# The links between healthy, problematic, and addicted Internet use regarding comorbidities and self-concept-related characteristics

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*Background:* Addicted Internet users present with higher rates of comorbidities, e.g., attention-deficit hyperactivity disorder (ADHD), depressive, and anxiety disorders. In addition, deficits in self-concept-related characteristics were found in addicted Internet gamers and social network users. The aim of this study was to examine the links between healthy, problematic, and addicted Internet use regarding comorbidities and self-concept-related characteristics. The association between recently developed ADHD-like symptoms without an underlying diagnosis and addictive Internet use was also examined. *Methods:* $n = 79$ healthy controls, $n = 35$ problematic, and $n = 93$ addicted Internet users were assessed for comorbidities, social and emotional competencies, body image, self-esteem, and perceived stress. Apart from an ADHD-diagnosis, recently developed ADHD-like symptoms were also assessed. *Results:* Addicted users showed more self-concept-related deficits and higher rates of comorbidities with ADHD, depressive, and anxiety disorders. Addicted and problematic users showed similarities in the prevalence of cluster B personality disorders and decreased levels of characteristics related to emotional intelligence. Participants with recently developed ADHD-like symptoms scored higher in lifetime and current severity of Internet use compared with those without ADHD symptoms. Addicted participants with recently developed ADHD symptoms showed higher lifetime Internet use severity compared with those without any symptoms. *Conclusions:* Our findings indicate that cluster B personality disorders and premorbid problems in emotional intelligence might present a link between problematic and addictive Internet use. Furthermore, the findings provide a first indication that addictive Internet use is related to ADHD-like symptoms. Symptoms of ADHD should therefore be assessed against the background of possible addicted Internet use.

*Keywords:* problematic and addicted Internet use, comorbidities, ADHD symptoms, self-concept

## INTRODUCTION

Due to accelerated digitalization, in particular, regarding portable digital devices, the Internet is accessible anywhere and anytime. Therefore, it is not particularly surprising that worldwide Internet use has drastically increased during the past three decades (Internet world stats). A survey in Germany showed that in 2015, 44.5 million people used the Internet daily and 3.5 million people (8.5%) more than the previous year (Tippelt & Kupferschmitt, 2015). Apart from the enjoyable aspects of the Internet, the incidence of Internet addiction seems to have increased in the recent years (Mihara & Higuchi, 2017; Rumpf et al., 2014).

Despite the inclusion of "Internet gaming disorder" in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013) as "a condition warranting more clinical research and experience before it might be considered for inclusion in the main book as a formal disorder," it is still under debate whether the addicted use of other Internet applications, such as social networks and online shopping, can be regarded as clinically relevant enough to be included in the diagnostic clinical classifications. In contrast to the DSM, the ICD-11 Beta Draft (World Health Organization, 2015) proposes to define gaming disorder (i.e., "digital gaming" or "video gaming") directly under the term "disorders due to substance use or addictive behaviors." This draft also suggests classifying addictive Internet use of other applications (e.g., addictive social network use) under the section "other specified disorders due to addictive behaviors."

Addictive Internet use is associated with psychological and cognitive problems, such as poor concentration, a decline in school and job performance, as well as sleep disturbances and social withdrawal (Lemola, Perkinson-Gloor, Brand, Dewald-Kaufmann, & Grob, 2015; Taylor,

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Pattara-angkoon, Sirirat, & Woods, 2017; Upadhayay & Guragain, 2017; Younes et al., 2016). The hikikomori syndrome (i.e., social withdrawal, cooping oneself up in one's own home, and not participating in society for 6 months or longer) is also linked to increased Internet consumption, but it is still unclear whether hikikomori can be regarded as an independent disorder or a clinical symptom strongly associated with other psychiatric conditions (Stip, Thibault, Beauchamp-Chatel, & Kisely, 2016).

Previous explanatory models of Internet addiction such as the Person-Affect-Cognition-Execution (I-PACE) model of Brand and colleagues suggest preceding psychopathological characteristics and dysfunctional personality traits as main factors that lead to the development of Internet addiction (Brand, Young, Laier, Wolfling, & Potenza, 2016; Davis, 2001). Accordingly, several studies on problematic and addictive Internet use reported high rates of comorbidities such as depression and anxiety disorders as well as attention-deficit hyperactivity disorder (ADHD) (Bozkurt, Coskun, Ayaydin, Adak, & Zoroglu, 2013; Chen, Chen, & Gau, 2015; Seyrek, Cop, Sinir, Ugurlu, & Senel, 2017). In addition, Zadra et al. (2016) reported that Internet addicts show higher frequencies of personality disorders (29.6%). In particular, the borderline personality disorder showed a higher prevalence in Internet addicts compared with the participants without Internet addiction. The occurrence of ADHD symptoms was often reported in studies on adolescent Internet addicts. Seyrek et al. (2017) found significant correlations between Internet addiction and attention disorder as well as hyperactivity symptoms in adolescents. In addition, Weinstein, Yaacov, Manning, Danon, and Weizman (2015) observed children with ADHD to score higher on the Internet Addiction Test compared with a non-ADHD group. The reverse question as to whether ADHD-like symptoms emerge as a negative consequence of excessive Internet use is, however, still unclear. Excessive Internet use is usually accompanied by the simultaneous management of several different ongoing online tasks (digital multitasking; Crenshaw, 2008). This often increases the stress levels, which lead to cognitive deficits that are comparable with those found in ADHD. Study findings indicate that digital multitasking correlates with deficits in executive functions (working memory and inhibitory control processing), increased perceived stress and depressive as well as anxiety symptoms (Cain, Leonard, Gabrieli, & Finn, 2016; Minear, Brasher, McCurdy, Lewis, & Younggren, 2013; Reinecke et al., 2017; Uncapher, Thieu, & Wagner, 2016). Patients with Internet gaming disorder reported increased daily and chronic stress levels compared with controls (Kaess et al., 2017).

Specifically for younger people growing up with digitalization and networking, excessive Internet use seems to be a determining factor in their everyday activities. This might also explain why the prevalence of Internet addiction is highest during adolescence. The main developmental task during this period is the formation of a personal identity (also referred to as self-concept; Erikson, 1968; Marcia, 1966). This process includes the acceptance of physical changes, culture-specific stereotypes of masculine and feminine characteristics as well as the development of social and emotional competencies and self-efficacy in performance-related features (Erikson, 1968; Marcia, 1966). Previous

studies indicate self-concept deficits in addicted gamers as well as in social networkers. Addicted gamers reject their own body image more strongly and exhibit deficits in self-esteem as well as emotional competencies (i.e., recognition of own and others' emotions and emotional expressions) compared with regular non-addicted gamers and healthy controls (Lemenager et al., 2016). Furthermore, problematic social networking was associated with problems in recognizing one's own emotions as well as in emotion regulation skills (Hormes, Kearns, & Timko, 2014).

