

# Attention Deficit/Hyperactivity Disorder is a Better Predictor for Problematic Internet use than Depression: Evidence from Germany

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## Abstract

**Objective:** This study aims to address possible associations between excessive use of the Internet and Attention Deficit/Hyperactivity Disorder (ADHD) and depression. As most of the studies on this topic were conducted in Asia, the aim of this investigation is to review the literature on this subject from Germany and examine problematic Internet use for potential associations with the propensity for depression and ADHD in a new, distinct German sample.

**Methods:** A review of the literature was conducted. Subsequently, a total of N=895 healthy participants from Germany (413 males, 482 females) took part in a new study. Participants filled in questionnaires on their Internet usage, propensity for depression and ADHD.

**Results:** The review of the literature revealed predominantly positive associations between problematic Internet use and depression, whereas only one study on the relationship between problematic Internet use and ADHD from Germany was found. The results from the current study showed that male participants had significantly higher scores on the Internet Addiction Test (IA-T) than female participants. Finally, the IA-T scores of the participants were linked to both the propensity for depression ( $r=.247, p<.01$ ) and ADHD ( $r=.335, p<.01$ ). This association was stronger for ADHD and in particular for the subscale "attention deficit", as revealed by a post-hoc analysis.

**Conclusion:** The results of this study are consistent with most of the research on this topic in other cultural circles and highlight the role of ADHD and depression when it comes to problematic Internet use. This study provides a basis for consideration about the clinical implications and treatment of comorbid problematic Internet use.

**Keywords:** Problematic internet use; ADHD; Depression; Germany

## Introduction

During the last decades, the Internet experienced a vast technological development, which still continues to evolve. It enables the contact to other people all over the world. More practical features, such as maps and constant e-mail access, serve for different aspects of personal and professional use. But while the Internet is getting more important for our work and leisure time, also potential psychological and other health risks rise due to an excessive use. Prevalence of problematic Internet use (PIU) varies strongly because of disagreement regarding diagnostic criteria, the size of the examined samples and country to name but a few reasons. For PIU they fluctuate between 0.7 % and 35.0 % [1].

With the inclusion of the category 'Addictive disorders' next to substance use disorders in DSM-5, behavioral addictions become a major focus of research interest. So far, only Gambling Disorder is listed as an addictive disorder in DSM-5 and Internet Gaming Disorder (IGD) is included in section III of the manual [2], which means that further research is needed before it is considered as a formal disorder. Of note, IGD represents a specific form of PIU. However, the overlap between IGD and generalized PIU is rather small [3]. Essential for the present study is that generalized PIU represents the focus, reflecting problematic use of the Internet in broad terms such as spending much time online and procrastinating everyday jobs.

Plenty of scientific literature exists on PIU, its causes and possible negative effects on one's life. PIU has been associated with low self-esteem [4] and low self-directedness [5-7]. It has also been linked to different psychological disorders such as substance use disorder, ADHD, depression and social anxiety disorder [8-10]. Special attention has been given to ADHD and depression, which show the highest comorbidity rates with PIU (e.g. 83.3 % with ADHD, 30 % with depression [9,11]). These two psychological disorders have been described as risk factors

for the development of PIU [12,13]. Furthermore, it has been shown that specific treatment of ADHD in children reduces their PIU scores [14]. In addition, Gamez-Guadix [15] showed in a longitudinal study over the course of one year from Spain that the depressive symptomatic at point 1 predicted an increase in PIU (here the preference for online relationships) at point 2. However, most of the studies in this field of research have been conducted in Asia [9-11,16,17]. As PIU seems to be culture-specific, based on different prevalences in different countries, the examination of comorbidities of PIU in different cultural circles plays an important role for clinical diagnosis and treatment. Moreover, there is an urgent need to assess the strength of the association between PIU and different psychiatric comorbidities in order to draw conclusions about its treatment.

ADHD is a psychopathological disorder with the core symptoms of inattention, impulsivity and hyperactivity. Patients lack self-control, are easily distracted and bored and are constantly in motion [18]. Until recently, ADHD used to be characterized as a disorder typical for the childhood. However, a substantial body of research showed that ADHD symptoms are still observed in adults, leading to some changes in

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DSM-5 in order to help diagnose ADHD in adults [2]. Studies show that ADHD patients respond better to immediate rewards with low long term value and find it hard to postpone a reward [19]. By using the Internet and its features one can easily switch between various activities. Therefore, the Internet keeps ADHD patients interested and delivers immediate rewards (winning a game, commenting pictures on Facebook etc.). Thus, further examination on the relationship between the propensity for ADHD and PIU is of great interest.

