The Harmful Dysfunction Analysis applied to the concept of behavioral addiction: A secondary analysis of data from the Health Behaviour in School-aged Children 2018

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Data availability

This study will analyze data from the Health Behaviour in School-aged Children (HBSC) 2018 study publicly available online and distributed by the HBSC Data Management Centre (https://www.uib.no/en/hbscdata) that coordinates the work with the international datafile and the

33 trend data and is the Data Bank for the HBSC study. The centre distributes data under the HBSC data

34 access policy.

35 **Conflict of Interest Statement**

36 The authors declare that this study is not related to any potential conflict of interest.

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Abstract

39 **Objective:** The present study is an attempt to advance the debate on the validity of the diagnosis of

40 gaming disorder and other specified disorders due to addictive behaviours by improving the

41 differentiation between excessive/high involvement versus pathological involvement. The principal

42 aim of the study is to explore the usefulness of the Harmful Dysfunction Analysis (HDA) in

43 identifying individuals with pathological social media use as an alternative approach to the study of

44 behavioral addictions while also analyzing similarities and differences with DSM-5-TR-based

45 scoring adopting criteria for internet gaming and substance use disorders.

46 **Method:** The present study will use Swiss data (N = 7,510) from the Health Behaviour in School-

47 aged Children Study 2018, a World Health Organization collaborative cross-national study of

48 adolescent health and well-being. First, convergence between different scoring methods (HDA and

49 DSM-5-TR-based) will be examined. Second, groups based on each scoring method (i.e., non-

50 overlapping cases) will be compared on measures of physical health (physical activity and body mass

51 index) and mental health (psychosomatic health, life satisfaction, school well-being). Adjusted

52 models for age, gender, migration status, and family affluence will also be tested. Data from Hungary

53 (N = 3,789) was selected to repeat the analysis as part of a sensitivity investigation.

54 **Results:** A detailed summary of the results of the above analysis will be provided in the text of the

55 manuscript while the results of the sensitivity analysis will be reported as supplementary material.

56 **Conclusions:** The conclusions will consist of a description of the research and clinical implications

57 of the findings. The limitations of the study will be discussed as well as recommendations for future

58 research applying the HDA.

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60 **Keywords**: harmful dysfunction analysis; theoretical framework; addictive behavior; normal

61 engagement; normal involvement.

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Introduction

The present study is an attempt to advance the debate on the validity of the diagnosis of gaming disorder and other specified disorders due to addictive behaviours by improving the differentiation between excessive/high involvement versus pathological behavioral involvement. The Harmful Dysfunction Analysis (HDA) (Wakefield, 1992b, 1992a, 2013, 2015, 2020) is proposed as a useful theoretical framework for constructing improved diagnostic criteria for addictive disorders (Amendola, 2023b; Wakefield & Schmitz, 2014, 2015). The DSM-5-TR's (American Psychiatric Association, 2022) definition of a mental disorder requires both the presence of symptoms that are manifestations of "a dysfunction in the psychological, biological, or developmental processes underlying mental functioning" and "are usually associated with significant distress or disability in social, occupational, or other important activities", and the Manual asserts that "each disorder…must meet the definition of a mental disorder" (p. 14). Building on the core of the DSM's definition of mental disorder, the HDA postulates that a mental disorder is a *harmful dysfunction* requiring the presence of both a dysfunction, i.e., the failure (even under the appropriate circumstances) of some psychological mechanism to perform a natural function that it was biologically designed to perform, and consequent harm, i.e., the dysfunction causes harm to the individual as evaluated by social values (Wakefield, 2017b, 2017a).

Our ultimate goal is to evaluate whether the HDA framework offers an appropriate approach to increasing the validity of diagnosis of (Internet) Gaming Disorder (GD) and other specified disorders due to addictive behaviors, an area in which the validity of diagnosis remains highly controversial. However, in this preliminary study, we use data on the related condition of Problematic Social Media Use (PSMU), not classified as a behavioral addiction in any major diagnostic manual, as a surrogate to test our hypothesis that the HDA offers a useful approach to validation. We first review evidence on the addictive potential of some forms of PSMU, the serious challenge of validly discriminating intensive but psychologically normal-range gaming or other behaviors from pathological versions of those behaviors, and we consider the limitations of current approaches to solving this problem. We then propose a test of the validity of the HDA against other recent approaches to behavioral addiction disorder validation, particularly the "confirmatory approach" that, relying on the components model of addiction (M. Griffiths, 2005), construes potential DSM behavioral addiction categories as strictly analogous logically to DSM's substance use disorder categories (Billieux et al., 2015).

Background

Despite the inclusion of specific diagnostic criteria for "Gaming Disorder" in ICD-11 (World Health Organization, 2019) and "Internet Gaming Disorder" as a "Condition for Further Study" in DSM-5-TR (American Psychiatric Association, 2022), debate continues on the optimal way to define GD as well as other conditions considered behavioral addictions. One issue is how to resolve differences between the DSM-5-TR and ICD-11 definitions of GD (Amendola, 2023b; Borges et al., 2021; Karhulahti et al., 2022). However, a more fundamental challenge is how to validly differentiate high-engagement/excessive but nonpathological gaming from true pathological/disordered gaming and thus limit "false positive" diagnoses (Amendola, 2023b, 2023c; Billieux et al., 2017; Deleuze et al., 2017; Fournier et al., 2023; Lehenbauer-Baum et al., 2015). This question is particularly urgent in a category such as GD that is concerned with an area of behavior in which it is common for individuals to have highly intensive and sometimes excessive involvement from a social or personal perspective that could easily be mistaken for pathological loss of control. In attempting to distinguish such cases, there exist no agreed biomarkers or other etiological markers of GD pathogenesis that could be used as a consensual criterion of validity.

