorder and gambling disorder. They may occur together but may also be an own entity [13,14]. As shown in a meta-review, technical advances additionally condition the mixing of the various IUDs and their underlying mechanisms [15]. To assess problem severity, a variety of screening instruments have been developed and the landscape of instruments is manifold – that applies to each different behavior and no instrument seems clearly preferable [16,17]. However, there are some instruments that have been used predominantly in previous research, for example the Ten-item Internet Gaming Disorder Test (IGDT-10) capturing the DSM-5 criteria for gaming disorder [18] or the Bergen Shopping Addiction Scale (BSAS) capturing Griffiths' addiction components (GAC; [8,19]). Some widely used screening instruments are not specifically based on diagnostic criteria or addiction components, such as Young's Internet Addiction Test and its specific modifications [20–22]. As shown in different reviews, many of these instruments show psychometric weaknesses or inconsistencies [23–25], but also show commonalities concerning assessed predominant dimensions of compulsiveness or impaired control, salience or increased priority and negative outcomes or marked distress/functional impairment [26], which is somehow consistent with the assessment of behavioral addictions through ICD-11 criteria [1].

The criteria for gambling and gaming disorder in the ICD-11 differ significantly from those included in the DSM-5. While there is some overlap - IC can be compared to unsuccessful attempts to quit gaming; IP can be compared to preoccupation with gaming and loss of interest in other activities; CE can be compared to continuing to game despite negative problems; and FI can be compared to risking jobs or relationships due to gaming — the DSM-5 proposes the following additional criteria which are strongly derived from substance dependence [27]: withdrawal symptoms (sadness, anxiety, irritability) when gaming is not possible, development of tolerance, deceiving family members, friends or others about the amount of gaming and the use of gaming to relieve negative moods, such as guilt or hopelessness. Given that the DSM-5 requires 5 or more symptoms to be fulfilled for a diagnosis, it may be that individuals are diagnosed with gambling or gaming disorder based on DSM-5 but fulfill only one of the ICD-11 criteria. Regarding the GAC, the overlaps with the ICD-11 criteria decrease further although some of the GAC are contained in the DSM-5 criteria [28]. IP can be compared to the salience component of the GAC, which refers to when an activity becomes the most important activity of a person's life and dominates their thinking, feelings, and behavior; FI can be compared to the conflict (interpersonal or intrapsychic of the person) component. Yet again, there are significant differences when it comes to criteria that are strongly derived from substance dependence, such as withdrawal symptoms, tolerance development and relapse. Table 1 provides an overview of ICD-11 criteria covered (and not covered) by frequently used instruments that are supposed to measure tendencies towards specific IUDs. It should be noted that questionnaires based on DSM-5 criteria are more consistent with ICD-11 criteria than those based on GAC.

To be able to determine commonalities and differences more validly across different types of disorders due to addictive behaviors, a uniform four-dimensional screening instrument based on the ICD-11 criteria for gaming disorder and gambling disorder was developed — the Assessment of Criteria for Specific Internet-use Disorders (ACSID-11; [17]). The special feature of the ACSID-11 is, that all (potential) specific IUDs are captured with the same 11 items following the principles of WHO's Alcohol, Smoking and Substance Involvement Screening Test (ASSIST, [29]). With a confirmatory factor analysis, the screener was found to represent the four ICD-11 factors IC, IP, CE and FI for each specific IUD, although the unidimensional evaluation is also possible. Additionally, high reliability in terms of internal consistency was shown, and the effectiveness of the ASSIST format was supported. Correlations of the ACSID-11 with depression, anxiety, and well-being demonstrated the convergent and divergent construct validity [17].

In this study, the ACSID-11 was further investigated in terms of its construct validity and is compared both convergently and divergently with established screening instruments capturing the specific types of IUDs based on GAC or the DSM-5 criteria. To this end, we propose a cut-off value for the ACSID-11, which strictly follows the diagnostic guidelines of the ICD-11 for disorders due to addictive behaviors and accordingly the recommendations of the WHO. Convergent and

Table 1
Exemplary screening instruments for specific Internet-use disorders and their coverage of the ICD-11 criteria for disorders due to addictive behaviors.

IUD screener	ICD-11 criteria for disorders due to addictive behaviors			
	Impaired Control	Increased Priority	Continuation/ Escalation	Functional Impairment or Marked Distress
IGDT-10 (Gaming)	●	●	●	●
BSAS (Shopping)	●	○	○	●
PPCS-18 (Pornography use)	●	●	○	●
BSMAS (Social media use)	●	○	○	●
BIG-S (Gambling)	●	●	○	●

Note. IGDT-10 = Ten-item Internet Gaming Disorder Test; BSAS = Bergen Shopping Addiction Scale; PPCS = Problematic Pornography Consumption Scale; BSMAS = Bergen Social Media Addiction Scale; BIG-S = The Berlin Inventory of Gambling behavior — Screening; filled circles indicate coverage of the respective ICD-11 criterion. For item-wise assignments to ICD-11 criteria see Appendix B.

divergent validity was analyzed using a multitrait-multimethod approach based on Pearson correlations. Additionally, divergences are shown for the different screening instruments by contingency tables.

2. Methods

2.1. Participants

We conducted a 15-min-long cross-sectional online survey with *LimeSurvey*© on local servers. To recruit and reward participants, we cooperated with the online access panel provider *respondi*. The panel provider recruited the participants throughout Germany and sent them individual links for filling out the survey. After completing the survey, the participants were forwarded back to the panel provider and received remuneration of participation within their system. The participants were 18 to 69 years old. All participants used regularly at least one internet application of gaming, social networking, online shopping, online pornography or online gambling. In total, there were 2212 complete datasets. We excluded a total of 615 records for the following reasons: 1) participants with multiple entries, 2) participant who had answered the question "If you are completely honest - have you filled out the survey conscientiously so that we should include your data in the analyses?" with a "No" 3) failed attention checks, 4) lack of language skills, and 5) unusually long duration for completion (>120 min). This filtering method follows recommended best practices for dealing with careless responding [30].