Depressive conditions can generally be divided into two types: Major depressive disorder (recurrent depressive episodes) or one depressive episode [20]. Some of the key symptoms of depression are feelings of sadness, anxiety, helplessness and fatigue [20]. As depression may result in a loss of interest in different areas of life, like hobbies and socializing, it might increase the risk for Behavioral/Substance addictions [21] in patients as a way to escape from their problems and negative affect.

The purpose of this study is to 1) provide a review on the already existing literature on PIU, ADHD and depression from Germany and 2) further examine the strength of the association between PIU and the propensity for ADHD, depression in a new German sample. Based on the existing literature [10,22], we expect positive correlations between PIU and ADHD, depression. Finally, we are able to take a look if ADHD or depression represents a better predictor for PIU.

A literature search using the key words “Internet addiction”, “problematic Internet use”, “depression”, “ADHD” and “Germany”

in pubmed.com on 10<sup>th</sup> December, 2014 revealed eight studies investigating the link between PIU and depression, ADHD on samples from Germany. To sum up, seven of these studies showed a positive association between PIU and depression and only one study did not report a difference between the group of problematic Internet users and control persons on depression [23]. However, in this last study PIU was measured, using single items for different aspects of problematic use and not through a more psychometrically sound questionnaire. Moreover, the authors did not theoretically explain the choice of a cut off value for the classification as a problematic vs. normal Internet user. Thus, these methodological differences may have had an impact on the results of the study. Compared to the studies mentioned above, literature on the relationship between ADHD and PIU from Germany is scarce. Only one study on this topic was found, showing a positive association between lifetime ADHD and PIU [24]\*. The results of the reviewed studies are presented in detail in Table 1.

In the following part of this article, the design and results of our own study from Germany are presented.

## Subjects and Methods

### Participants

A total of N=895 participants from Germany took part in the study (413 males, 482 females). The mean age of the participants was M=25.69 (SD=7.55) years. They were mostly recruited at university campuses

\*As an exception, this study was not found on pubmed.com

Authors	Participants	Inventory	Results
Peukert et al. [24]	N=2506 German students (n=970 males), age M=23.9, SD=3.85 were divided into two subgroups: CIUS <sub>risk</sub> group (CIUS>28) n=90 vs. control group n=90	CIUS, daily average Internet use duration, German Depression Scale, European Addiction Severity Index, Quality of life	The CIUS <sub>risk</sub> group (high CIUS-values) showed increased depressive and manic affect profiles and lower quality of life. Concerning lifetime psychopathology the CIUS <sub>risk</sub> group reported more depressive episodes, anxiety disorders, ADHD and suicidal ideation.
Barke et al. [25]	1. sample (online) N=1041; 2. sample (paper pencil, students) N=841; 3. sample (retest sample, students) N=105	GPIUS2, IA-T, UCLA-Loneliness Scale, State-Trait-Depression Scale, Brief Fear of Negative Evaluations Scale	The GPIUS2 scores correlated strongly with depression (r=.54). Depression along with loneliness and social anxiety explained 46% of the variance in GPIUS2 scores.
Müller et al. [26]	N=290 German treatment seekers (due to suspected PIU) in an outpatient clinic specialized for behavioral addictions at the age between 18 and 64 years	AICA-S; diagnostic interviews to assess symptoms of Internet addiction; SCL-90-R; PHQ	71% of the sample was classified as being Internet addicted. Half of the patients with Internet addiction met criteria for one further psychiatric disorder according to clinical interviews, especially depressive disorders.
Wölfling et al. [27]	Two groups: 1. N=71 male patients meeting criteria for comorbid Internet addiction vs. 2. control group of N=58 male patients treated for alcohol addiction without addictive Internet use at the age between 16 and 65 years	AICA-S, SCL-90-R, PHQ, the seven-item Generalized Anxiety Disorder, subjective perceived impairment of the general health condition (3 items)	Comorbid Internet addiction was associated among others with higher levels of depression. Moreover, the patients with IA more frequently met criteria for additional mental disorders, especially depression.
Müller et al. [28]	N=71 patients (64% boys) between the age of 8 and 17 in psychiatric inpatient settings	AICA-S, Youth Self-Report and Child Behavior Checklist	11.3 % of the patients fulfilled the criteria of addictive Internet use. These patients were older and more often affected by anxiety and depression than patients without Internet addiction.
Fischer et al. [29]	N=1435 students (48% boys)	Young Diagnostic Questionnaire, BDI, Deliberate Self Harm Inventory, Paykel Suicide Scale	80.7% of the students reported regular, 14.5% risky, and 4.8 % pathological Internet use. The risky and the pathological Internet users showed significant higher rates of depression, deliberate self-harm and suicidal behavior compared to students with regular Internet use.
Beutel et al. [23]	Representative sample of N=1401 females, N=1111 males between the ages of 14 and 94 years; randomly selected subjects	Face-to-face interviews, Cambridge Depersonalization Scale, Hospital Anxiety and Depression Scale, Internet use was measured with single items	There was no difference between problematic and normal Internet users regarding anxiety or depression.
teWildt et al. [30]	N=18 Internet-dependent patients with depressive mood disorder vs. matched control participants	Barrat Impulsiveness Scale, Internet addiction scale, BDI, SCL-90-R subscale for depression, Sense of Coherence Scale, Dissociative Experience Scale, Inventory for interpersonal problems	Within the initial sample of N=23 Internet dependent patients, 18 (78.3%) were diagnosed with a depressive disorder. Patients with Internet dependency scored significantly higher in BIS, Depression (BDI) and SCL-90R subscale for depression than the control group.