The issue of valid diagnosis is not specific to GD and offers an especially difficult conceptual challenge to the entire field of behavioral addiction. Indeed, in recent years, based on the currently dominant "confirmatory approach" to disorder category formation (considered below), a seemingly endless number of apparently excessive behaviors have been proposed as categories of behavioral addiction. For example, Griffiths (2019) offers a partial list of conditions for which psychometric tests of disorder status have been formulated that includes gaming addiction, work addiction, exercise addiction, social media addiction, Facebook addiction, YouTube addiction, Tinder addiction, shopping addiction, pornography addiction, sex addiction, love addiction, dance addiction, tanning addiction, and television series watching addiction. This proliferation of categories of presumptively undesirable or excessive behavior as possible disorder categories underscores the need for procedures to establish valid diagnostic criteria that avoid over-pathologizing healthy highly-involved users, if the behavioral addictions field is to gain the credibility and acceptance that it deserves (Billieux et al., 2015, 2019).

Social media use and its addictive potential

Social media refers to "websites and applications which enable users to create and share content or to participate in social networking" or "websites and computer programs that allow people to communicate and share information on the internet using a computer or mobile phone" according to the Oxford English Dictionary and the Cambridge Advanced Learner's Dictionary & Thesaurus,

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128 respectively. The present study focuses on social media use for social networking rather than on the

129 broader concepts of smartphone use and screen time. Indeed, social media and networking are only

130 some of the possible activities to which screen time and smartphone use refer.

131 Besides disorders due to addictive behaviors related to gaming and gambling, the ICD-11 considers

132 the possibility of other problematic behaviors as "other specified disorders due to addictive

133 behaviours" (code: 6C5Y). According to the results of a recent review and experts' opinions study

134 (Brand et al., 2020), problematic forms of pornography use, buying and shopping, and use of social

135 networks may represent conditions of clinical importance and fit the category of "other specified

136 disorders due to addictive behaviours". Additionally, the American Psychological Association (2023)

137 issued its "Health Advisory on Social Media Use in Adolescence" recommending screening

138 adolescents for signs of PSMU, which refer to typical symptoms of addictive behaviors, and training

139 adolescents to recognize them. In an updated document, PSMU is linked with hypersensitivity to

140 social feedback/stimuli and rejection from others (e.g., likes and followers counts) and

141 underdeveloped impulse control (e.g., infinite scroll) contributing to difficulty disengaging from

142 social media and symptoms of dependency (American Psychological Association, 2024). The

143 importance of poor social competencies (Boer, Stevens, Finkenauer, & Eijnden, 2022; Chegeni et al.,

144 2021) and fear of missing out (Kuss & Griffiths, 2017) as part of PSMU were also emphasized. All

145 of this aligns well with a previous contribution discussing the complexity of social media (Bayer et

146 al., 2020). Despite the conceptualization and validity of PSMU as a behavioral addiction being

147 debated (Casale, 2020; Varona et al., 2022; Zendle & Bowden-Jones, 2019), findings from qualitative

148 studies examining subjects' perspectives about the use of social media supported the view that some

149 forms of social media use may be addictive (Ciudad-Fernández et al., 2024; O'Reilly et al., 2018;

150 Throuvala et al., 2019, 2021). The PSMU may thus refer to a spectrum of PSMU patterns with the

151 possibility that one extreme of the spectrum (or some difficult-to-define part of the spectrum) is a

152 problematic/harmful disorder, whereas other parts are problematic/harmful non-disorders.

153 The present study attempts to provide insights that will be helpful to the correct identification of

154 addictive behaviors in general. It uses PSMU as a condition with addictive potential, in a test of

155 validity. In line with the above discussion, PSMU is a particularly good domain in which to explore

156 whether an HDA approach can discriminate disordered from non-disordered variants. According to a

157 recent meta-analytic study, the estimated prevalence of PSMU ranges from 5% to 25% depending on

158 the classification scheme used (Cheng et al., 2021). This very substantial range suggests differences

159 in how various diagnostic instruments draw the line between pathology versus high-frequency

160 normality. The literature reveals that PMSU correlates with a variety of negative conditions, including

161 poorer social support, cyberbullying, and lower well-being across multiple domains of functioning

including psychological, school, and sleep problems (Boer et al., 2020; Boer, Stevens, Finkenauer, Koning, et al., 2022; Boer, van den Eijnden, et al., 2022; Boniel-Nissim et al., 2022; Borraccino et al., 2022; Marengo et al., 2021; Šablatúrová et al., 2022), as well as with lower life satisfaction and school performance (Van Den Eijnden et al., 2018). Yet, findings of initial longitudinal studies show no significant causal relationship between PSMU and distress (Di Blasi et al., 2022). Other longitudinal studies present a confusing picture in which PSMU correlates with such conditions as anxiety, insomnia, and depression, but at an individual level it is at most weakly and inconsistently is not necessarily causally related to such conditions (Chang et al., 2022; Lin et al., 2021). Despite the findings suggesting a negative impact on functioning, the definition of the category of PMSU, resulting from the use of a confirmatory approach (see below), appears to potentially encompass high and pathological involvement, which might explain the confusing findings.