This resulted in a total sample of $N = 1597$ (803 female, 786 male, 8 non-binary) with an age range of 18 to 69 years ($M = 39.33$, $SD = 12.52$). More than half (54.2%) of the sample were employed full-time, 13.7% were employed part-time, 11.4% were students, the rest consisted of trainees, unemployed individuals and pensioners. In terms of highest vocational education, 27.2% completed a vocational-in-company training, 27.2% had a university degree, 11.7% completed vocational-school training, 10.3% graduated from a master school/technical academy, 9.7% had a polytechnic degree, 9.1% were still in education or studies, the rest had no degree. Further descriptions of the sample can be found in Appendix A.

2.2. Measures

2.2.1. Assessment of Criteria for Specific Internet-use Disorders (ACSID-11)

The ACSID-11 is a tool for assessing specific IUDs in a short but comprehensive, and consistent manner. It was developed based on theory by an expert group of addiction researchers and clinicians. For more details of the development and a first introduction of the tool see [17].

The ACSID-11 consists of 11 items that reflect the ICD-11 diagnostic requirements for gaming disorder [1], which could be applied to other specified disorders due to addictive behaviors [4]. These criteria are: impaired control over the online activity (IC), increased priority given to the online activity (IP), continuation or escalation of the online activity despite negative consequences (CE). Furthermore, the behavior results in marked distress (MD) and/or significant functional impairments (FI) in life over an extended period of time (12 months). The three main criteria IC, IP and CE are represented by 3 items each. Two additional items capture FI and MD. Every item is measured with a 4-point dual Likert scale, one for the frequency (0: "never", 1: "rarely", 2: "sometimes", 3: "often") and one for the intensity (0: "not at all intense", 1: "rather not intense", 2: "rather intense", 3: "intense"). The 11 items are captured for every online activity (gaming, online shopping, use of online pornography, use of social-networks or online gambling) for which the participants have indicated an at least occasional use in the past 12 months (screening question). An assumed four-factor model for each online activity with the factors IC, IP, CE and FI was supported by confirmatory factor analysis [17]. The items can be found in Appendix B.

2.2.1.1. Proposed cut-off score.

To use the ACSID-11 in a clinical and diagnostic context, a cut-off value was created in addition to the mean value. The cut-off value is strictly based on the ICD-11 criteria for gambling and gaming disorders and thus corresponds to the recommendations of the WHO. Further it is supported by the four factorial structure confirmed within the previously calculated CFA [17]. We created dichotomized items reflecting meeting/not meeting (1/0) the respective criterion. The dichotomization was carried out as follows: individuals must report "often" (3) on at least one of the three items of the "essential (required) features" IC, IP, and CE, respectively to meet the particular criterion (i.e., score 1). In addition, either the MD or FI criterion must be met. MD and FI are met if either "often" (3) is indicated on the frequency scale or "sometimes" (2) is indicated on the frequency scale in combination with "rather strong" or "strong" on the intensity scale. The dichotomization results in a sum score ranging between 0 and 4. We propose a cut-off of 4 to be classified as disordered, which means all the essential criteria must be met. This reflects the existing requirements for the diagnosis of a gaming disorder according to the ICD-11 in a rather conservative manner (i.e., all criteria must be fulfilled). In the future, the cut-off value must be tested clinically. The mean and cut-off values are further compared with correlation calculations.

2.2.2. Ten-item Internet Gaming Disorder Test (IGDT-10)

The IGDT-10 is an instrument to assess Internet Gaming Disorder based on the nine DSM-5 criteria for gaming disorder [18]. It has ten items with a 3-point Likert scale ("never", "sometimes", "often"). Every item operationalizes one of the DSM-5 criteria, only the last criterion is measured by two items (9 and 10). To evaluate the IGDT-10, the Likert scale is dichotomized, with "never" and "sometimes" corresponding as criterion not met and "often" as criterion met. For items 9 and 10, it is sufficient if "often" is indicated for one of the two items to fulfill the last criterion.

Overall, the IGDT-10 score ranges from 0 to 9. The cut-off threshold for Internet Gaming Disorder is a score of 5 or more.

2.2.3. Bergen Shopping Addiction Scale (BSAS)

The BSAS is a screening tool for assessing buying-shopping disorder, also referred to as shopping addiction [19]. It has seven items measured on a 5-point Likert scale (0: "completely disagree", 1: "disagree", 2: "neither disagree nor agree", 3: "agree", 4: "completely agree"). Each item operationalizes one of the GAC, namely salience, mood modification, tolerance, withdrawal, conflict, relapse, and resulting problems [28]. A higher score indicates a higher tendency towards a possible buying-shopping disorder.

Congruent to the formation of cut-off thresholds for DSM-5 criteria, the authors propose a polythetic procedure for the formation of the BSAS cut-off value, i.e., a pathological use is indicated if at least four of the seven items were rated 3 or more [19]. This proposed cut-off value of 12 or more was not supported in another representative study [8], up to now, we are not aware of any other validity tests for the cut-off value. The range of the total sum score is 0–28. The dichotomous range is 0–7.

2.2.4. Problematic Pornography Consumption Scale (PPCS-18)

The PPCS-18 is an instrument to measure problematic pornography consumption [31]. It has 18 items with a 7-point Likert scale (1: "never", 2: "rarely", 3: "occasionally", 4: "sometimes", 5: "often", 6: "very often", 7: "all the time"). It captures GAC salience, mood modification, tolerance, withdrawal, conflict, and relapse, each represented by 3 items.