Note. AICA-S: Scale for the Assessment of Internet and Computer Game Addiction; SCL-90-R: Symptom Checklist 90-R; PHQ: Patient Health Questionnaire; BDI: Beck Depression Inventory; GPIUS2: Generalized Pathological Internet Use Scale; IA-T: Internet addiction test; CIUS: Compulsive Internet Use Scale

**Table 1:** Overview on studies investigating the relationship between PIU and depression, ADHD.

and were not paid for their participation. Along with demographics (age, gender, education), participants filled in questionnaires on PIU, depression and ADHD. In the following a detailed description of all administered inventories is presented. The study was approved by the psychological ethic committee of the University of Bonn, Germany.

### Questionnaires

**Internet Addiction Test (IA-T):** The IA-T [31] is a measure of generalized PIU. It contains 20 items on a 5-point Likert scale on the impact of the Internet on productivity, sleep behavior and emotion, to name but a few. The Likert scale ranges from never (1) to always (5). In addition, participants were asked how many hours per week they spend on the Internet for private and for business purposes (Internet time (private/business)). Cronbach's Alpha in the present sample was  $\alpha=.89$ .

**Adult Self-Report Scale (ASRS):** ASRS [32] is a self-report screening scale on adult Attention Deficit / Hyperactivity Disorder. It includes 18 questions, which are based on the DSM-IV symptoms of adult ADHD. Participants answered the items on a 5-point Likert scale, ranging from 0 (never) to 4 (very often). The internal consistency of the questionnaire in this sample was  $\alpha=.80$ .

**Beck Depression Inventory (BDI):** BDI [33] is a self-report questionnaire on depression. It consists of 21 groups of four statements each on depressive symptoms. The four statements in each group range from 0 (symptom does not exist) to 3 (shows severe symptoms) and describe the severity of the particular symptom. Higher total scores indicate more severe depressive symptoms. The reliability of BDI in this sample was  $\alpha=.86$ .

### Statistical analyses

First, we calculated the descriptive statistics of the variables under investigation. Second, we tested if the metric variables were normally distributed. As this assumption was not met, we used a Blom rank-based transformation in order to normalize the data [34]. The data was also trimmed, in order to reduce the influence of extreme (but existent) values on the results of the analyses. T-tests were conducted in order to examine for gender differences. Correlation analyses were run between metric variables for the reason of testing the associations between the variables under investigation. And finally, a stepwise multiple regression analysis was conducted for the purpose of examining the predictors of PIU among depression and ADHD under the consideration of gender, age and the time spent on the Internet for private/business purposes.