High involvement versus pathological involvement

Billieux et al. (2019) reviewed the characteristics of high involvement and pathological involvement in video games as well as the boundaries between the two conditions. The authors referred to previous studies showing that high involvement in terms of time spent playing video games is not necessarily problematic or associated with impairment/distress. At the same time, there is a close association between time spent gaming and risk of gaming disorderGD diagnosis using standard criteria (Jeong et al., 2018; Király et al., 2019; Liao et al., 2023; Pontes et al., 2022). This suggests that, while time spent playing video games seems to play a major role in determiningis associated with GD diagnosis under current approaches, it may not be an effective indicator for validly differentiating high versus pathological involvement, indicating a challenge to current approaches.

The Dualistic Model of Passion (Vallerand et al., 2003) was suggested as a useful theoretical framework for identifying pathological gamers characterized by the inability to control gaming or by a compulsive pattern of gaming that interferes with daily functioning (Billieux et al., 2019). This conceptualization is in line with the definition of GD in the ICD-11 from the World Health Organization (World Health Organization, 2019) which focuses specifically on impaired control over behavior and its negative consequences in daily life. The ICD's approach is congruent in many respects with the HDA approach, as we shall see. By contrast, in the DSM-5-TR, GD is conceptualized under a broader addiction framework in which loss of control or impaired control over gaming is only one of the dependence symptoms (Amendola, 2023b; American Psychiatric Association, 2013). Consequently, the importance of impaired control over behavior, although acknowledged as one essential aspect of addiction, remains understudied as a primary factor indicating pathological involvement (Fillmore, 2003; Kahler et al., 1995; Leeman et al., 2012, 2014;

195 Sripada, 2022). Regarding PSMU specifically, it has been recently documented that help-seekers may
196 apply different self-limiting strategies to control social media use and that success in achieving it
197 depends on both individual and environmental factors but also that lack of knowledge about PSMU
198 complicates seeking and receiving support (Vainio et al., 2023).

199 **The confirmatory approach to behavioral addiction and its challenges**
200 Increasing recent criticism has been aimed at what has come to be called the "confirmatory approach"
201 to behavioral addictions. This criticism is also aimed at distinctive features of the DSM-5-TR
202 approach that differentiate it from the ICD-11. The basic idea of the DSM criteria is to adapt
203 behavioral addiction criteria from the DSM substance use disorder (SUD) criteria (Brown, 1993; M.
204 Griffiths, 1996, 2005; Marlatt et al., 1988). This yields a logically appealing approach that consists
205 of simply confirming that analogs of SUD criteria are satisfied by the target behavior (Billieux et al.,
206 2015; Flayelle et al., 2022).

207 Thus, according to the confirmatory approach, new apparently excessive behavior can be
208 conceptualized as a behavioral addiction if one can, first, demonstrate the presence of symptoms
209 similar to those of SUD; second, create new psychometric measures of the behavior using SUD
210 criteria; and third, establish associations with variables traditionally correlated with SUD. By
211 following these steps, a considerable number of daily life activity that are normally prone to intensive
212 involvement can be theorized as a behavioral addiction when performed in an intensive high-
213 engagement way, resulting in the proliferation of behavioral addictions (Billieux et al., 2015).
214 Accordingly, several studies have questioned the validity of the confirmatory approach (Deleuze et
215 al., 2017; Fournier et al., 2023; Lehenbauer-Baum et al., 2015). Despite stimulating critical thinking
216 and new research, these studies have often had methodological limitations (e.g., interpretation of
217 results based on small sample sizes and possibly resulting from researchers arbitrary choices, use of
218 extreme groups) that may have influenced their results (Amendola, 2023c, 2023a; Fisher et al., 2020;
219 Nylund-Gibson & Choi, 2018). At the same time, Griffiths (2019) emphasized the need for some
220 degree of a confirmatory approach to unify the study of addictions, suggesting that "addictions should
221 be conceptualized based on similarities rather than differences […] otherwise there is little point in
222 calling such behaviours 'addictions.'" (p.181). However, Griffiths' concern does not require a
223 mechanical analogy to SUD criteria, and could be addressed by retaining some core features of SUD.
224 As we discuss below, this is how Griffiths has pursued his "components model" that, based on DSM
225 SUD criteria, requires several necessary components of behavioral addiction. Alternative
226 perspectives to the confirmatory approach have been proposed. For example, the (addictive)

behaviors have been considered as reflecting impulse control or compulsive problems, or a coping strategy to deal with problems in daily life, rather than true addiction (Kardefelt-Winther et al., 2017).