A problematic pornography use is given if a sum score of 76 or higher is reached (range: 18–126).

2.2.5. Bergen Social Media Addiction Scale (BSMAS)

The BSMAS is an adaptation of the Bergen Facebook Addiction Scale (BFAS) and is a robust tool to measure problematic social media use [32–34]. It has six items measured on a 5-point Likert scale (1: "very rarely", 2: "rarely", 3: "sometimes", 4: "often", 5: "very often"),

therefore it ranges from 6 to 30. Every item operationalizes one of the GAC salience, mood modification, tolerance, withdrawal, conflict, relapse. The optimal cut-off score for a social media use disorder was determined at 24 or higher [35].

2.2.6. The Berlin Inventory of Gambling behavior – Screening (BIG-S)

The BIG-S is a screening tool for gambling disorder and was clinically validated [36]. It has 13 items with a 0: "no", 1: "yes" scale which operationalize the DSM-IV criteria for gambling disorder. Four criteria (need to gamble with increasing amounts of time/increasing amounts of money, concealment/lying, jeopardizing a significant relationship/jeopardizing a job opportunity, different aspects of loss of control) are represented by two items and are met if one or both of these two items is answered with yes. A total sum score is formed over all criteria resulting in a score ranging from 0 to 9. The cut-off score for gambling disorder on the BIG-S is 4 or higher.

2.2.7. Brief Symptom Inventory (BSI) – Subscales obsessive-compulsive, depression, anxiety

The BSI is a self-report inventory that assesses 9 different symptom dimensions [37]. In this study only the 3 subscales "obsessive-compulsive", "depression" and "anxiety" were used. This results in 17 items measured on a 5-point Likert scale (0: "not at all" to 4: "extremely"). Thus, the symptom distress index ranges from 0 to 68.

2.2.8. Adult ADHD Self-Report Scale (ASRS)

The ASRS is a screening scale for attention-deficit/hyperactivity disorder for adults [38]. It has 18 items measured on a 5-point Likert Scale (0: "never", 1: "rarely", 2: "sometimes", 3: "often", 4: "very often"). For determining the severity of ADHD, the items are dichotomized and the resulting sum score (range = 0–18) is parted in three strata. Strata 1 ranges from 0 to 3, strata 2 from 4 to 8 and strata 3 from 9 to 18.

2.2.9. Short loneliness scale (LON)

The LON measures overall, emotional and social loneliness [39]. It comprises 6 items - of which 3 are inverted - measured on a 5-point scale ("yes!", "yes", "more or less", "no", "no!"). Those items are then dichotomized with "more or less" counting as criterion met. This results in a total score of 0 to 6, with a higher total score indicating greater loneliness.

2.2.10. General life satisfaction short scale (L-1) and general wellbeing (G-1)

The L-1 measures general life satisfaction with one item [40] measured on a 11-point scale from "not at all satisfied" to "completely satisfied". The G-1 is adapted from the L-1 and uses the same scale and response format for the question "How satisfied are you, all things considered, with your health at present?"

2.2.10.1. Analyses procedure. For analysis SPSS version 28 was used. In addition to reliability measures and validity calculations with a multitrait-multimethod approach based on Pearson correlations, divergences are shown for the different screening instruments by contingency tables. Further, correlations with psychopathological measures and screening instruments are analyzed to investigate construct validity. To interpret the effect sizes of the Pearson correlations, the recommended thresholds according to Cohen are used [41].

2.3. Ethics

The study was carried out in accordance with the Declaration of Helsinki. The study was approved by the ethics committee (reference number: 2104APBA6107) of the division of Computer Science and Applied Cognitive Sciences at the Faculty of Engineering of the University of Duisburg-Essen. All subjects provided informed consent prior to participation.

3. Results

The individuals (whole sample of 1597 participants) reported the following online activities (at least occasionally) in the past twelve months (multiple indications were possible): Gaming 797 (49.9%; age: $M = 37.71$, $SD = 12.20$; gender: 465 male, 326 female, 6 non-binary), online shopping 1579 (98.9%; age: $M = 39.28$, $SD = 12.46$; gender: 773 male, 799 female, 7 non-binary), online pornography 739 (46.3%; age: $M = 38.80$, $SD = 12.80$; gender: 512 male, 222 female, 5 non-binary), social networks 1455 (91.1%; age: $M = 38.48$, $SD = 12.30$; gender: 697 male, 750 female, 8 non-binary), online gambling 385 (24.1%; age: $M = 39.02$, $SD = 11.59$; gender: 252 male, 131 female, 2 non-binary). This corresponds to a similar distribution as in our previous study introducing the ACSID-11 [17].

3.1. Descriptive statistics

On all subscales of the ACSID-11, the full possible range of answers (0–3) was indicated. As expected from a non-clinical sample, the mean scores of the subscales are low and right skewed (median is lower than the mean). Kurtosis is especially high for online buying-shopping and online pornography use (see Table 2). The transformation of the ACSID-11 into the dichotomous scoring system skews the subscales more to the right than the mean scores (cf. Appendix C). Kurtosis also gets generally higher. Other screening-instruments for the different behaviors show also expectably low means and right-skewed distributions (see Table 2). Scales for psychopathology show no anomalies for a convenient sample (see Table 2).

Table 2
Descriptive Statistics of the ACSID-11 dichotomized sum score, other screening instruments and psychopathological scales.