### Results

Means and standard deviations of the variables under investigation are presented in Table 2.  $N=741$  (82.8 %) of all participants gained an IA-T score between 20 and 39, which represents the normal range.  $N=150$  (16.8 %) participants had an IA-T score between 40 and 69 (problematic tendencies towards the Internet) and only 4 (0.4 %) participants could be classified as problematic Internet users, having a score of or above 70. These cut-off scores have been suggested by Widyanto and McMurrin [35].

Next, we tested if the metric variables were normally distributed. For this purpose we used the guidelines provided by Miles and Shevlin [36]. As all of the variables deviated from the normal distribution, we normalized the data as described in Statistical Analyses.

In Table 2 the influence of gender on the IA-T score and the rest of the variables under investigation are tested for significance. Male participants had significantly higher scores on the IA-T compared to females ( $t_{(893)}=4.995, p<.01$ ). Furthermore, males and females did not differ in the time spent on the Internet for business purposes,

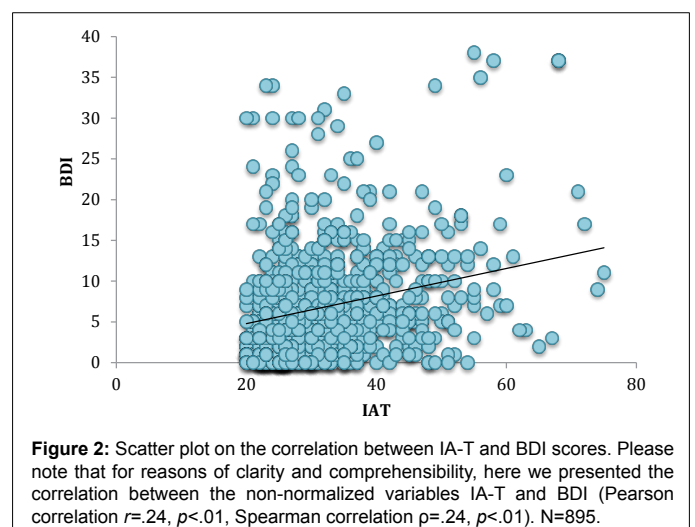
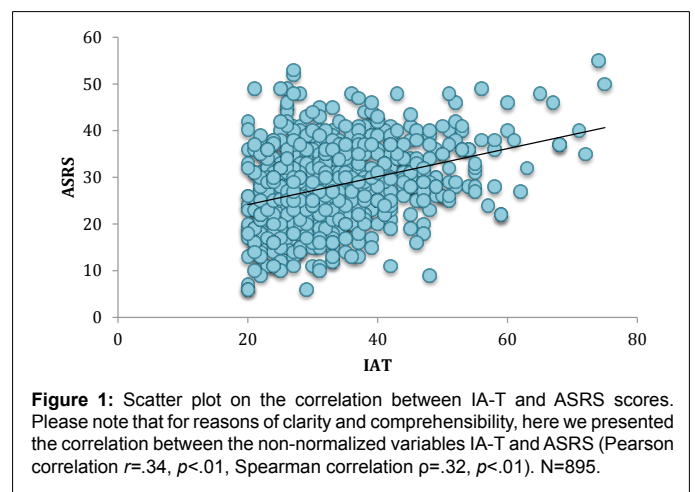
but for private purposes ( $t_{(893)}=7.349, p<.01$ ). Female participants had significantly higher scores on both the ASRS ( $t_{(893)}=-3.084, p<.01$ ) and BDI ( $t_{(893)}=-3.803, p<.01$ ).

The results of the correlational analyses showed that the IA-T scores were positively related to both: the ASRS and BDI scores (Figures 1 and 2;  $r=.335, p<.01$  and  $r=.247, p<.01$  respectively).