A major problem with Griffiths' argument is that SUD diagnostic criteria themselves vary in their face validity as indicators of pathology. Thus, the validity of the analogous criteria Griffiths has used have been questioned as being peripheral or irrelevant to diagnosis of behavioral addiction. For example, Charlton (2002) and Charlton and Danforth (2007) examined the components model of addiction as applied to computer and video game use, with two factors labelled "Addiction" and "Low engagement" consistently found across the two studies, and these results provided evidence that some criteria (i.e., tolerance, euphoria, cognitive salience) of the components model may be peripherical as criteria for addiction or represent phenomena that occur early in the process of disorder development and are best considered risk factors. The primary grounds for criterion selection in the present study are conceptual, in terms of face validity in satisfying the dysfunction and harm criteria of the HDA. However, previous reviews offer useful input to these judgments. A systematic review of the psychometric validity and usefulness of the tolerance criterion for Gaming Disorder (2023) found that tolerance lacks relevance in measuring Gaming Disorder. Withdrawal is perhaps one of the more controversial but least studied criteria. A review by Kaptsis et al. (2016) found that that many of the reviewed studies reported no withdrawal symptoms in their samples, but overall "the available evidence on Internet gaming withdrawal is very underdeveloped" (p. 58). Starzec et al. (2024) observed that most of the studies on GD withdrawal that they reviewed had no control for abstinence in evaluating withdrawal, raising questions about the validity of responses. In Castro-Calvo et al.'s (2021) Delphi study of expert appraisals of criteria for GD, withdrawal was among the intermediate group with 31% endorsement for diagnostic validity, meeting the study's criteria neither for inclusion (>80% endorsement) nor exclusion (<20% endorsement). It is difficult to draw any conclusions from this weak result for two reasons. First, other criteria that are widely seen as indicative of addictive dysfunction—for example, craving—also fell into this intermediate category, perhaps because they are less prevalent and thus seen as less "important" (which is how the study's question was worded). Second, as noted, recent reviews indicate that withdrawal in GD has not been extensively studied in methodologically adequate ways and so it is not yet a salient, well-defined, and well-supported marker for many in the field.

Moreover, the DSM symptom threshold for SUD diagnosis—any two or more out of nine possible symptoms—has been criticized as too low, potentially yielding false positive problems for the substance use disorder category itself (Wakefield & Schmitz, 2014, 2015). Those taking a confirmatory approach, including Griffiths in his components model, implicitly attempt to address

this problem by following DSM's approach in GD criteria of requiring more symptoms than are required for SUD, and picking and choosing what they consider central among the SUD criteria. Yet, given the essential rationale of the confirmatory approach in which the symptomatic equivalence of a form of behavior to SUD is postulated as the rationale for diagnosis of behavioral addiction, these alterations and the raised threshold levels appear conceptually arbitrary until tested for validity. These various issues regarding SUD criteria and their uses make the current overarching confirmatory approach to behavioral addiction, and the components model on which it is based, a questionable conceptual baseline for diagnosing behavioral addiction pending further validation of criteria and thresholds.

The Harmful Dysfunction Analysis of the concept of behavioral addiction

In accordance with the viewpoints expressed by previous commentators (Billieux et al., 2015; Kardefelt-Winther et al., 2017), it is possible that the risk of over-pathologizing common behaviors results from two challenges to validity: (1) the use of atheoretical and confirmatory approaches with a focus on symptoms analogous to the DSM's SUD symptoms rather than a focus on key dimensions that have conceptual validity, such as dysfunction and impairment/distress; and (2) inherent ambiguities in vague SUD-type symptom descriptions that have long been criticized as encompassing both pathological and normal-range phenomena. Regarding the first problem, although the DSM-5-TR definition of GD includes some criteria indicating the presence of impairment/distress (e.g., criteria 6 and 9), the presence of impairment/distress is not a requirement for the GD diagnosis because diagnosis depends only on any five (or more) of the nine criteria being met, regardless of their content. Moreover, the aspect of dysfunction in psychological domains has not been explicitly addressed or required by the criteria, either. Therefore, the risk of false-positive cases, even when judged by the DSM's own definition of mental disorder, needs to be considered. It is true that the high DSM diagnostic threshold of 5 or more symptoms—as compared to the SUD threshold of 2 or more symptoms—does make it highly likely that most diagnosed cases will have symptoms of dysfunction and impairment/distress. However, in addition to a risk of false positives, the DSM-5 diagnostic threshold risks making false negative diagnoses in which true disorder is present at a lower number of symptoms. More importantly, it has no conceptual rationale as a threshold given its dramatic deviation from the two-symptom SUD threshold and the theory of the confirmatory approach, and so requires validation.

In some ways, the ICD-11 comes closer to the HDA approach than does the dominant DSM approach. A focus on significant harm/distress and persistence over time, and not just a repetitive behavior in itself, has been recommended by previous writers (Kardefelt-Winther et al., 2017) and the optimal

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nature of exclusion criteria has been debated (M. Griffiths, 2019; Kardefelt-Winther et al., 2017). The ICD-11 definition of GD benefited from these suggestions and incorporated ~~changes clarifying that the main symptom of GD~~ a criterion that requires not just excessive involvement but impaired control over gaming, reflecting a dysfunction, in addition to the other three criteria of increasing priority of gaming over other activities, continuation of gaming despite negative consequences, and significant distress or impairment resulting from gaming. ~~is not excessive involvement itself but rather impaired control over gaming, with other classic symptoms of dependence included as possible additional clinical features. Notably, increasing priority given to gaming over other life interests and daily activities, continuation or escalation of gaming despite the occurrence of negative consequences, and significant impairment are required for the diagnosis of GD. However, despite providing some suggestions to differentiate GD from normal gaming behavior, the definition of the ICD-11 does not propose specific and effective indicators for discriminating between normal range (e.g., functional, high-involvement gaming) and pathological gaming.(Amendola, 2023b)~~ The perceived validity of the ICD-11 criteria by experts is high, with all four reaching a consensus for "inclusion" as diagnostically valid in Castro-Calvo et al.'s (2021) Delphi study, whereas only four out of nine DSM-5-TR criteria reached an inclusion consensus. Moreover, ICD-11 adds useful indicators of the "boundary with normality (threshold)," emphasizing that sheer excessive use without other indicators of disorder does not qualify for diagnosis. However, questions remain about the source of the perceived validity of the ICD-11 criteria and how the precision and conceptual validity of the criteria might best be increased in the future. The present study is a first step toward clarifying whether an explicit HDA approach can provide a path to increased clarity, specificity, and validity