Scales	Min	Max	M	SD	Skewness	Kurtosis
ACSID-11						
Gaming*	0	4	0.311	0.827	3.023	8.850
Online buying-shopping*	0	4	0.187	0.599	4.088	18.812
Online pornography use*	0	4	0.252	0.715	3.449	12.698
Social-networks use*	0	4	0.453	0.926	2.301	4.823
Online gambling*	0	4	0.369	0.901	2.793	7.371
Other Screening-Instruments						
IGDT-10*	0	8	0.393	1.019	3.273	12.166
BSAS*	0	7	0.456	1.174	3.208	11.024
PPCS-18	18	124	33.336	17.953	1.867	3.899
BSMAS	6	30	10.798	5.267	1.254	0.959
BIG-S*	0	9	1.600	2.387	1.606	1.571
Other Psychological Constructs						
BSI obsessive-compulsive	0	4	0.873	0.830	1.233	1.217
BSI depression	0	4	0.878	0.986	1.275	0.868
BSI anxiety	0	4	0.575	0.719	1.800	3.317
ASRS	0	72	20.714	12.169	0.576	0.315
LON	0	6	2.772	1.825	0.169	1.024
L-1	0	10	6.340	2.250	0.748	0.015
G-1	0	10	6.550	2.378	0.770	0.049

* Uses dichotomous scoring system that reflects the number of fulfilled criteria. ACSID-11 = Assessment of Criteria for Specific Internet-use Disorders; IGDT-10 = Ten-item Internet Gaming Disorder Test; BSAS = Bergen Shopping Addiction Scale; PPCS = Problematic Pornography Consumption Scale; BSMAS = Bergen Social Media Addiction Scale; BIG-S = The Berlin Inventory of Gambling behavior – Screening; BSI = Brief Symptom Inventory; ASRS = Adult ADHD Self-Report Scale; LON = Short Loneliness Scale; L-1 = General Life Satisfaction Short Scale; G-1 = General Wellbeing Short Scale.

3.2. Reliability

For each type of potential IUD, the ACSID-11 and one other screening questionnaire based on either DSM-5 criteria or GAC were used. Reliability in terms of internal consistency was calculated for all relevant questionnaires. The reliability measures of the scales of the ACSID-11 are excellent with all Cronbach's alphas >0.9, for the other screening questionnaires Cronbach's alpha >0.8 is at least good [42]. This shows that the ACSID-11 is a reliable measure (see Table 3).

3.3. Convergent validity

Regarding convergent validity, it can be shown that the scores for the specific types of IUD measured by the dichotomous ACSID-11 sum score correlate significantly with the original score of the corresponding DSM-5/GAC screening questionnaires with large effect sizes ($r > 0.5$). Only for online buying-shopping the effect size is medium (see Table 3). As can be seen in Table 3, the types of IUD are more strongly correlated with themselves than with other types, therefore the monotrait-heteromethod correlations are stronger than the heterotrait-monomethod correlations which again are stronger than the heterotrait-heteromethod correlations. For example: The correlation between the ACSID-11 Gaming and the IGDT-10 (monotrait-heteromethod) is stronger than the correlation between the ACSID-11 Gaming and ACSID-11 Online buying-shopping (heterotrait-monomethod), which is again stronger than the correlation between IGDT-10 and ACSID-11 Online buying-shopping or ACSID-11 Gaming and BSAS (heterotrait-heteromethod; see Table 3). To note, online gambling generally correlates more strongly with all other types of IUD. There is also a stronger correlation between the ACSID-11 scores of the different IUDs than between the other screening questionnaires.

3.4. Divergent validity

The divergence of the different screening questionnaires is particularly noticeable in the different assessments for (non-)problematic behavior based on the proposed cut-off values by the authors of each screening measure. For the matched accuracy calculations and contingency tables, the ACSID-11 classifications are used as "actual conditions" and the other screening measures as "predicted condition", not problematic classification is used as "negative case", and problematic classification is used as "positive case" (see Table 4). Apparently and although the prevalence rates are representative for a convenient sample, there are only few overlaps, especially in the problematic classification (see Tables 4 and 5). Overall, there are some differences between the classifications for a problematic use (all markedness < 0.5) and the prevalence is generally very low, which is due to the non-clinical sample and therefore unbalanced data. The classifications match better for screening questionnaires that are based on DSM-5 criteria with the ACSID-11, than those questionnaires that are based on GAC.

3.5. Correlations with other psychological constructs

The measures for compulsivity, depression, anxiety, ADHD, and loneliness show a significant correlation with the ACSID-11 scales with a low to medium effect size. This means participants who score higher on the ACSID-11 scales for different IUDs are more likely to be compulsive, more likely to have a depression, more likely to have anxiety, and ADHD and are more likely to feel lonely. For social networks use and online gambling disorder the effect sizes are highest. Additionally, problematic social-networks use correlates negatively with overall satisfaction with life and wellbeing with low to equal to zero effect sizes, which means that people with a higher dichotomous score at the ACSID-11 scale are generally less satisfied with their life overall and feel less healthy (see Table 6).

Table 3
Multitrait-Multimethod-Matrix with Pearson correlations for all Internet-use disorders measured by the ACSID-11 and the corresponding screening measures.

Type of IUD		1)		2)		3)		4)		5)	
	Measure	a)	b)	a)	b)	a)	b)	a)	b)	a)	b)
1) Gaming	N	797									
	a) ACSID-11 gaming	(.932)									
	b) IGDT-10	.609	(.861)								
2) Online buying-shopping	N	789		1579							
	a) ACSID-11 online buying-shopping	.532	.317	(.921)							
	b) BSAS	.306	.381	.462	(.908)						
3) Online pornography use	N	454		731		739					
	a) ACSID-11 online pornography use	.445	.389	.455	.310	(.923)					
	b) PPCS	.340	.370	.255	.326	.591	(.951)				
4) Social-networks use	N	751		1439		693		1455			
	a) ACSID-11 social-networks use	.520	.364	.522	.317	.368	.237	(.919)			
	b) BSMAS	.358	.357	.367	.426	.307	.345	.593	(.896)		
5) Online gambling	N	269		382		227		361		385	
	a) ACSID-11 online gambling	.674	.534	.667	.386	.547	.422	.578	.419	(.951)	
	b) BIG-S	.436	.482	.453	.430	.525	.537	.419	.502	.602	(.898)

Note. In brackets = Cronbach's alpha or reliability diagonal. All correlations are significant on a $p < .001$ level. Grey = monotrait block, orange = heterotrait block, blue marking = monotrait-heteromethod correlations or validity diagonal, yellow marking = heterotrait-heteromethod correlations, green marking = heterotrait-monomethod. a) = ACSID-11, b) = DSM-5/GAC measures. N = size of group with active use of the applications.