To the best of our knowledge, studies on comorbidities and self-concept in Internet addiction assessed differences between addicted users and healthy controls, but did not additionally consider problematic usage that possibly mirrors the transition between healthy and addicted Internet use. Including a group of problematic Internet users might contribute to clarifying whether there are similarities between problematic and addicted Internet users or whether problematic use can be considered as a transitional phase between healthy and addicted individuals. Finding those characteristics that are associated with problematic and addictive Internet use would contribute to the identification of potential risk factors for the development of addicted Internet use and therefore enable better preventive interventions.

Thus, the aim of this study was to examine differences and similarities in comorbidities and self-concept-related characteristics between addictive and problematic Internet users.

In the first attempt, apart from examining subjects with an ADHD diagnosis, we also examined whether recently developed ADHD-like symptoms without an underlying ADHD diagnosis might be associated with addictive Internet use.

## METHODS

### Participants

We recruited $n = 79$ healthy controls, $n = 35$ problematic, and $n = 93$ addicted Internet users (Table 1). Group assignment to problematic and addicted users was carried out using participant's scores in the checklist for the Assessment of Internet and Computer Game Addiction (AICA; Wölfling, Beutel, & Müller, 2012) and in the scale for online addictive behavior for adults [Skala zum Onlinesuchtverhalten bei Erwachsenen (OSVe-S; Wölfling, Müller, & Beutel, 2010)].

The addicted sample comprised the subgroups of $n = 32$ gamers, $n = 24$ social network users, and $n = 37$ users of other applications (information platforms: $n = 1$; pornographic sites: $n = 4$; gambling sites: $n = 9$; shopping sites: $n = 2$; streaming: $n = 13$; and other forms: $n = 8$). The group of addicted Internet gamers played massively multiplayer online role-playing games (e.g., World of Warcraft or League of Legends) or online first-person shooter games (such as Counterstrike, Battlefield, or Call of Duty) extensively. All of these games included communication features. The social network users were active in Internet applications, such as online chats, forums, or social communities (e.g., Facebook).

Table 1. Sample description

| | Total (N = 207) | Healthy controls (n = 79) | Problematic Internet users (n = 35) | Addicted Internet users (n = 93) | Test statistic | p value | Post hoc: controls versus problematic p | Post hoc: controls versus addicted p | Post hoc: addicted versus problematic p |
|---|---|---|---|---|---|---|---|---|---|
| Gender (% male) | 128 (61.8) | 47 (59.5) | 20 (57.1) | 61 (65.6) | $1.066 \chi^2$ (CT) | .589 | | | |
| Age (SD) | 27.1 (8.5) | 27.4 (8.8) | 23.8 (3.0) | 28.0 (9.3) | $3.294 F$(ANOVA) | .039 | .036 | .641 | .012 |
| Education [years, (SD)] | 14.5 (2.5) | 15.0 (2.3) | 14.3 (2.6) | 14.2 (2.6) | $3.667 \chi^2$ (KW) | .160 | | | |
| AICA 30 days (SD) | 8.9 (6.7) | 3.4 (3.0) | 7.2 (2.9) | 14.2 (5.9) | $115.805 \chi^2$ (KW) | <.001 | <.001 | <.001 | <.001 |
| AICA lifetime (SD) | 16.8 (8.7) | 9.2 (6.6) | 16.0 (6.0) | 23.5 (4.8) | $117.890 \chi^2$ (KW) | <.001 | <.001 | <.001 | <.001 |
| OSVe (SD) | 8.9 (5.3) | 3.4 (1.6) | 10.1 (2.0) | 13.2 (3.7) | $151.857 \chi^2$ (KW) | <.001 | <.001 | <.001 | <.001 |

*Note. SD*: standard deviation; $\chi^2$ (CT): $\chi^2$ crosstab; $\chi^2$ (KW): $\chi^2$ Kruskal–Wallis Test; *F*(ANOVA): one-way ANOVA; AICA: Assessment of Internet and Computer Game Addiction; OSVe: Skala zum Onlinesuchtverhalten bei Erwachsenen.

The group of problematic users consisted of $n = 9$ gamers, $n = 15$ social networkers, and $n = 11$ users of other applications (information platforms: $n = 3$; shopping sites: $n = 1$; streaming: $n = 4$; and other forms: $n = 3$).

The healthy control group ($n = 79$) included $n = 35$ participants who regularly used social network sites, $n = 6$ participants who played online games sometimes, and $n = 38$ participants who used "other applications," such as information platforms ($n = 15$), shopping sites ($n = 2$), gambling sites ($n = 1$), streaming ($n = 15$), or other forms ($n = 5$). All participants were recruited either through the day clinic of the Department of Addictive Behaviour and Addiction Medicine at the Central Institute of Mental Health in Mannheim, by an online survey or through advertisements.

A $\chi^2$ test revealed significant gender-specific between-group differences within healthy controls and problematic Internet users regarding the main Internet applications that were used (Fisher's exact test in healthy controls: $p = .008$; in problematic users: $p = .035$; and in addicted users: $p = .069$). Females with healthy or problematic Internet use showed higher frequencies of social networking and males more often used other applications.

## Interviews and questionnaires

The existence and severity of participants' Internet addiction was measured using the AICA checklist (Wölfling et al., 2012) as well as the OSVe (Wölfling et al., 2010). The AICA is an established diagnostic clinical interview, which aims to assess the severity of participants' computer and/or Internet addiction. It does so by recording their computer or Internet use over the previous 30 days (AICA_30) as well as over their lifetime (AICA_lifetime). The AICA checklist has a high reliability as demonstrated by a Cronbachs $\alpha = .90$. Based on the Kaiser–Guttman criterion and inspection of the scree test, a principal component analysis revealed one single factor explaining 67.5% of variance that can be interpreted as "addicted Internet use" (Wölfling et al., 2012). The OSVe is a self-report questionnaire also used to screen adults for the existence and severity of Internet addiction. Participants with a score of ≥13 on the AICA_30 or of ≥13.5 on the OSVe were assigned to the addicted group. Given that the AICA_30 only identifies addictive computer and/or Internet use, we used the OSVe scores to define problematic use. Following the study of Wölfling et al. (2010), we classified participants with OSVe scores between 7 and 13 as problematic users. Accordingly, participants scoring <7 were assigned to the control group. The OSVe showed an internal consistency (Cronbach's α) of $\alpha = .89$ (Wölfling et al., 2012). A principal component analysis revealed one single factor explaining 43.9% of variance that can be interpreted as "addicted Internet use" (Müller, Glaesmer, Brähler, Wölfling, & Beutel, 2014).