In the case of addictive disorders, dysfunctions may be caused by evolutionarily novel stimuli (e.g., technological creations) for which the brain and other biological systems were not designed and that lead to failures of designed regulatory systems (Wakefield, 2017b, 2017a). The dysfunction that results from the novel input has been referred to as a dysfunction in self-regulation, a dysfunction of the desire/deliberation/choice system, a pathological degree of diminution of control (Wakefield, 2009, 2013, 2017a, 2017b) or a motivational dysfunction (Wakefield, 2018, 2020). The compulsive behavior may be a symptom that the biological design of motivational and choice systems has failed. This fits well with the discussion about mechanistic and functional explanations of addiction and may represent a phenomenon that unifies all the manifestations of interest (Murphy & Smart, 2018). Wakefield and Conrad (2019) clarified that "social values or standards are not synonymous with the attitudes or opinions that predominate at any given moment" and that "whether a condition is a disorder is not determined by how the diagnosed individual subjectively happens to feel about the condition's effects, but by more 'objective' standards determined by the culture's value system" (p.1).

327 In this sense, there is some degree of social relativity present in disorder status because harm is related

328 to what a specific culture values as important and as indicating impairment/distress.

329 The HDA offers a potentially useful perspective on how to distinguish high involvement and

330 pathological (i.e., dysfunctional and harmful) involvement. According to this view, both dysfunction

331 and harm are required for a disorder. Dysfunction not causing harm does not qualify as a disorder but

332 rather as a harmless abnormality. For example, some passionate or excessive gamers/social media

333 users (e.g., professional gamers, influencers) may experience difficulties in controlling the time spent

334 gaming/using social media or resisting the urge to play/use social media but their functioning in daily

335 life is not directly affected (e.g., they display good sleep quality, are physically active, attend

336 school/work, and maintain intimate/social relationships). The behavior and experience of such

337 gamers/social media users do not qualify as an addictive disorder or psychopathology. Similarly, the

338 absence of harm may distinguish addiction from addictive disorder (Wakefield, 2020).

339 Conversely, harmful consequences in the absence of a dysfunction do not qualify as a disorder. For

340 example, obesity or postural problems may be consequences of inactivity or sedentary behaviors due

341 to high amount of time spent gaming/using social media in absence of a dysfunction. Information

342 about the specific contexts in which symptoms occur can often help to clarify whether a syndrome is

343 due to a dysfunction or to normal mental functioning under stressful or problematic circumstances

344 (Wakefield & First, 2012). For example, some gamers/social media users may use technological

345 devices to cope with adverse events and/or negative and painful emotions that may decrease self-

346 regulation and motivation. Under these circumstances, the gaming/social media use behavior may

347 increase distress even if a dysfunction causing the behavior itself is absent. According to the HDA, if

348 there is only harm and no dysfunction, the behavior does not qualify as a disorder. However, the

349 possibility also exists that problematic contexts can cause internal dysfunctions in vulnerable

350 individuals, with symptoms then no longer dependent on the context, and this can complicate

351 diagnostic inferences (Wakefield & First, 2012). The importance of environmental influences, such

352 as familial and social/cultural norms and values, has been previously discussed in-depth (Bax, 2014;

353 Snodgrass et al., 2021).

354 **Study objectives**

355 The principal aim of the study is to explore the usefulness of the HDA applied to the concept of

356 PSMU in differentiating individuals showing a pathological involvement with social media from

357 those with a high non-pathological involvement. HDA as an alternative approach to the study of

358 behavioral addictions is further analyzed investigating similarities and differences with DSM-5-TR-

359 based scoring. This aim will be pursued by 1) exploring differences between HDA cases and non-

cases (i.e., the rest of the sample), 2) examining convergence between different scoring methods and 3) comparing groups based on each scoring method (i.e., non-overlapping cases) on measures of physical health (physical activity and body mass index) and mental health (i.e., psychosomatic health, life satisfaction, school well-being). In the latter analysis, different groups of non-overlapping cases as defined by different scoring methods will be directly compared. Adjusted models for age, gender, migration status and family affluence will also be tested.

Methods

We report how sample size was determined, all data exclusions (if any), all manipulations, and selected measures from the original study.

Data

The present study uses data from the Health Behaviour in School-aged Children (HBSC) study, a World Health Organization collaborative cross-national study of adolescent health and well-being. The survey is undertaken every four years using a self-report questionnaire exploring health behaviors and complaints, school context, family and peer relationships, with randomly selected representative samples of adolescents aged 11-15 years. Data collection is conducted under a multidisciplinary protocol developed (and updated over the years) by the international surveillance group made up of researchers from all the participating countries (Inchley et al., 2018). The HBSC International Protocol specifies a nationally representative sample of approximately 1,500 pupils from each age group in each participating country, giving a total national sample size of approximately 4,500 children. According to the study protocol, ethical approval for the study protocol was sought from the involved institutions and where ethics committees were not in place, countries adhered to national ethical guidelines concerning research with children and submitted the protocol to any relevant board at country level. Data from the HBSC 2018 was obtained from the HBSC Data Management Centre (https://www.uib.no/en/hbscdata), that coordinates the work with the international datafile and the trend data and is the Data Bank for the HBSC study. The present study was not required to undergo independent approval by an ethical committee because freely online available data, with no identifiable information, was re-analyzed. Data from Switzerland (N= 7,510) and Hungary (N= 3,789) (randomly selected for conducting sensitivity analyses; see statistical analysis paragraph below) will be used.