Table 4
Contingency tables of cut-off values of ACSID-11 for specific IUDs and respective comparative screeners.

		IGDT-10		
		Not problematic	Problematic	Overall
ACSID-11 gaming	Not problematic	773	7	780
	Problematic	15	2	17
	Overall	788	9	797
		BSAS		
		Not problematic	Problematic	Overall
ACSID-11 online buying-shopping	Not problematic	1400	164	1564
	Problematic	5	10	15
	Overall	1405	174	1579
		PPCS		
		Not problematic	Problematic	Overall
ACSID-11 online pornography use	Not problematic	708	19	727
	Problematic	3	9	12
	Overall	711	28	738
		BSMAS		
		Not problematic	Problematic	Overall
ACSID-11 social networks use	Not problematic	1384	34	1418
	Problematic	25	12	37
	Overall	1409	46	1455
		BIG-S		
		Not problematic	Problematic	Overall
ACSID-11 online gambling	Not problematic	316	57	373
	Problematic	1	11	12
	Overall	317	68	385

Note. ACSID-11 = Assessment of Criteria for Specific Internet-use Disorders; IGDT-10 = Ten-item Internet Gaming Disorder Test; BSAS = Bergen Shopping Addiction Scale; PPCS = Problematic Pornography Consumption Scale; BSMAS = Bergen Social Media Addiction Scale; BIG-S = The Berlin Inventory of Gambling behavior – Screening

Table 5
Comparative classification metrics for each type of IUD.

Parameter	Gaming	Online buying-shopping	Online pornography use	Social-networks use	Online gambling
$PR_{ACSID-11}$	2.13%	0.95%	1.63%	2.54%	3.12%
$PR_{DSM-5/GAC}$	1.13%	11.02%	3.79%	3.16%	17.66%
Accuracy	97.24%	89.30%	97.15%	95.95%	84.94%
Precision	22.22%	5.75%	32.14%	26.09%	16.18%
Sensitivity	11.76%	66.67%	75.00%	32.43%	91.67%
Informedness	0.109	0.562	0.724	0.300	0.764
Markedness	0.203	0.054	0.317	0.243	0.159
MCC	|0.149|	|0.174|	|0.479|	|0.270|	|0.348|

Note. IUD = Internet-use disorder; PR = prevalence ratio (refers only to active users of the application and not the population); informedness = bookmarker informedness; MCC = Matthews correlation coefficient; DSM-5/GAC gaming = IGDT-10; DSM-5/GAC online buying-shopping = BSAS; DSM-5/GAC online pornography use = PPCS-18; DSM-5/GAC social-networks use = BSMAS; DSM-5/GAC online gambling = BIG-S.

4. Discussion

Problematic and addictive use of the internet or specific online applications, respectively, is a growing mental health condition that needs public health considerations [43]. Given that estimated prevalence rates differ significantly when considering methodological approaches including screening instruments [44], a gold-standard for diagnostic instruments is urgently needed [45,46]. Since inclusion of gaming and gambling disorders in the ICD-11 as disorders due to addictive behaviors, further online addictive behaviors have been suggested as potentially belonging to this category based on comparable psychological and neurobiological mechanisms [47]. Accordingly, an instrument that may be able to assess the ICD-11 criteria for gaming and gambling disorder also for other types of IUDs would be helpful in order to have comparable assessment across types of IUDs [17]. For that the ACSID-11 was developed. In addition to the initial study by Müller et al. [17], this study further validated the ACSID-11. The new screening instrument was compared convergently as well as divergently with a multitrait-mulitmethod approach and contingency tables to commonly established screening instruments assessing specific types of IUDs: gaming disorder, online buying-shopping disorder, online pornography use disorder, social networks use disorder and online gambling disorder. The ACSID-11 is based on ICD-11 criteria for gaming disorder while the other instruments used for validating the ACSID-11 are based on DSM-5 criteria or GAC. For the ACSID-11, an ICD-11-criteria-based cut-off value was created and items of screening instruments that are based on DSM-5 criteria or GAC were also matched to the ICD-11 criteria. It shows that ICD-11 criteria differ from DSM-5 criteria and GAC and that only few overlaps exist, which is in accordance with current literature about the diagnostic criteria [48,49]. With the dichotomization of the scales, we want to depict the fulfilment of the respective diagnostic criteria according to ICD-11 and use the cut-off score to reflect the relatively strict criterion of the diagnosis as a disorder, because until now the ICD-11 gives no gradations between pathological and non-pathological use. In other words, the cut-off score should reflect pathological behavior and not just screen risky behavior. Although all established screening instruments measure some level of functional impairment and/or marked distress in individuals due to their use of specific internet applications, there are major differences in content and scoring which results in divergence when it comes to diagnostic accuracy about whether a potential IUD might be present or not (given that functional impairment/marked distress is a required diagnostic criterion in the ICD-11). The ACSID-11 is shown to be a reliable and valid screening instrument for specific IUDs, especially capturing all ICD-11 criteria including functional impairment/marked distress and enables the comparison between the different specific IUDs. Validity was demonstrated primarily with a multitrait-multimethod approach and by correlations with psychopathological measures, differences to other measurements were shown with contingency tables.