Lifetime and current comorbidities on axes I and II were assessed on the basis of the Structured Clinical Interview for DSM-IV (SCID I and II; Wittchen, Zaudig, & Fydrich, 1997). Current depressive symptoms were assessed by the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). For the exploration of ADHD, a non-standardized interview (according to the DSM-IV criteria) and the Brown attention-deficit disorder (ADD)

Scale for adults (Brown, 1996) were applied by clinically experienced psychologists. According to DSM-IV (American Psychiatric Association, 2000), the ADHD interview assesses current cognitive deficits in school or job (as well as in school days prior to the age of 7 years), hyperactivity symptoms, birth-related complications, general mood swings, sleeping problems, substance misuse to relieve ADHD symptoms, and family history of ADHD. Two clinical psychologists performed the interviews and were previously trained by a clinical expert to focus on the specific symptoms. The 40-item Brown ADD Scale for adults helps to assess a wide range of actual symptoms reflecting executive function impairments associated with ADHD that occurred during the past 6 months, including (a) organizing, prioritizing, and activation for work; (b) focusing, sustaining, and shifting attention to tasks; (c) regulating alertness, sustaining effort, and processing speed; (d) managing frustration and modulating emotions, as well as (e) utilizing working memory and accessing recall (Murphy & Adler, 2004). Patients rated these symptoms on a 4-point Likert scale ("never," "once a week," "twice a week," and "daily"). Harrison reported that a high probability of having ADHD would be reflected by a cut-off >55, which was also applied to this study. A current ADHD diagnosis was given when a participant fulfilled the criteria of the interview and the cut-off of the Brown ADD Scale (Harrison, 2004). The Brown ADD Scale has an internal consistency (Cronbach's α) of α = .96 for adults (Brown, 1996). The lifetime ADHD criteria included a reported diagnosis of ADHD in the past was given by a medical expert. Participants scoring above the cut-off of 55 in the Brown ADD Scale but who did not fulfill the conditions for a current or lifetime ADHD diagnosis in the interview were classified under "recently developed ADHD symptoms."

To assess the aspects of self-concept, we applied the Rosenberg Scale (Rosenberg, 1965; investigating self-esteem), the Body Image Questionnaire (BIQ-20; Clement & Löwe, 1996) as well as the Emotional Competence Questionnaire (ECQ; Rindermann, 2009). The Rosenberg Scale is a 10-item questionnaire regarding positive and negative feelings about the self, measured on a 4-point Likert scale. The internal consistency of the items was reported to be Cronbach's α = .88 (Greenberger, Chen, Dmitrieva, & Farruggia, 2003).

The BIQ-20 that comprises 20 items identifies body image disturbances by measuring "rejection of the body image" and "vital body image." The internal consistencies for the scales range from 0.65 to 0.91 in German samples. The cross-validation of the scales' factorial structure revealed a high stability across one clinical and two non-clinical sample populations (Clement & Löwe, 1996). The ECQ assesses participant's abilities in (a) recognizing and understanding one's own emotions; (b) recognizing and understanding the emotions of others (being able to perceive and understand others' emotions based on their behavior, spoken communication, facial expression, and gestures depending on the situation); (c) regulating and controlling one's own emotions; and (d) emotional expressiveness (being able and willing to express one's feelings). Internal consistencies of the scales ranged between α = 0.89 and 0.93 (Rindermann, 2009).

Social anxiety and social competence were measured using the questionnaire for Social Anxiety and Social Competence Deficits (SASKO; Kolbeck & Maß, 2009). It aims to assess the fear of speaking in front of others or of being in the center of social attention (subscale "speaking"), of being socially rejected ("rejection") and of social interaction ("interaction"), as well as deficits in social perception ("information") and feelings of loneliness ("loneliness"). The internal consistencies of the subscales ranged between α = .76 and .87 for healthy samples and between α = .80 and .89 for clinical samples (Kolbeck & Maß, 2009). Besides, factorial validity was confirmed by a confirmatory factor analysis (Kolbeck & Maß, 2009). Additionally, the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) was applied to explore participants' perception of stress. The internal consistency (Cronbach's α) of the PSS is α = .78 (Cohen et al., 1983).

## Statistical analyses

Data analyses were carried out using SPSS Statistics 23 (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA). Differences in prevalence rates between addicted and problematic Internet users as well as healthy controls were assessed by $\chi^2$ tests and Fisher's exact tests where appropriate. Furthermore, analyses of differences in self-concept-related characteristics between addicted Internet users, problematic Internet users, and healthy controls included analyses of variance (ANOVAs), followed by post hoc analyses using Scheffé's tests. Linear regression analyses were applied to assess the association between the variables and current or lifetime symptom severity of Internet use.

Concordance between the two ADHD tests (the interview and the Brown ADD Scale) was assessed by cross tabulation and Cohen's kappa statistic. We also applied $\chi^2$ tests to assess between-group differences in the prevalence rates of positive test results within the categories (yes/no) of "recently developed ADHD symptoms" as well as current and lifetime ADHD diagnosis. In addition, to assess whether participants with an ADHD diagnosis or more recently developed ADHD symptoms display a higher current or lifetime symptom severity of Internet use compared with those without fulfilling the conditions for ADHD, we applied two-sample *t*-tests to the total sample as well as to healthy controls, addicted, and problematic Internet users.

## Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The study was approved by the ethics committee of Mannheim, Baden Württemberg (application number: 2013-528N-MA). Before taking part in the study, all participants were informed of the purpose of the study, and consented after having received this information.

# RESULTS

## Lifetime and current comorbidities

The data revealed that 62.4% (45.2%) of the addicted group, 31.4% (20.0%) of the problematic group, and 22.8% (13.9%)
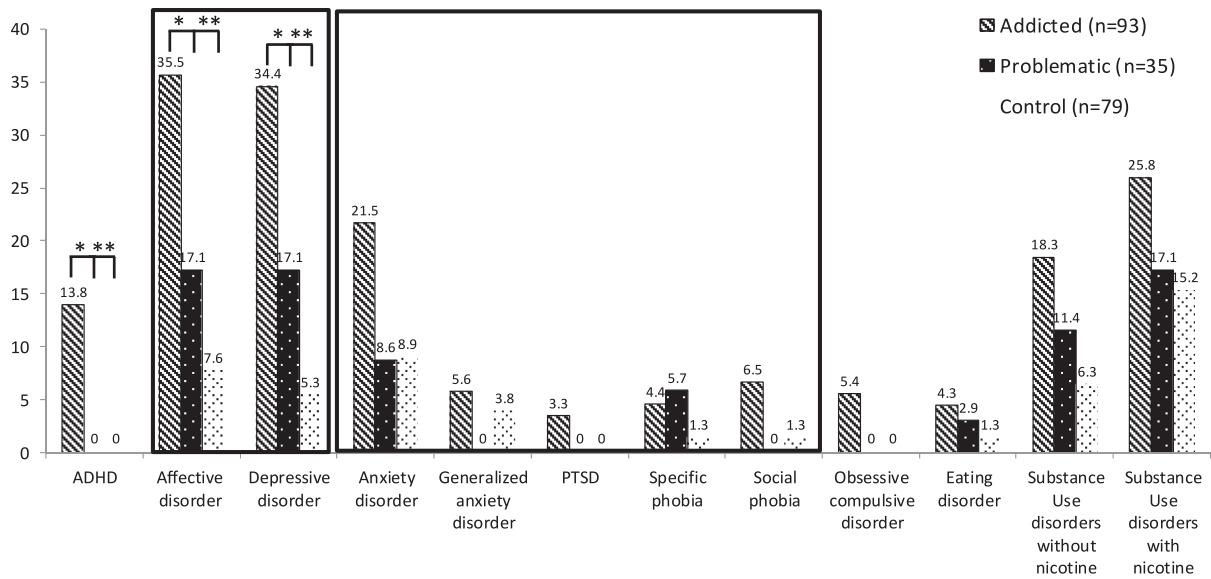
*Figure 1.* Proportion of lifetime diagnoses and differences between addicted and problematic Internet users as well as healthy controls (diagnosis %, $\chi^2$ and Fisher's exact tests; *$p \leq .05$, **$p \leq .01$). Affective and anxiety disorders were also differentiated within their classifications