Measures

Independent variable

The nine-item Social Media Disorder Scale (SMDS) measures symptoms of PSMU during the last year (van den Eijnden et al., 2016). It consists of nine items with a dichotomous response ("yes", "no") corresponding to the nine diagnostic criteria for GD according to the DSM-5. The questions were introduced as follows: "We are interested in your experiences with social media. The term social media refers to social network sites (e.g. Facebook, [add other local examples]) and instant messengers (e.g. [insert local examples], WhatsApp, Snapchat, Facebook messenger). During the past year, have you…", followed by items description. The scale showed adequate psychometric properties in recent studies (Boer et al., 2020; Boer, Stevens, Finkenauer, Koning, et al., 2022; Boer, van den Eijnden, et al., 2022).

Considering that our interest is on diagnosis and conceptualization of addictive disorder, we will focus in this study on the definition and criteria for GD and SUD from the DSM-5-TR. Although testing for ICD-11 criteria would also be useful, the Social Media Disorder Scale items used here were constructed to be compatible with the DSM-5-TR criteria, so an attempt to use them as measures for ICD-11 criteria would involve questionable assumptions about how they are interpreted by respondents. Thus, we leave the evaluation of ICD-11 criteria for another time. It should be noted that we would expect a substantial convergence between HDA and ICD-11 diagnoses because HDA and ICD-11 GD criteria applied to PSMU both require what amounts to the presence of both harm and dysfunction for diagnosis.

DSM-5-TR-based scoring methods derived from the diagnostic threshold for the diagnosis of GD (i.e., endorsing at least five of the nine diagnostic criteria) and SUD (i.e., endorsing at least two of the seven diagnostic criteria explored by the instrument), will be used (Table 1). Consequently, DSM-5-TR GD-based PSMU will be considered present if five or more symptoms are met ("yes"). Conversely, DSM-5-TR SUD-based PSMU will be considered present if two or more symptoms are met.

Harmful dysfunction analysis (HDA) of Problematic Social Media Use (PSMU)

According to the HDA, dysfunction and harm are both required for the diagnosis of a disorder. The nine items of the scale exploring symptoms of PSMU were categorized depending on whether each item indicated dysfunction or harm or neither one (Table 1). The latter category is necessary because some items do not directly indicate harm and do not most plausibly reflect an underlying dysfunction according to the HDA.

Note that both the concepts of "dysfunction" and "harm" are fuzzy and open to a degree of interpretation, and the DSM criteria were not originally formulated with these concepts in mind. Consequently, there is a degree of judgment involved in our categorization, and alternative judgments are possible. In this study, where possible we have followed or tried to remain consistent with consensus judgments of harm and dysfunction made in earlier studies of alcohol use disorder (Wakefield & Schmitz, 2014, 2015). Nonetheless, the formulations of several of the DSM criteria retain a degree of ambiguity as to whether a criterion suggests a dysfunction or a normal-range behavior, and similarly whether a criterion rises to the level and kind of harm that would justify a diagnosis. Thus, to evaluate whether a more demanding approach would yield different and potentially more valid results, we tested two versions of the HDA. The first version, HDA1, as in earlier studies of alcoholism, requires just one dysfunction and one harm symptom, whereas the second version, HDA2, requires two dysfunction and two harm symptoms, to reach diagnostic threshold.

Thus, we categorized items indicative of reduced inhibitory control (persistence despite desiring to stop), lessened interest in alternative rewards (preoccupation with this one type of reward), and withdrawal symptoms as suggesting that internal mechanisms are not functioning as designed (Wakefield, 2018; Wakefield & Schmitz, 2014, 2015). The withdrawal item content was judged as indicating dysfunction because it has been judged a consensus HDA dysfunction indicator in previous studies in adjacent areas of research (see, e.g., Wakefield & Schmitz, 2014, 2015), and because symptoms following pausing of gaming suggest impaired control or self-regulation under the HDA framework. This is also in line with the recent classification of withdrawal symptoms as aspects of obsessive passion (Infanti et al., 2023). We categorized neglect of other activities and roles, serious conflict with family members, and regular arguments with others as harm caused by excessive use. Items exploring tolerance, escape/mood regulation (which can be adaptive), and deception of others in regard to one's behavior were not judged to be direct indicators of dysfunction or harm. The categorization of these latter symptoms is consistent with recent research on GD that suggests that those criteria are weak or questionable indicators of addictive disorder (Castro-Calvo et al., 2021; Ko et al., 2020; Yen et al., 2022). PSMU diagnosis based on the HDA (HDA1) required that an individual meet at least one dysfunction criterion and at least one harm criterion, as previously reported (Amendola, 2023b; Wakefield & Schmitz, 2014), or, for our stronger criterion, HDA2, that the individual meet at least two dysfunction criteria and at least two harm criteria.