4.1. Reliability

It has been shown that the internal consistency of the ACSID-11 for each of the five potential specific IUDs is excellent and even higher in this sample than for established screeners like the IGDT-10. Similar reliability results could be found in the first validation of the ACSID-11 [17], the other screening instrument's reliability corresponds to usual values [16].

4.2. Validity

The multitrait-multimethod approach shows high monotrait-heteromethod correlations of the ACSID-11 scales for specific IUDs with their corresponding non-ICD-11 screening instrument (i.e., IGDT-10 for gaming, BSAS for buying-shopping, PPCS-18 for pornography use, BSMAS for social networks use and BIG-S for gambling) and lower heterotrait-heteromethod correlations. That indicates that the ACSID-11 and the other screeners measure similar constructs and therefore convergent and divergent validity of the ACSID-11 subscales (for the different IUDs) is confirmed. As one should avoid using recycled or not clinically validated screening instruments [50], we do not want to cross-validate the ACSID-11 through the established screening instruments. A clinically validation of the ACSID-11 is currently in process.

Table 6
Correlations of other psychological constructs with the ACSID-11 scales.

	ACSID-11 dichotomized sum score				
	Gaming	Online buying-shopping	Online pornography use	Social-networks use	Online gambling
BSI compulsive	0.346**	0.267**	0.248**	0.434**	0.373**
BSI depression	0.301**	0.230**	0.236**	0.349**	0.376**
BSI anxiety	0.337**	0.273**	0.269**	0.367**	0.432**
ASRS	0.323**	0.272**	0.222**	0.405**	0.407**
LON	0.179**	0.133**	0.122**	0.207**	0.251**
L-1	−0.024	−0.012	−0.060	−0.137**	0.055
G-1	−0.018	0.014	−0.025	−0.078**	0.049

Note. **significant on a < 0.01 level. BSI = Brief Symptom Inventory; ASRS = Adult ADHD Self-Report Scale; LON = Short Loneliness Scale; L-1 = General Life Satisfaction Short Scale; G-1 = General Wellbeing Short Scale.

4.3. Similarities across different types of IUDs

Heterotrait-monomethod correlations with medium to high effect sizes show the comorbidity and a lot of overlaps between the indicated use of a technology. The co-occurrence of the different specific IUDs has been shown previously [51], for example for gaming and gambling [52], gaming and social network use [14,53] or buying-shopping and social network use [14,54]. For the ACSID-11 scales, heterotrait-monomethod correlations (e.g., ACSID-11 gaming with ACSID-11 online buying-shopping) are higher compared to the heterotrait-monomethod correlations of non-ICD-11 screening instruments (e.g. IGDT-10 with BSAS) which is not surprising given the co-occurrences of the IUDs and given that the ACSID-11 scales use the same set of items for each type of IUD. But the heterotrait-monomethod correlations of the ACSID-11 scales still indicate that the ACSID-11 is a good tool for a comprehensive measure of the five specific IUDs.

Significant correlations with compulsiveness, depression, anxiety, ADHD, and loneliness scores reaffirm the perceived impairment and distress of individuals as measured by the ACSID-11 across the different behaviors [55,56]. These results are also in accordance with other studies that show psychopathological comorbidities for specific IUDs [57–63] and thus reaffirm the ACSID-11's construct validity.

4.4. Differences across measurements of IUDs

Comparing the ICD-11 and DSM-5 criteria for gaming disorder and the GAC only few overlaps exist between the criteria and thus also between the screeners based on them. Overlaps between the criteria are: increased priority (ICD-11) with preoccupation (DSM-5) and with salience (GAC), impaired control (ICD-11) with unsuccessful attempts to quit (DSM-5), and continuation/escalation (ICD-11) with continuing despite negative consequences (DSM-5). The essential criterion of functional impairment or marked distress (ICD-11) is comparable (but similar) to risking jobs or relationships (DSM-5) and the conflict component (GAC). Criteria that are strongly derived from substance dependence, such as withdrawal symptoms or tolerance development are not represented in the ICD-11 criteria [27]. Prior discussions [64,65] lead to a partly harmonization of DSM-5 and ICD-11. Nevertheless, the two systems still have different approaches in the details or diagnostic criteria with some remarks, that the DSM-5 should be revised [66]. In a clinical study, individuals diagnosed with gaming disorder based on ICD-11 criteria show higher functional impairment and higher values in psychopathological comorbidities than those with gaming disorder diagnosed with DSM-5 criteria [48]. Also, some DSM-5 criteria, namely deception and escapism, do not have a high diagnostic accuracy [67] or in the case of tolerance are regarded as incapable of distinguishing between problematic and non-problematic gaming [68]. Therefore, an assessment based on the ICD-11 criteria for gaming and gambling disorder places more emphasis on the detection of functional impairment in individuals who game/gamble excessively to not overpathologize everyday behavior [3].

Classifications into problematic/not problematic users based on the different screening instruments result in high divergences. Though the accuracy is very high for each behavior, the MCC and markedness is medium. The high accuracy paired with other indicators with low values is due to the unbalanced data. For unbalanced data the measurements of informedness, markedness, and MCC are better suited to describe classifications [69,70], therefore a high divergence concerning classifications can be assumed. In gaming and social networks use, there are only few overlaps of problematic classifications between the ACSID-11 scales and IGDT-10, respectively BSMAS. The BSAS and BIG-S result in huge differences to the ACSID-11 scales concerning prevalence rates. The BSAS' prevalence rate in this sample is eleven times higher than the ACSID-11's prevalence rate. The BIG-S also results in a higher prevalence rate. Current prevalence rates for gambling disorder are estimated to be around 0.5–3.0% [71] and for buying-shopping disorder about 3.4–6.9% [72].