of healthy controls showed a lifetime axis I or axis II diagnosis. According to our expectations, addicted Internet users showed depressive and anxiety disorders as well as ADHD significantly more often compared with healthy controls (see Figures 1 and 2 as well as Tables 2 and 3). Higher prevalence rates of lifetime and current ADHD and depressive disorders were observed in the addicted group compared with problematic users. Furthermore, Internet addicts and problematic users displayed cluster B personality disorders significantly more often than healthy controls, but these between-group differences were not mirrored within each separate cluster B personality disorder (Figure 3).

*Conformity of the two ADHD instruments*

Assessing the conformity between the two applied instruments (i.e., Brown ADD Scale and the interview), the

findings revealed a match of 63.21% in the addicted group (Kappa = 0.21, $p = .012$) and of 82.1% in the total sample (Kappa = 0.28; $p < .001$).

Figure 4 demonstrates the percentage of participants' positive results for ADHD in the two applied instruments (interview and Brown ADD Scale) as well as in the derived categories of recently developed ADHD symptoms, current and lifetime ADHD diagnosis.

A $\chi^2$ test revealed significant between-group differences between healthy controls, addicted, and problematic Internet users in the ADHD interview (Fisher's exact test: $p < .001$). Pairwise comparisons showed that addicted users fulfilled ADHD criteria in the interview significantly more often than healthy controls (Fisher's exact test: $p < .001$) but not compared with problematic users (Fisher's exact test: $p = .232$). Significant between-group differences were also observed in the Brown ADD Scale (Fisher's exact test:
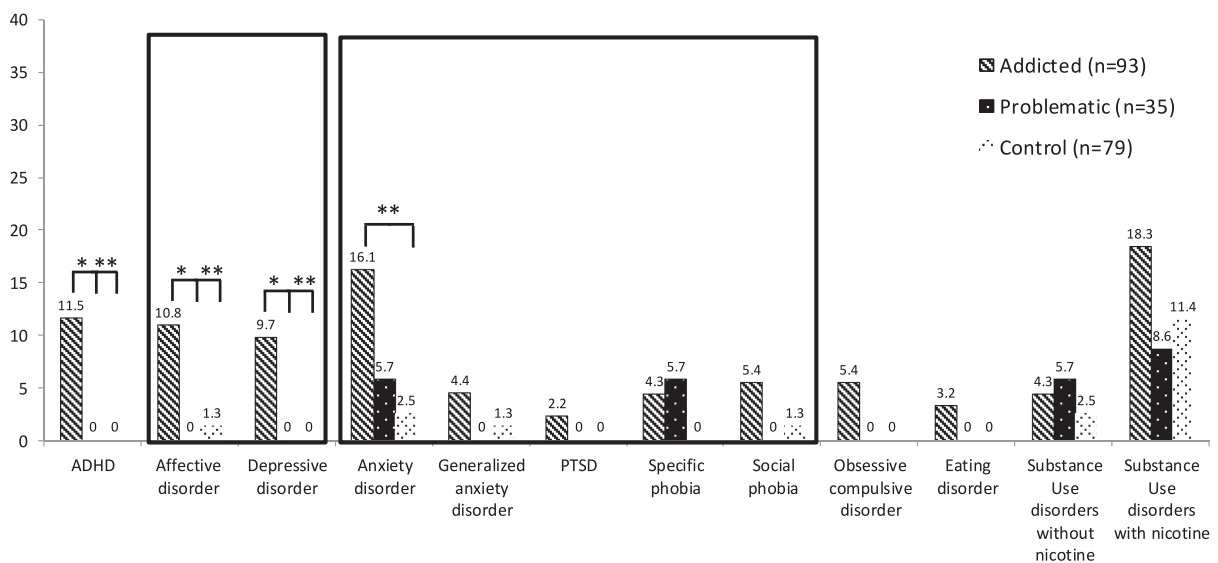


*Figure 2.* Proportion of current diagnoses and differences between addicted and problematic Internet users as well as healthy controls (diagnosis %, $\chi^2$ and Fisher's exact tests; *$p \leq .05$, **$p \leq .01$). Affective and anxiety disorders were also differentiated within their classifications

*Table 2.* Differences in prevalence rates of diagnoses between addicted and problematic users as well as healthy controls