The original scoring of the SMDS (Table 1) is based on DSM criteria but deviates in one important way: it requires 6 out of 9 symptoms parallel to substance use disorder symptoms for diagnosis, rather

than 5 out of 9 as in the DSM-5-TR proposed criteria for GD. These thresholds for the respective behavioral additions appear arbitrary because neither one matches the substance use disorder threshold of 2 symptoms or more. If it was applied literally, the confirmatory approach would presumably match the criteria for substance use disorder, allowing a lower threshold than either the SMDS or DSM-5-TR.

Table 1. The nine items of the Social Media Disorder Scale according to DSM-5-TR-based scoring methods and the Harmful dysfunction analysis (HDA) categories of dysfunction and harm.

Item content	Factor	DSM-5-TR GD-based	DSM-5-TR SUD-based	HDA category
During the past year, have you...				
1. ... regularly found that you can't think of anything else but the moment that you will be able to use social media again?	Preoccupation	✓	✓	Dysfunction
2. ... regularly felt dissatisfied because you wanted to spend more time on social media?	Tolerance	✓	✓	*Not used*
3. ... often felt bad when you could not use social media?	Withdrawal	✓	✓	Dysfunction
4. ... tried to spend less time on social media, but failed?	Persistence	✓	✓	Dysfunction
5. ... regularly neglected other activities (e.g., hobbies, sport) because you wanted to use social media?	Displacement	✓	✓	Harm
6. ... regularly had arguments with others because of your social media use?	Problem	✓	✓	Harm
7. ... regularly lied to your parents or friends about the amount of time you spend on social media?	Deception	✓	*Not used*	*Not used*
8. ... often used social media to escape from negative feelings?	Escape	✓	*Not used*	*Not used*
9. ... had a serious conflict with your parents, brother(s), or sister(s) because of your social media use?	Conflict	✓	✓	Harm

Note. ✓: item used as an indicator of a criterion according to DSM-5-TR diagnosis.

Dependent variables

In addition to the HDA1 and HDA2 validity tests, we formulated other validators available in the HBSC. Although the HBSC included many measures of well-being, none of them are pathognomonic for disorder or non-disorder. Nonetheless, we selected measures of well-being and health-promoting behaviors that could serve as indirect individually weak validators but that as part of an overall picture could yield revealing correlates with diagnostic status.

Physical health. Physical activity was examined asking respondents to report how many hours a week they usually exercise in their free time ("Outside school hours: how many hours a week do you usually exercise in your free time so much that you get out of breath or sweat?"). Responses were on a seven-

474 point scale (from 1= every day, to 7= never) and were dichotomized as regular physical activity (0=

475 once a week, 2-3 times per week, 4-6 times a week, every day) and no or low physical activity (1=

476 never, less than once a month, once a month).

477 Body mass index (BMI) was also used and calculated using information on height and weight.

478 *Mental health.* The HBSC-Symptom Checklist was used to measure psychosomatic health during the

479 last six months (Heinz et al., 2022). It consists of eight items covering the following eight symptoms:

480 headache, abdominal pain, backache, feeling low, irritability or bad mood, feeling nervous, sleeping

481 difficulties and dizziness. Respondents are asked to answer using a five-point scale from 1 (about

482 every day) to 5 (rarely or never). Scores were reversed in order that higher total scores indicate higher

483 psychosomatic distress.

484 Further, life satisfaction was measured using a one-item scale (Cantril, 1965; Levin & Currie, 2014).

485 Respondents rated their life satisfaction using Cantril's ladder [30], ranging from 0 (worst possible

486 life) to 10 (best possible life). Scores were reversed in order that higher scores indicate higher life

487 dissatisfaction.

488 Not liking school was used as an indicator of school dissatisfaction. Respondents were asked to

489 indicate their feeling about school ("How do you feel about school at present?") using a four-point

490 scale (from 1= I like it a lot, to 4= I do not like it at all) (Boer et al., 2020; Inchley et al., 2016).

491 Responses were dichotomized as liking school (0= like a bit, like a lot) and not-liking school (1= not

492 at all, not very much).

493 *Summary variables.* Despite the heterogeneity and non-independence of these five variables, for ease

494 of presentation and provide a rough sense of global outcome we formulated two summary variables

495 defined as 1) a "composite index" of poor psychophysical health or distress, and 2) as different

496 profiles of psychophysical health or distress obtained relying on a latent profile analysis approach.

497 More information is provided below in the paragraph "Statistical analysis".

498 ***Covariates***

499 The following sociodemographic information will be included as covariates. Gender was explored by

500 asking respondents whether they are boy or girl (1= boy, 2= girl). Age was computed according to

501 respondents' month and year of birth and the date of the survey administration. Socio-economic status

502 (SES) was measured using the Family Affluence Scale III (FAS III) (Torsheim et al., 2016). It consists

503 of six items exploring material assets in the household (e.g., number of bathrooms, family holidays).

504 The raw total score ranges from 6 (low SES) to 19 (high SES). Finally, migration status will be

505 measured using information on respondents' and parents' country of birth and coded into: Swiss

506 (respondent and at least one parent born in Switzerland or both parents born in Switzerland), second-

generation immigrant (respondent born in Switzerland and parents born abroad), and first-generation immigrant (both respondent and parents born abroad) (Kjelgaard et al., 2017).

Statistical analysis

Responses with missing values on any of the variables of interest will be excluded from the analysis. Differences between participants included (i.e., participants with complete responses) and excluded from the analysis will be tested.

To analyze convergence between different scoring methods Chi-squared test of independence and Cohen's kappa coefficient will be used.

