THE RELATIONSHIP BETWEEN INTERNET ADDICTION AND ALCOHOL CONSUMPTION IS INFLUENCED BY THE SMOKING STATUS IN MALE ONLINE VIDEO GAMERS

Marko Müller and Christian Montag

Abstract

Objective: Mounting evidence suggests a putative link between overuse of digital media and easily accessible drugs such as alcohol and nicotine.

Method: We assessed Internet addiction tendencies in a sample of N=1,362 male players of online first-person-shooter-video games. We used Young’s 20-item Internet addiction test (IAT). We also asked participants about their smoking status and alcohol consumption.

Results: No significant differences were observed on the IAT between smokers, non-smokers and ex-smokers. However, in line with the majority of the literature, the results yielded support for a link between Internet addiction and alcohol consumption. Of importance, this correlation was influenced by the current smoking status. This relationship was especially pronounced for the group of ex-smokers.

Conclusions: It is possible that after quitting smoking, drinking habits and online activities may be used to compensate for nicotine abstinence.

Key words: Internet addiction (IA), smoking, alcohol, problematic internet use (PIU)

Declaration of interests: none

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Introduction

Being online provides many advantages, including easy access to the accumulated human knowledge, our treasury of human creativity and loads of real-time information, anytime and almost anywhere in the world (see also Schimmenti and Caretti 2010, Schimmenti et al. 2014). At present, nearly 40% of the world population is online (Kuss et al. 2014), i.e. in October 2016 there were 3.49 billion users (http://www.internetlivestats.com). Internet use has grown six-fold over the past 10 years. The Internet penetration in Germany is around 88% of the population (http://www.internetlivestats.com/internet-users/germany). The Internet entertains us when we are bored and opens new dimensions for communication. Virtual realities might even support individuals to temporarily cope with emotional stress or let them experience new facets of themselves (Schimmenti and Caretti 2010). Internet allows us to live different versions of ourselves through social media or characters in online games, i.e. we can “try out” several digital identities representing various facets of our personality; therefore, even shy (Caplan 2002, Chak and Leung 2004, Ebeling-Witte et al. 2007) and introverted people can feel secure opening a conversation without feeling emotions of shame or rejection, which they might experience in the real world due to lacking self-presentation skills (Caplan 2005).

However, a preference for online communication in lieu of face-to-face interaction could nurture problematic Internet use. In this context, an on-going debate in the scientific community centers on whether Internet overuse (Aboujaoude 2010, Aboujaoude et al. 2006, Ko et al. 2012) resembles a novel form of (behavioral) addiction, as first proposed by Young (1996, 1998a). This would include symptoms such as withdrawal when not online and preoccupation with the Internet, as well as the development of tolerance and negative repercussions in private and/or work life due to the problematic use of the Internet1 (Tao et al. 2010).

1 Several researchers still prefer the term problematic Internet use (PIU) (Aboujaoude 2010), because Internet addiction has not been officially accepted as a behavioral addiction yet. Nevertheless, given the “handiness” of the term and its broad use, we prefer to use both in the present research article.
In the context of the debate about the nature of Internet addiction (Kuss et al. 2014, Van Rooij and Praise 2014), it has been shown that a generalized form of Internet addiction might exist, along with several forms of specific Internet addiction (Aboujaoude 2010), such as compulsive online buying, online social networking, online pornography (Pawlikowski et al. 2014), and online computer gaming (Montag et al. 2015a). With respect to the latter, a growing body of research demonstrates that Internet Gaming Disorder (IGD) (Yee 2006) is a specific variant of Internet addiction, may be particularly problematic (Kuss and Griffiths 2012). This is supported by the inclusion of IGD in section III of the DSM-5 as a so-called emerging disorder (Petry et al. 2015). IGD research tends to focus on massively multiplayer online games (MMOGs), particularly massively multiplayer online role-playing games (MMORPGs).

Players of such games typically spend many hours gaming. From a motivational perspective, Ng and Wiemer-Hastings (2005) observed that these online players search for social interaction they lack in their real lives. Furthermore, they may want to compensate for social deficits, shyness (Caplan 2002, Chak and Leung 2004, Ebeling-Witte et al. 2007) and experiences of frustration (Wan and Chiou 2006a) in their real life by escaping (Wan and Chiou 2006b) into the online gaming world. Moreover, they might want to experience success in these games, both in terms of ‘achievement’ in the game but also through an interconnection or social interaction with other players (Yee 2006). Other researchers have suggested that the main motivation for playing these online games is the experience of a state of flow (observed by Wan and Chiou [2006a] in a sample of Taiwanese adolescents). The state of flow is characterized by positive emotionality. A prerequisite of the flow experience is that one’s own abilities match with the difficulty of a given task – here the difficulty of the computer game (e.g. Csikszentmihaly and LeFevre 1989; Csikszentmihalyi M, Csikzentmihaly M 1991; see also Keller and Landhäusler 2012, for more elements characterizing the flow process).