4.5. Limitations

The current study investigated a non-clinical, and non-representative sample of adults. Adolescents are particularly affected by IUDs, which is why the ACSID-11 should also be tested on a younger sample to be able to generalize the results to a broader population. Furthermore, test-retest reliability could not be calculated due to the cross-sectional design. The comparative screening instruments we used in this study (e.g., BSAS for online buying-shopping disorder or BIG-S for gambling disorder) have been carefully selected, but there are other instruments, and there might be objectively better instruments but so far there is no gold standard to screen for the corresponding IUDs [16,45,46]. Especially only few instruments are clinically validated which weakens the informative value of the comparisons with those instruments (to note: the clinical validation of the ACSID-11 is ongoing). The variety of instruments, their different response scales, e.g. dichotomous vs. non-dichotomous, and the different evaluation strategies, e.g. sum score vs. cut-off scores, make comparability even more difficult. This again shows how important a comprehensive assessment of the different IUDs is. There are also new questionnaires that assess general problematic usage of the Internet comprehensively and do not follow the criteria of the ICD-11 or DSM-5, e.g. the Internet severity and activities addiction questionnaire (ISAAQ) [73]. While the ISAAQ shows it's strength in measuring the different forms problematic online activities in addition to the severity of general problematic Internet use [74], the ACSID-11 has strong validity in a clinical context and therefore can be used for population prevalence studies. Showing construct validity with the multitrait-multimethod approach is debatable and a confirmatory factor analysis, which we carried out in a previous validation, might be better suited for that [17,75]. But with the multitrait-multimethod approach we can also show that the ACSID-11 is a comprehensive tool for different Internet use disorders and not just one. The use of contingency tables relies on categorical data, here cut-off values are needed. As most measures are not clinically validated the cut-off values might not reflect reality. Therefore, the assumptions made from the contingency tables only reflect comparisons between different measures and do not

represent the perfect observations. Regarding the classification into problematic use with the ACSID-11, the cut-off value has yet to be clinically validated, although it stringently follows the ICD-11 diagnostic criteria for disorders due to addictive behaviors. Also it has to be clinically validated whether a lower cut-off value for a risky use could be introduced by fulfilling only two out of three ICD-11 criteria plus functional impairment. This in turn could be controversial, as not every problematic behavior surveyed belongs yet to behavioral addictions but can also be classified as an impulse control disorder, especially buying-shopping disorder and problematic pornography consumption. Therefore, the ACSID-11 should not yet be used as a (single) tool to diagnose a specific IUD but can be used as a starting point for a clinical interview within the diagnostic procedure.

5. Conclusion

Overall, the ACSID-11 has proven to be a reliable screening instrument that captures the ICD-11 diagnostic criteria for gaming/gambling disorder of increased priority, impaired control, continuation/escalation, and functional impairment in a valid and comprehensive way across the different potential specific IUDs (i.e., gaming disorder, online buying-shopping disorder, online pornography use disorder, social networks use disorder and online gambling disorder). This work has shown that screening instruments based on the DSM-5 criteria show strong correlations, but at the same time low convergence with the ICD-11-based ACSID-11 when it comes to classifying pathological Internet use. When comparing the screening instruments in detail, it shows that there are only few overlaps between the different classification criteria and therefore items, which leads to different prevalence rates. For the ACSID-11, prevalence rates are closer to current epidemiological estimates than for DSM-5 or the components model based screening instruments, that means that the risk of overpathologizing everyday behavior could be reduced [76]. With a subsequent clinical validation of the scale and the proposed cut-off score, the ACSID-11 will be a thoroughly validated useful screening tool for clinical practice.

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CRediT authorship contribution statement

Andreas Oelker: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing – original draft, Writing – review & editing. **Hans-Jürgen Rumpf:** Validation, Writing – original draft, Writing – review & editing. **Matthias Brand:** Funding acquisition, Investigation, Supervision, Writing – original draft, Writing – review & editing. **Silke M. Müller:** Conceptualization, Formal analysis, Investigation, Supervision, Validation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

None.

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Appendix A. Demographics

Table A.1
Gender distribution of the sample.

Gender	Amount	%
Female	803	50.3
Male	786	49.2
Other	8	0.5

Table A.2
School education (German system) distribution of the sample.

School/academic education	Amount	%
School ended without graduation	4	0.25
Special school certificate (Förderschulabschluss)	2	0.13
Secondary school certificate (Hauptschulabschluss)	118	7.39
Intermediate school leaving certificate (Realschulabschluss)	434	27.18
Advanced technical college entrance qualification (Fachabitur)	198	12.40
General higher education entrance qualification (Abitur)	826	51.72
Still a pupil	8	0.50
Other	7	0.44

Table A.3
Professional education degree distribution of the sample.

Professional education degree	Amount	%
Completion of vocational-school education (vocational or commercial school)	187	11.71
Completion of vocational in-company training (apprenticeship)	435	27.24
Graduation from a technical school, master craftsman or technician school, vocational or technical academy	164	10.27
Polytechnic degree	155	9.71
University degree	434	27.18
No educational qualification	72	4.51
Still in training / studying / a pupil	145	9.08
Other	5	0.31

Table A.4
Employment distribution of the sample.

Employment	Amount	%
Pupil	21	1.31
Student	182	11.40
Voluntary service	2	0.13
Trainee/apprentice/retrainee	26	1.63
Housewife/househusband (family work)	65	4.07
Retired person/retiree, in early retirement	115	7.20
Not gainfully employed for other reasons	74	4.63
Part-time employed	219	13.71
Full-time employed	865	54.16
Other	28	1.75

Table A.5
Marital status distribution of the sample.