| | Total (N = 207) | Addicted (n = 93) | Problematic (n = 35) | Healthy controls (n = 79) | p |
|---|---|---|---|---|---|
| ADHD (LT) | 5.1 | 13.8 | 0 | 0 | <.001[f]** |
| ADHD (C) | 6.1 | 11.5 | 0 | 0 | <.001[f]** |
| Affective disorder(LT) | 21.7 | 35.5 | 17.1 | 7.6 | <.001[c]** |
| Affective disorder (C) | 5.3 | 10.8 | 0 | 1.3 | .008[f]* |
| Depressive disorder (LT) | 20.8 | 34.4 | 17.1 | 5.3 | <.001[c]** |
| Depressive disorder (C) | 4.3 | 9.7 | 0 | 0 | .003[f]* |
| Anxiety disorder (LT) | 14.5 | 21.5 | 8.6 | 8.9 | .035[c] |
| Anxiety disorder (C) | 9.2 | 16.1 | 5.7 | 2.5 | .005[f]* |
| Generalized anxiety disorder (LT) | 3.9 | 5.6 | 0 | 3.8 | .452 |
| Generalized anxiety disorder (C) | 2.5 | 4.4 | 0 | 1.3 | .655 |
| PTSD (LT) | 1.5 | 3.3 | 0 | 0 | .073 |
| PTSD (C) | 1.0 | 2.2 | 0 | 0 | .032 |
| Specific phobia (LT) | 3.4 | 4.4 | 5.7 | 1.3 | .559 |
| Specific phobia (C) | 3.0 | 4.4 | 5.7 | 0 | .050 |
| Social phobia (LT) | 3.4 | 6.5 | 0 | 1.3 | .105[f] |
| Social phobia (C) | 2.9 | 5.4 | 0 | 1.3 | .185[f] |
| Obsessive–compulsive disorder (LT) | 2.4 | 5.4 | 0 | 0 | .075[f] |
| Obsessive–compulsive disorder (C) | 2.4 | 5.4 | 0 | 0 | .075[f] |
| Eating disorder (LT) | 2.9 | 4.3 | 2.9 | 1.3 | .556[f] |
| Eating disorder (C) | 1.4 | 3.2 | 0 | 0 | .292[f] |
| Substance use disorders without nicotine (LT) | 12.6 | 18.3 | 11.4 | 6.3 | .060[f] |
| Substance use disorders without nicotine (C) | 3.9 | 4.3 | 5.7 | 2.5 | .635[f] |
| Substance use disorders with nicotine (LT) | 20.3 | 25.8 | 17.1 | 15.2 | .198[c] |
| Substance use disorders with nicotine (C) | 14.0 | 18.3 | 8.6 | 11.4 | .306[f] |
| Cluster A | 1.9 | 3.2 | 0 | 1.3 | .663[f] |
| Cluster B | 4.8 | 7.5 | 8.6 | 0 | .013[f]* |
| Cluster C | 7.2 | 9.7 | 5.1 | 5.7 | .525[f] |

*Note.* Rates in %. f: Fisher's exact test; c: $\chi^2$ test; LT: lifetime; C: current corrected by Bonferroni–Holm for multiple comparisons of lifetime and current diagnoses as well as personality disorders. ADHD: attention-deficit hyperactivity disorder; PTSD: post-traumatic stress disorder. *$p \leq .05$ and **$p \leq .01$ after correction by Bonferroni–Holm for multiple comparisons.

*Table 3.* Post hoc comparisons of differences in prevalence rates of diagnoses between addicted and problematic users as well as healthy controls

| | Healthy controls versus addicted users p | Healthy controls versus problematic users p | Addicted versus problematic users p |
|---|---|---|---|
| ADHD (LT) | <.001[f]** | – | .014[f]* |
| ADHD (C) | .001[f]** | – | .029[f]* |
| Affective disorder (LT) | <.001[c]** | .117[f] | .033[c]* |
| Affective disorder (C) | .010[c] | .693[f] | .036[f]* |
| Depressive disorder (LT) | <.001[c]** | .076[f] | .043[c]* |
| Depressive disorder (C) | .003[f]** | – | .050[f]* |
| Anxiety disorder (C) | .002[c]** | .360[f] | .100[f] |
| Cluster B | .012[f]* | .027[f]* | .549[f] |

*Note.* f: Fisher's exact test; c: $\chi^2$ test; LT: lifetime; C: current; ADHD: attention-deficit hyperactivity disorder.

$p < .001$). Pairwise comparisons revealed significantly higher frequencies of ADHD in addicted users using the Brown ADD Scale compared with healthy controls ($p < .001$) and problematic users (Fisher's exact test: $p < .001$). Furthermore, between-group comparisons of the variable "recently developed ADHD symptoms" (yes/no) were significant (Fisher's exact test: $p < .001$): addicted Internet users recently revealed developed symptoms significantly more often than healthy controls (Fisher's exact test: $p < .001$) and problematic users (Fisher's exact test; $p < .001$).

We additionally observed that the addicted group showed a significantly higher frequency of ADHD in the Brown ADD Scale compared to the interview (Fisher's exact test: $p = .016$).

To assess differences in current and lifetime Internet use severity (AICA-30 and AICA lifetime) between groups with and without ADHD (derived from each criteria in Figure 4), we applied two-sample *t*-tests to the total sample. In each condition, we observed that participants with positive ADHD scored significantly higher on lifetime and current Internet use severity compared with those with negative test results (Table 4).
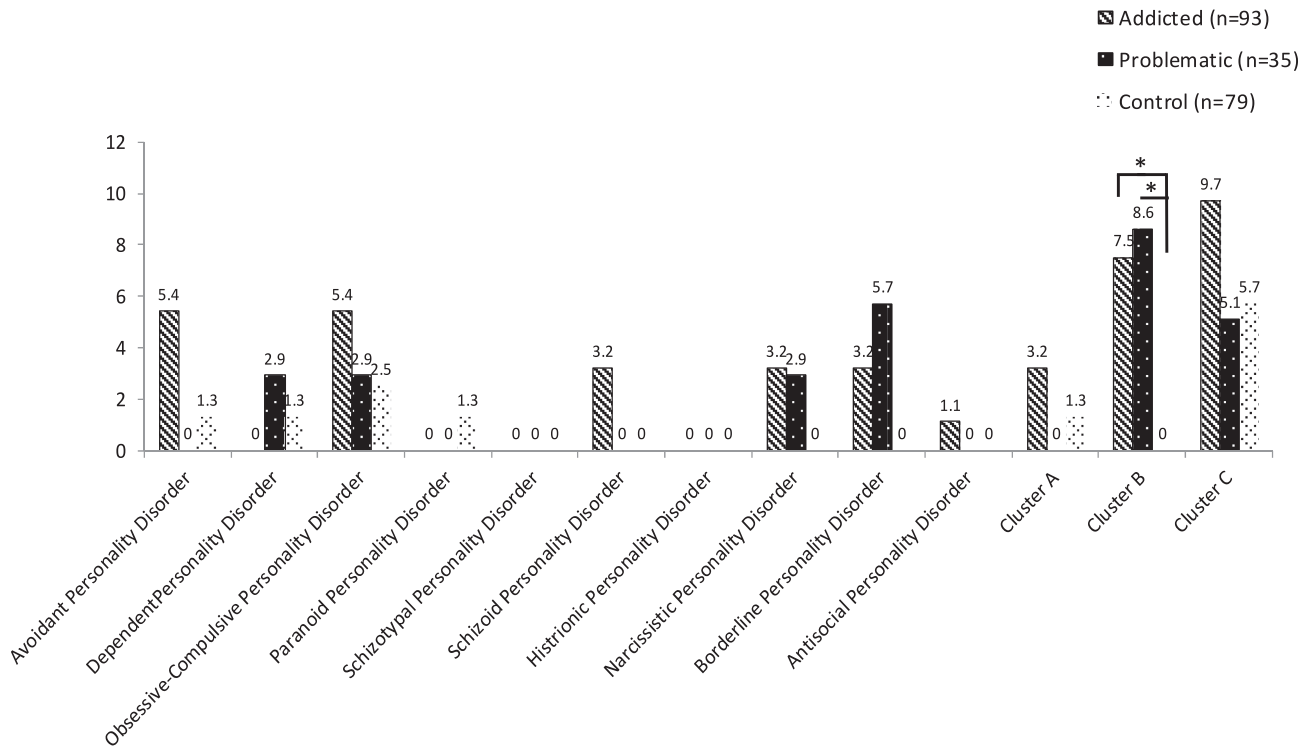
*Figure 3.* Proportion of personality disorders according to DSM-IV and differences between addicted and problematic Internet users as well as healthy controls (diagnosis %, $\chi^2$- and Fisher's Exact tests; *$p \leq .05$, **$p \leq .01$)
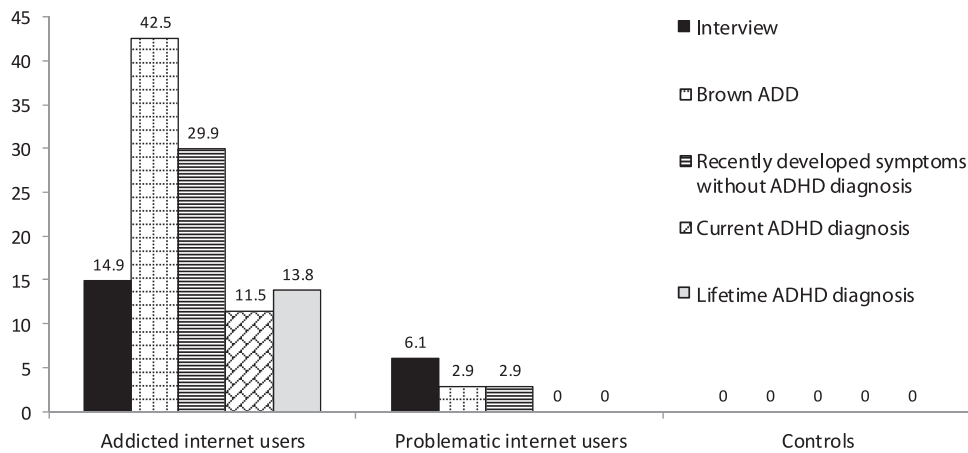