	Gender	Min.	Max.	M	SD
Age $T_{(893)}=7,369^{**}$	male	18	56	27.00	7.81
	female	17	57	24.57	7.14
IA-T $T_{(893)}=4,995^{**}$	male	20	74	33.83	10.14
	female	20	75	30.52	7.87
Internet time (business) $T_{(893)}=1,216$	male	0	70	8.29	10.17
	female	0	50	6.81	7.23
Internet time (private) $T_{(893)}=7,349^{**}$	male	0	90	12.44	11.43
	female	0	54	8.08	7.80
ASRS $T_{(893)}=-3,084^{**}$	male	6	55	26.89	8.20
	female	6	53	28.49	7.87
BDI $T_{(893)}=-3,803^{**}$	male	0	38	6.08	6.14
	female	0	37	7.45	6.41

Note: \*\* $p<.01$ , \* $p<.05$

**Table 2:** Means, Standard Deviations, Minimum and Maximum of the variables under investigation for males and females separately. T-tests of gender differences.





R <sup>2</sup> = .30	change in R <sup>2</sup>	Stand. Beta	t	Sign.
Internet time (private)	.153	.324	7.548	.000
ASRS	.120	.308	7.001	.000
BDI	.019	.154	3.495	.001
Internet time (business)	.007	.106	2.459	.014
Age	.009	-.098	-2.297	.022

Note. Dependent variable: IA-T score.  $F_{(5, 407)}=36.208, p<.01$

**Table 3:** PIU Regression Model for male participants.

R <sup>2</sup> = .38	change in R <sup>2</sup>	Stand. Beta	t	Sign.
Internet time (private)	.250	.445	12.196	.000
ASRS	.091	.261	6.735	.000
Age	.026	-.159	-4.372	.000
BDI	.014	.128	3.318	.001

Note. Dependent variable: IA-T score.  $F_{(4, 477)}=73.398, p<.01$

**Table 4:** PIU Regression Model for female participants.

With respect to the significant gender differences regarding IA-T, ASRS and BDI, we conducted two regression analyses for both genders. The objective of these analyses was to determine the predictors of PIU among ADHD, depression under the consideration of age and time spent on the Internet (business/private). The IA-T score was entered in both analyses as a dependent variable. The variables BDI, ASRS, age and Internet time (private/business) were entered as independent variables in one block of a stepwise regression analysis. We present in Tables 3 and 4 the results of the regression analyses. The model explaining most of the variance (38 %) in the IA-T scores for female participants included the variables time spent on the Internet for private purposes, ASRS, age and BDI as significant predictors ( $F_{(4,477)}=73.398, p<.01$ ). Similar results gained the regression analysis for male participants: here the time spent on the Internet for business purposes also gained significance beside the time spent on the Internet for private purposes, BDI, ASRS and age (30 % explained variance;  $F_{(5, 407)}=36.208, p<.01$ ). The largest amount of variance in the IA-T scores for male and female participants could be explained by the variables time spent on the Internet for private purposes (males 15 % and females 25 %), followed by ASRS (males 12 % and females 9 %).

## Discussion

The purpose of the present study was to provide a review on the literature from Germany on the link between PIU and depression, ADHD. Furthermore these associations were again investigated in a distinct large sample from Germany, using psychometrically sound and well-established questionnaires [35,37].

Most of the reviewed studies, with the exception of one, showed a positive link between PIU and depression. To date, the literature on the association between PIU and ADHD from Germany is scarce, however, also suggesting a positive relationship between these disorders. These results support the already existing findings in international comparison and highlight the importance of investigating comorbidities of PIU with respect to its diagnosis and suitable treatment.

The results of the current study additionally show that men are more prone to develop PIU compared to women. There is a controversy in the literature about gender differences in PIU, with some studies suggesting that men exhibit higher scores in problematic Internet use [38,39], some find that more women than men have PIU [31] and other studies do not find a significant gender effect [40]. More conclusive are studies, exploring differences in the preferred online activities between men and women. Weiser [41] studied the different applications that

men and women use on the Internet. He showed that females spent time online for the reasons of communication and education, whereas males used the Internet primarily for entertainment and pleasure. These results were supported by a recent study by Heo et al. [42].