Marital status	Amount	%
Married/ registered civil partnership	636	39.82
Divorced	105	6.57
Widowed	13	0.81
Single	819	51.28
Other	24	1.50

Table A.6
Partnership distribution of the sample.

Partnership	Amount	%
Yes	1060	66.37
No	530	33.19
other	7	0.44

Appendix B

Table B.1
Item matching of screening questionnaires with ICD-11 gaming disorder criteria.

	Impaired Control	Increased Priority	Continuation/ Escalation	Functional Impairment or Marked Distress
IGDT-10 *	●	●	●	●
IGDT10_01	○	○	○	○
IGDT10_02	○	○	○	○
IGDT10_03	○	○	○	○
IGDT10_04	●	○	○	○
IGDT10_05	○	●	○	○
IGDT10_06	○	○	●	○
IGDT10_07	○	○	○	○
IGDT10_08	○	○	○	○
IGDT10_09	○	○	○	●
IGDT10_10	○	○	○	●

(*continued on next page*)

Table B.1 (*continued*)

	Impaired Control	Increased Priority	Continuation/ Escalation	Functional Impairment or Marked Distress
BSAS *	●	○	○	●
BSAS_01	○	○	○	○
BSAS_02	○	○	○	○
BSAS_03	○	○	○	●
BSAS_04	○	○	○	○
BSAS_05	●	○	○	○
BSAS_06	○	○	○	○
BSAS_07	○	○	○	●
PPCS-18 *	●	●	○	●
PPCS_01	○	○	○	○
PPCS_02	○	○	○	○
PPCS_03	○	○	○	●
PPCS_04	○	○	○	○
PPCS_05	●	○	○	○
PPCS_06	○	○	○	○
PPCS_07	○	○	○	○
PPCS_08	○	○	○	○
PPCS_09	○	○	○	●
PPCS_10	○	○	○	○
PPCS_11	●	○	○	○
PPCS_12	○	○	○	○
PPCS_13	○	○	○	○
PPCS_14	○	○	○	○
PPCS_15	○	●	○	○
PPCS_16	○	○	○	○
PPCS_17	●	○	○	○
PPCS_18	○	○	○	○
BSMAS *	●	○	○	●
BSMAS_01	○	○	○	○
BSMAS_02	○	○	○	○
BSMAS_03	○	○	○	○
BSMAS_04	●	○	○	○
BSMAS_05	○	○	○	○
BSMAS_06	○	○	○	●
BIG-S *	●	●	○	●
BIGS_01	○	○	○	○
BIGS_02	○	○	○	○
BIGS_03	●	○	○	○
BIGS_04	●	○	○	○
BIGS_05	○	○	○	○
BIGS_06	○	○	○	○
BIGS_07	○	○	○	○
BIGS_08	○	○	○	○
BIGS_09	○	○	○	●
BIGS_10	○	○	○	○
BIGS_11	○	○	○	○
BIGS_12	○	○	○	○
BIGS_13	○	●	○	○

Note. ACSID-11 = Assessment of Criteria for Specific Internet-use Disorders; IGDT-10 = Ten-item Internet Gaming Disorder Test; BSAS = Bergen Shopping Addiction Scale; PPCS = Problematic Pornography Consumption Scale; BSMAS = Bergen Social Media Addiction Scale; BIG-S = The Berlin Inventory of Gambling behavior – Screening

Table B.2
Items of the Assessment of Criteria for Specific Internet-use Disorders (ACSID-11) screener (proposed English translation) see also Müller et al. (2022) [17].

Item numbers	Original items
IC1	In the past 12 months, have you had trouble keeping track of when you started the activity, for how long, how intensely, or in what situation you did it, or when you stopped?(Király et al., 2017)(Király et al., 2017)
IC2	In the past 12 months, have you felt the desire to stop or restrict the activity because you noticed you were using it too much?
IC3	In the past 12 months, have you tried to stop or restrict the activity and failed with it?
IP1	In the past 12 months, have you given the activity an increasingly higher priority than other activities or interests in your daily life?
IP2	In the past 12 months, have you lost interest in other activities you used to enjoy because of the activity?
IP3	In the past 12 months, have you neglected or given up other activities or interests that you used to enjoy because of the activity?
CE1	In the past 12 months, have you continued or increased the activity even though it has threatened or caused you to lose a relationship with someone important to you?
CE2	In the past 12 months, have you continued or increased the activity even though it has caused you problems in school/training/work?
CE3	In the past 12 months, have you continued or increased the activity even though it has caused you physical or mental complaints/diseases?
FI1	Thinking about all areas of your life, has your life been noticeably affected by the activity in the past 12 months?
MD1	Thinking about all areas of your life, did the activity cause you suffering in the past 12 months?

Note. IC = impaired control; IP = increased priority; CE = continuation/escalation; FI = functional impairment; MD = marked distress.

Appendix C

Table C.1
Descriptive Statistics of the ACSID-11 mean score subscales.

ACSID-11 Subscale	Min	Max	M	SD	Skewness	Kurtosis
Frequency						
Gaming	0	3	0.447	0.621	1.824	2.912
Online buying-shopping	0	3	0.310	0.504	2.483	7.058
Online pornography use	0	3	0.330	0.538	2.308	5.785
Social-networks use	0	3	0.520	0.637	1.580	2.312
Online gambling	0	3	0.419	0.670	1.886	2.879
Intensity						
Gaming	0	3	0.433	0.648	2.013	3.824
Online buying-shopping	0	3	0.324	0.580	2.615	7.158
Online pornography use	0	3	0.357	0.606	2.289	5.220
Social-networks use	0	3	0.504	0.661	1.672	2.506
Online gambling	0	3	0.423	0.692	1.968	3.301

Note. ACSID-11 = Assessment of Criteria for Specific Internet-use Disorders.

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