*Figure 4.* Percentages of ADHD for the two different measures: Interview and Brown ADD. Recently developed ADHD symptoms without diagnosis, lifetime, and current diagnosis derived from the overlap of both instruments

Two-sample *t*-tests within each group (addicted and problematic users as well as healthy controls) only revealed addicted participants with recently developed symptoms ($n = 27$) to show a higher lifetime Internet use severity ($t = -2.549$, $p = .013$) compared with those without any symptoms ($n = 46$).

### Self-concept-related characteristics between addicted and problematic Internet users as well as healthy controls

Tables 5 and 6 demonstrate differences between controls, problematic, and addicted Internet users in self-concept-related characteristics. The ANOVAs revealed significant main effects on all scales (Table 5).

Addicted Internet users compared with healthy controls showed a significantly worse body image, higher social anxiety (SASKO), decreased social competence (all scales of the SASKO), increased perceived stress (PSS), as well as deficits in emotional competencies (ECQ). Furthermore, they had lower self-esteem (Rosenberg) and displayed increased perceived stress (PSS) as well as depressive symptoms (BDI; Table 6). Addicted users also showed significantly increased values regarding most self-concept-related characteristics (apart from recognizing one's own and others' emotions as well as being able to express one's own emotions to others) compared with problematic users.

We further observed Internet addicts and problematic users to differ significantly from healthy controls regarding

*Table 4.* Differences in current and lifetime Internet use severity (AICA) between participants scoring positive and negative for ADHD for different criteria in the whole sample

|  | Symptom severity of Internet use | Positive for ADHD Mean (SD) | Negative for ADHD Mean (SD) | t statistic | p |
|---|---|---|---|---|---|
| ADHD interview | Current | 12.20 (7.91) | 8.68 (6.53) | −1.970 | .050* |
|  | Lifetime | 23.00 (8.01) | 16.12 (8.31) | −3.088 | .002** |
| Brown ADD | Current | 15.13 (5.77) | 7.34 (5.95) | −7.425 | <.001** |
|  | Lifetime | 24.00 (5.35) | 14.80 (8.10) | −6.807 | <.001** |
| Recently developed ADHD symptoms | Current | 15.11 (5.29) | 6.00 (7.42) | −6.260 | <.001** |
|  | Lifetime | 24.33 (4.29) | 14.77 (8.05) | −6.025 | <.001** |
| Current ADHD | Current | 15.10 (7.85) | 8.59 (6.48) | −3.063 | .003** |
|  | Lifetime | 24.50 (7.58) | 16.24 (8.32) | −3.068 | .002** |
| Lifetime ADHD | Current | 14.83 (7.21) | 8.54 (6.49) | −3.236 | .001** |
|  | Lifetime | 24.50 (6.86) | 16.16 (8.32) | −3.397 | .001** |

*Note.* SD: standard deviation corrected by Bonferroni–Holm for multiple comparisons. ADHD: attention-deficit hyperactivity disorder; AICA: Assessment of Internet and Computer Game Addiction.
*$p \leq .05$. **$p \leq .01$.

*Table 5.* Between-group differences of addicted users, problematic users, and healthy controls

|  | Total (N = 207) | Addicted (n = 93) | Problematic (n = 35) | Healthy controls (n = 79) | F | p |
|---|---|---|---|---|---|---|
| PSS perceived stress | 16.35 (6.74) | 20.01 (6.21) | 15.06 (5.13) | 12.67 (5.72) | 34.437 | <.001** |
| BDI | 8.43 (7.63) | 12.96 (8.36) | 6.51 (4.89) | 4.06 (4.02) | 42.256 | <.001** |
| Rosenberg self-esteem | 21.80 (6.25) | 18.89 (6.74) | 22.66 (5.36) | 24.85 (4.14) | 24.285 | <.001** |
| SASKO speaking | 9.98 (7.19) | 13.90 (7.71) | 8.17 (5.38) | 6.22 (4.46) | 33.825 | <.001** |
| SASKO social rejection | 9.33 (6.43) | 12.76 (7.08) | 7.86 (3.67) | 5.99 (4.24) | 32.247 | <.001** |
| SASKO interaction | 6.98 (5.38) | 10.15 (5.67) | 5.51 (3.59) | 3.94 (3.28) | 41.819 | <.001** |
| SASKO information | 7.03 (4.26) | 8.97 (4.39) | 6.26 (3.45) | 5.11 (3.41) | 21.729 | <.001** |
| SASKO loneliness | 2.98 (3.26) | 4.49 (3.58) | 2.66 (2.72) | 1.37 (2.07) | 24.239 | <.001** |
| ECQ-EE | 55.17 (10.46) | 50.79 (10.29) | 54.40 (10.83) | 60.61 (7.75) | 22.827 | <.001** |
| ECQ-EO | 65.06 (10.96) | 62.99 (11.86) | 65.29 (11.12) | 67.37 (9.35) | 3.481 | .034* |
| ECQ-RE | 47.47 (8.87) | 43.50 (9.05) | 49.51 (8.26) | 51.19 (6.87) | 20.293 | <.001** |
| ECQ-EX | 53.87 (13.71) | 49.61 (13.83) | 52.34 (17.79) | 59.52 (10.97) | 12.670 | <.001** |
| BIQ rejection of body image | 22.59 (8.45) | 26.41 (9.57) | 21.72 (6.47) | 18.53 (5.32) | 22.664 | <.001** |
| BIQ vital body image | 33.73 (6.97) | 31.27 (7.59) | 34.72 (5.31) | 36.17 (5.87) | 12.075 | <.001** |