As the correlation analysis showed, the levels of depression and ADHD were related to the severity of PIU. Although these correlations were not very high ( $r=.247, p<.01$  and  $r=.335, p<.01$  for depression and ADHD respectively), we would like to emphasize the fact that the investigated sample was recruited from a subclinical population. Thus, we believe that the relationship between PIU and depression or PIU and ADHD will be much stronger in a population of individuals, who have been diagnosed with these disorders. The idea of such a continuum model is also for example reflected in the association between IA-T and the personality characteristic Self-Directedness. While in a study investigating such a link in students and persons from the normal population the correlation was  $r=-.35 (p<.01)$ , the same association was much stronger in persons more prone to PIU, namely first person shooter video game players ( $r=-.48, p<.01$ ) [5,6]. Moreover, the results of the current study support the so far existing literature on PIU [e.g. 10]. As we already mentioned in the introductory part of this article, people with propensity for ADHD and / or depression might start using the Internet as coping strategies in order to compensate for some dysfunctions due to the disorder [43] as for example low self-esteem, negative emotionality, lacking social skills and interpersonal difficulties. In addition to this, people with propensity for ADHD or ADHD patients might in particular overuse the Internet due to the immediate rewarding aspects of Internet use. It is essential in this regard, to further explore, which disorder (ADHD, depression or PIU) develops first and which are the best treatment methods, when dealing with more than one disorder at a time.

Our next research question aimed to shed light on potential predictors of PIU and by this means determine the strength of the association between PIU and ADHD and depression. A stepwise regression analysis was conducted in order to carve out such predictors. The time spent on the Internet for private purposes and the propensity for ADHD were the strongest predictors of PIU for male and female participants (explaining 27 % and 34 % respectively). The rest of the variables explained only 4 % of the IA-T scores (in both males and females). These results further draw the attention towards ADHD, as its association with PIU was stronger than the link between depression and PIU. These findings support the already existing literature [9,11] and add a sample from Germany, where the relationship between PIU and ADHD has only been investigated scarcely so far. Another relevant aspect as suggested by Ho et al. [44] is the role of ADHD as predisposing factor of PIU, based on the onset of ADHD (at the age of 7 by clinical definition), that usually predates the incipience of PIU. In a prospective study over the course of two years, Ko et al. [13] could show that adolescents with ADHD were more prone to develop problematic Internet use in the two-year follow-up. These and other factors such as the investigation of ADHD subtypes (predominantly inattentive, predominantly hyperactive or the combined type) and their interaction with problematic Internet use, are of critical importance for the diagnosis and appropriate treatment of PIU. For the purpose of examining ADHD subtypes and their link to PIU, we conducted a post-hoc stepwise regression analysis. Two scales gained significance ( $F(2,891)=71.828, p<.01$ ): attention and impulsivity, whereby attention (13 % explained variance) was a much stronger predictor than impulsivity (less than 1 % explained incremental variance). These results support the findings by Yen et al. [22], where attention deficit as a symptom of ADHD followed by impulsivity showed the strongest association with PIU.

The time spent on the Internet for private (but not for business) purposes appears to be a robust predictor of PIU, as it was shown by the present study and a couple of other studies in the literature [6,7,45]. In fact, this variable was one of the strongest predictors in the present study. These results suggest that the differentiation of the time spent on the Internet for private and business purposes is of importance for both the definition and diagnosis of PIU.

There are some limitations of the present study we would like to discuss at this point. A first drawback of the present study is the fact that participants were recruited mainly at university campuses, thus primarily students participated in the study. Hence, the data of the study were based on selective samples, thereby limiting its generalizability. Further limitations of the study are its correlative and cross-sectional character. For gaining further understanding on the relationship between PIU, ADHD and depression one should also investigate these relationships in a longitudinal study. Furthermore, the questionnaires were self-reported, which increases the probability of gaining inaccurate data due to for example social-desirability-effects [46]. Another drawback of the study is that we investigated a pathological behaviour in the general population, not relying on good characterized clinical groups. Hence, research using clinical samples is needed, in order to test the robustness of the effects found. Finally, given the rapid evolving research field dealing with PIU we apologize for omissions in the review part of this article.

## Conclusion

In conclusion, the results of the present study sum up the existing literature on the relationship between PIU and ADHD and depression from Germany and add new data from a new distinct German sample. All in all, depression and ADHD both seem to play a crucial role as comorbidities to PIU, whereby the effect of ADHD and in particular of the ADHD symptom attention deficit on PIU was much stronger than depression. Further studies on the cause-effect relationship between these psychopathologies and the consideration of the ADHD subtypes are needed in order to gain information about diagnostic implications and appropriate treatment of PIU.

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