Regarding summary measures, the composite index representing poor psychophysical health or distress will be calculated as the mean of z-scores for the five dependent variables. While different profiles of psychophysical health or distress will be obtained relying on a latent profile analysis approach (using z-scores for the five dependent variables).

Analysis of variance (ANOVA) and analysis of covariance (ANCOVA) will be used for groups comparisons on continuous dependent variables z-scores (i.e., body mass index, psychosomatic distress, life dissatisfaction and composite index) without and with adjustment for the effects of covariates (i.e., gender, age, SES, and migration status) in the models, respectively. For continuous dependent variables (i.e., BMI, psychosomatic distress, and life dissatisfaction) z-scores will be used to interpret effect sizes in terms of standardized mean difference.

Finally, logistic regression models will be used to test associations between PSMU and dichotomous dependent variables (i.e., poor physical activity and school dissatisfaction) without and with adjustment for the effects of covariates (i.e., gender, age, SES, and migration status). While multinomial logistic regression will be used to test associations between PSMU and profiles resulting from latent profiles analysis as a dependent variable.

As a sensitivity analysis, the above analysis will be re-run with a sample from another country randomly selected from the dataset. The sample, from Hungary (N= 3,789), was randomly selected on March 29, 2023. Results of sensitivity analysis will be presented as supplementary material.

Limitations

Some limitations of the current analysis should be considered for proper contextualization of the study findings. First, the present analysis used data from adolescents aged 11-15 years. PSMU has been mainly studied in young people (Cheng et al., 2021). However, adolescents show a greater propensity towards impulsive and risky behaviors and are more attracted to novel stimuli than other age groups (Dayan et al., 2010; Gladwin et al., 2011). Therefore, considering both harm and dysfunction and the more conservative criterion, HDA2, requiring at least two dysfunction criteria and at least two harm

criteria for PSMU, allowed the identification of the most impaired users by differentiating them from high-involved non-problematic users, mitigating the risk of over-medicalization.

Second, our analysis will benefit from existing data not tailored for investigating the usefulness of the HDA for the conceptualization of behavioral addictions. As a consequence, seven predefined self-report items that derive from the component model of addiction will be used. Third, related to the previous, the use of self-report items leads to harm inference being self-reported. However, it needs to be considered that the items we will use are arguably indicative in the sampled culture of objective harm. Fourth, and related to all the above, additional potential theory-driven dysfunction and harm must be investigated in future research. Despite being understudied, the importance of impaired control over behavior is acknowledged as a primary factor indicating pathological involvement in our investigation, in the ICD-11 definition of GD, and previous research (Fillmore, 2003; Kahler et al., 1995; Leeman et al., 2012, 2014; Sripada, 2022). We believe that the examination of more articulated symptoms of impaired control representing behavioral (e.g., inhibition such as resisting to and stopping the behavior) (Fillmore, 2003; Kahler et al., 1995; Kowalik et al., 2024) and psychological aspects related to cognition and affect (e.g., salience, preoccupation, distortions, negative urgency and craving) (Fillmore, 2003; Gonçalves et al., 2024; Leeman et al., 2014; Quintero et al., 2020; Sripada, 2022) may advance our understanding of dysfunction in addictive disorders. This is consistent with the HDA focus on dysfunction in self-regulation and desire/deliberation/choice system (Wakefield, 2009, 2013, 2017a, 2017b) or motivation (Wakefield, 2018, 2020). Additionally, harm conceptualization and operationalization should be enhanced through the investigation of other informative aspects such as relational, performance, health, financial and, possibly, existential harms (Karhulahti et al., 2023). Importantly, future research should deepen our understanding of body image dissatisfaction as a potential harm of PSMU evident in self-injury and anorexia (Logrieco et al., 2021) and invasive cosmetic and plastic surgery procedures (Jenny et al., 2020; Laughter et al., 2023; Montemurro et al., 2015; Oregi et al., 2024). Similarly, the study of dysfunctional factors specific to PSMU could explore fear of missing out as an additional symptom of impaired control in affect regulation (for example see findings from (Brailovskaia et al., 2021; Li et al., 2024)). Qualitative study findings may represent a valuable starting point for such an exploratory investigation. As well, as the literature develops, a broader network of probabilistic validators could be tapped to offer a more complex and comprehensive test of validity as in earlier HDA studies of alcohol use disorder (Wakefield & Schmitz, 2015).

Finally, in our analysis, we focus on addictive disorders of social media use at the individual level of analysis. However, social media use is inevitably related to the context in which it occurs and can also be analyzed in terms of social and cultural perspectives (Karlsen, 2016) that may render these

activities unproblematic and pleasurable (Costello & Edmonds, 2007). Moreover, the structural characteristics of social media (e.g, like-button, read-receipt functions, endless scrolling, personalization of content, push notifications, time restrictions of content) may influence users' behaviors independently of pathology/nonpathology, prolonging time spent using them (Flayelle et al., 2023; Montag et al., 2019; Montag & Elhai, 2023). The effects of design elements have been more investigated for gaming (Flayelle et al., 2023; Griffiths & Nuyens, 2017) whereas research is in its infancy for social media use(Alutaybi et al., 2019; Montag & Elhai, 2023; Purohit et al., 2020). As in gaming research, future research on social media use adopting a wider perspective incorporating both social and structural mechanisms will fill a relevant gap in the literature (Karlsen, 2016).

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