*Note.* Mean (standard deviation), SASKO: Social Anxiety and Aocial Competence Deficits Questionnaire; ECQ: Emotional Competence Questionnaire; ECQ-EE: recognizing and understanding the own emotions; ECQ-EA: recognizing and understanding others' emotions; ECQ-RE: regulation and control of the own emotions; ECQ-EX: emotional expressiveness; BDI: Beck Depression Inventory; PSS: Perceived Stress Scale; BIQ: Body Image Questionnaire; F: ANOVA F statistic.
*$p \leq .05$ and **$p \leq .01$ after correction by Bonferroni–Holm for multiple comparisons.

the emotional competence scales "recognition of one's own emotions" (ECQ-EE) and "emotional expressiveness" (ECQ-EX; Table 6). Linear regression analyses revealed that these two variables explained 11% ($R^2 = .111$; $p < .001$) of current Internet use severity (AICA_30) and 22% ($R^2 = .217$; $p < .001$) of lifetime Internet use severity (AICA lifetime).

## DISCUSSION

The general aim of this study was to examine differences in comorbidities and self-concept-related characteristics between healthy controls, addicted and problematic Internet users to clarify the role of problematic use in the transition from healthy to addicted Internet use.

*Comorbidities in addicted and problematic Internet users as well as in healthy controls*

The results indicated that Internet addicts have higher comorbidity rates of ADHD, depressive and current anxiety disorders as well as cluster B personality disorders compared with healthy controls. Furthermore, higher comorbidity rates of ADHD and depressive disorders were also observed in the addicted group compared with the problematic users. These results are in accordance with the previous explanatory models of Internet addiction that assume a strong underlying psychopathology in addicted Internet use (Brand et al., 2016; Davis, 2001). In their I-PACE model, Brand et al. (2016) particularly refer to depression and (social) anxiety disorders as well as ADHD as the three main psychopathological features related to Internet addiction. All of these mental disorders are strongly associated

*Table 6.* Post hoc pairwise comparisons (Scheffé) between addicted users, problematic users, and healthy controls

| | Healthy controls versus addicted users | | Healthy controls versus problematic users | | Addicted versus problematic users | |
|---|---|---|---|---|---|---|
| | Differences of means | *p* | Differences of means | *p* | Differences of means | *p* |
| PSS | −7.37 | <.001 | −2.39 | .137 | 4.99 | <.001 |
| BDI | −8.89 | <.001 | −2.45 | .175 | 6.44 | <.001 |
| Rosenberg self-esteem | 5.96 | <.001 | 2.19 | .163 | −3.77 | .004 |
| SASKO speaking | −7.80 | <.001 | −1.96 | .305 | 5.84 | <.001 |
| SASKO social rejection | −6.84 | <.001 | −1.87 | .264 | 4.97 | <.001 |
| SASKO interaction | −6.28 | <.001 | −1.58 | .234 | 4.71 | <.001 |
| SASKO information | −3.90 | <.001 | −1.14 | .352 | −2.75 | .002 |
| SASKO loneliness | −3.17 | <.001 | −1.29 | .098 | 1.88 | .006 |
| ECQ-EE | 9.89 | <.001 | 6.21 | .006 | −3.69 | .152 |
| ECQ-EO | 4.37 | .035 | 2.08 | .641 | −2.29 | .572 |
| ECQ-RE | 7.85 | <.001 | 1.68 | .599 | −6.17 | .001 |
| ECQ-EX | 9.95 | <.001 | 7.18 | .027 | −2.77 | .565 |
| BIQ rejection of body image | −7.99 | <.001 | −3.18 | .127 | 4.80 | .008 |
| BIQ vital body image | 4.99 | <.001 | 1.45 | .558 | −3.54 | .028 |

*Note.* SASKO: Social Anxiety and Social Competence Deficits Questionnaire; ECQ: Emotional Competence Questionnaire; ECQ-EE: recognizing and understanding the own emotions; ECQ-EA: recognizing and understanding others' emotions; ECQ-RE: regulation and control of the own emotions; ECQ-EX: emotional expressiveness; BDI: Beck Depression Inventory; PSS: Perceived Stress Scale; BIQ: Body Image Questionnaire.

with intense negative emotions, such as anxiety, depressiveness, and rage. This aspect is also considered in the description of Internet gaming disorders in DSM-5 where Internet gaming is used to find relief from a negative mood state.

In the stage of problematic use, only the occurrence of cluster B personality disorders was significantly higher compared with the healthy control group and did not differ from the addicted use. The literature describes cluster B personality disorders to be associated with a more dramatic, emotional, erratic, and impulsive behavior (American Psychiatric Association, 2013) often accompanied by episodes of depression. They were also linked to a reduced likelihood of chronic depression remission (Agosti, 2014). These findings indicate that cluster B personality disorders might be a correlate of problematic and addicted Internet use. Zadra et al. (2016) observed an increased prevalence of cluster B Borderline personality disorder in Internet addicts. We did not find between-group differences within a specific cluster B personality disorder possibly due the low number of cases ($n_{borderline} = 5$; $n_{narcissistic} = 4$; $n_{histrionic} = 0$; $n_{antisocial} = 1$ in the whole sample). It would be interesting to compare prevalence rates of specific personality disorders in addicted and problematic users using larger sample sizes in further studies. Further replication studies are also necessary to confirm our findings.

### ADHD comorbidity and ADHD-like symptoms in Internet addicts

Regarding ADHD diagnoses in this study, the current and lifetime prevalence in the group of Internet addicts (13.8% and 11.5%) was significantly higher compared with problematic Internet users and healthy controls. A meta-analysis estimated the general prevalence of ADHD at about 2.5% (Simon, Czobor, Bálint, Mészáros, & Bitter, 2009). Most of the studies on ADHD and Internet addiction were conducted on adolescents and not on young adults (Seyrek et al., 2017; Tateno et al., 2016). There is only one study reporting an ADHD prevalence of 5.5% in adult "problematic" Internet users (Kim et al., 2016). However, the sample also included addicted users and therefore the findings might be not comparable with those of this study.

To our knowledge, this was the first study to attempt at including the assessment of the impact of recently developed ADHD symptoms in addition to the ADHD diagnosis in Internet addicts. Participants with ADHD as well as those with only recently developed ADHD-like symptoms showed significantly higher lifetime and current Internet use severity compared with those who did not fulfill these conditions. Furthermore, addicted participants with recently developed ADHD symptoms (30% of the addicted group) exhibited increased lifetime Internet use severity compared with those addicted participants without ADHD symptoms. Our results indicate that recently developed ADHD symptoms (without fulfilling the diagnostic criteria for ADHD) are associated with Internet addiction. This may lead to a first indication that the excessive Internet use has an impact on the development of cognitive deficits similar to those found in ADHD. A recent study of Nie, Zhang, Chen, and Li (2016) reported that adolescent Internet addicts with and without ADHD as well as participants with ADHD alone showed comparable deficits in inhibitory control and working memory functions.

This assumption seems to also be supported by certain studies reporting reduced gray matter density in the anterior cingulate cortex in addictive Internet users as well as in ADHD patients (Frodl & Skokauskas, 2012; Moreno-Alcazar et al., 2016; Wang et al., 2015; Yuan et al., 2011). Nevertheless, to confirm our assumptions, further studies assessing the relationship between the onset of excessive Internet use and ADHD in Internet addicts are needed.

In addition, longitudinal studies should be applied to clarify causality. If our findings are confirmed by further studies, this will have clinical relevance for the diagnostic process of ADHD. It is conceivable that the clinicians would be required to carry out a detailed assessment of possible addictive Internet usage in patients with suspected ADHD.

## Comparisons of self-concept-related characteristics between addictive, problematic, and healthy Internet use

Regarding between-group differences of self-concept-related characteristics, the results revealed addicted Internet users to show significant deficits on all scales of the "self-concept" compared with healthy controls. As mentioned above, developmental theories postulate adolescence to be the phase where the formation of a self-concept is the main developmental task. An individual has to explore and choose adequate and relevant roles, values, and goals from a variety of life domains, such as gender role, vocations, relational choices, etc. (Erikson, 1968; Marcia, 1966). If unsuccessful, this leads to a diffusion of identity as well as societal roles and increases the risk of mental disorders, such as personality, depressive, or addictive disorders. Without appropriate treatment, these disorders usually persist into adulthood (Erikson, 1968; Marcia, 1966). Due to its possibilities for social interaction and its concomitant anonymity, the Internet provides a tempting opportunity for the compensation of negative feelings and self-concept deficits. Accordingly, our findings of increased self-concept deficits in young adult Internet addicts suggest that maladaptive coping with certain developmental tasks during adolescence might contribute to the formation of Internet addiction. Repeated experience of compensating these deficits through Internet use, e.g., by finding virtual friends or being successful in a game (Brand et al., 2016; Davis, 2001; Tavolacci et al., 2013) might elevate the risk of addicted use. Additionally, the lack of real interpersonal and performance-related positive experiences might increase self-concept deficits and the development of psychiatric disorders. The latter aspect might explain the high observed occurrence of depression, anxiety, and cluster B personality disorders in addicted users.

Despite the significant differences between problematic and addicted Internet use regarding most of the assessed variables, all of the means calculated for the characteristics of the problematic group lay between those of addicted users and the healthy control group, indicating a link between the two stages of excessive Internet use in a descriptive way.

However, we also observed similarities between problematic and addicted users. Both groups rated themselves as less able to recognize, understand, and express own emotions compared with healthy controls. In their model of emotional intelligence, Mayer and Salovey postulated the perception, use, understanding, and management of emotions, which mostly occur in the context of relationships, to be the main interrelated abilities for emotional intelligence (Mayer & Salovey, 1993; Mayer, Salovey, Caruso, & Sitarenios, 2001). Our results of these deficits in problematic and addictive Internet users might indicate that lower degrees of these abilities might specifically depict

premorbid factors in the transition from problematic to addictive Internet use. Regression analyses revealed that these variables explained 11% and 22% of the variance of current as well as lifetime Internet use severity, respectively, in the total sample.

### Limitations of the study

The limitations of this study include the following aspects.

The sample sizes of the subgroups were relatively small. This should be considered when interpreting our results and makes future studies necessary.

Another limitation refers to the diagnostic procedure for ADHD. Besides the Brown ADD Scale, we used a non-standardized interview including open questions for the investigation of ADHD. It cannot be fully ensured that the same interview with the same participant and a different interviewer would generate similar results (Kromrey, 2002). On the other hand, the combination of interviews by qualified clinical psychologists with the additional application of the Brown ADD Scale in the diagnostic process might have ensured a higher validity of the diagnoses. Nevertheless, these investigations should be replicated and additionally include external assessments (e.g., family interviews) as well as neuropsychological testing in the diagnostic process.

A further limitation is that we did not analyze gender-specific differences, because it would have exceeded the scope of the manuscript. We only assessed gender differences in the subsamples. The $\chi^2$ analyses within each group revealed that females with healthy and problematic Internet use showed social networking more often and males more often used other applications. In accordance with the literature (Dany, Moreau, Guillet, & Franchina, 2016), the analyses of the main sample revealed higher frequencies of gaming in males and a higher usage of social networking sites in females. However, these results have to be interpreted with caution due to very small subsample sizes. Further studies are needed to investigate gender-specific differences in the characteristics examined in this study.

## CONCLUSIONS

Taken together, our results suggest that cluster B personality disorders and deficits in understanding and expressing one's own emotions might be specific influential factors in the transition from problematic to addictive use. We also found that addicted users, compared with problematic users and healthy controls, showed significantly higher frequencies of ADHD, depressive and current anxiety disorders as well as greater self-concept-related deficits. Thus, our results might indicate that cluster B personality disorders and deficits in emotional intelligence, relating to interpersonal and performance-related problems, influence the transition from problematic to addicted Internet use. Experiencing the Internet as initially ensuring a fast compensation for these problems elevates the risk for addicted use. Simultaneously, the lack of interpersonal and performance-related positive experiences in real life increases and leads to escapism into the

virtual world. These results suggest that interventions targeting Internet addiction should increase their focus on the learning of mindfulness-based techniques and social competencies to recognize and cope with negative emotions and interpersonal conflicts.

Our data also reveal a high prevalence of ADHD in the addicted but not in problematic users which might indicate that ADHD is associated with an accelerated transition to addictive Internet use.

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