Many roads have been travelled to understand if Internet addiction is best characterized as a behavioral addiction (Grant et al. 2010, Yau et al. 2012). Evidence from the neurosciences (e.g. Hong et al. 2013, Love et al. 2015, Park et al. 2016, Weinstein and Lejoeux 2015, Zhang et al. 2016b) has highlighted homologies and shared pathophysiology (Yongjun Zhang et al. 2016) between brain dysfunctions – e.g. volume differences, brain connectivity, brain activity patterns (Brand et al. 2014, Zhang et al. 2016a) – or a link between well known risk gene variants for addiction (such as smoking) and Internet addiction – see Montag et al. (2012, 2015b) or a complete overview from Montag and Reuter (2015). Classic approaches from personality psychology (Ko et al. 2008, Yen et al. 2009) have also emphasized some similarities showing that personality traits such as low self-directedness are not only vulnerability factors for substance dependent addictions, such as alcoholism (Basiaux et al. 2001), but also Internet addiction (Sariyska et al. 2014). Of note, this has also been observed for MMOG players (Montag et al. 2011).

Another line of research giving insight into the diverse and constantly changing nature of Internet addiction (Schimmenti et al. 2014, Weigle 2014, Yau et al. 2012) deals with the investigation of comorbidities. Here, robust associations between psychiatric disorders such as ADHD and depression have been observed (Sariyska et al. 2015, Yen et al. 2007a). Other studies have highlighted comorbidities with substance dependent disorders, which we develop further with the present study.

For exploring research investigating the association between Internet addiction (any kind of problematic Internet use, cyber addiction or Internet gaming disorder (IGD)) and substance-related dependencies regarding alcohol, smoking or other substances, such as cannabis and other drugs, over 250 studies were screened. About 150 were mainly excluded due to a mismatch resulting from the content of the abstract. 96 citations in English language were analyzed in detail of which two were reviews (Fattore et al. 2014, Ko et al. 2012), three dealt with parental problematic drinking (Jang and Ji 2012, Jang et al. 2012, Yen et al. 2007b), another three had a focus on indirect associations between Internet addiction and substance use (Busch et al. 2015, Smith et al. 2014, Tavolacci et al. 2013) and further two investigated comorbidity (Bibbey et al. 2015, Zhou et al. 2014). For these reasons the mentioned studies were excluded. Two thirds (64) of the remaining citations examined the association between PIU and alcohol and/or substance use in humans using inferential statistical assessments (the remaining studies were descriptive in nature or investigated PIU and substance use separately or only qualitatively). Internet addiction was found to be associated with alcohol (32), nicotine (20), cannabis (8), other drugs (7) or unspecified substance use (9) in 44 publications. However, no relationship was demonstrated for PIU and alcohol (15), nicotine (13), cannabis (1), other drugs (3) or unspecified substance use (2) in 24 papers, moreover, controversial or mixed results were observed in nine studies for alcohol (7), nicotine (5), cannabis and other drugs (only indirectly associated over tobacco) or unspecified substance use (once only in boys, not in girls significant). The investigation of smoking and problematic Internet use demonstrated a relationship in 21 studies, no relationship was found in 12 studies and four showed ambiguous results. Regarding the type of Internet addiction, some of the papers reviewed focused on compulsive online buying (Di Nicola et al. 2015, Duroy et al. 2014), online pornography (Böhle et al. 2015, Frangos et al. 2011, Harper and Hodgins 2016), online social networking (Bouna-Pyrrou et al. 2015, Hormes et al. 2014), gambling (Kairouz et al. 2012) or online gaming (Korkelia et al. 2010, Van Rooij et al. 2014).

To sum up, the relevant studies (n=64) mainly in Europe (30) and Asia (24) searched for associations between Internet addiction and alcohol, nicotine and substance dependent forms of addiction, including marijuana and other drugs. Here, only around 30% of the studies focused on the analysis of PIU and substance dependent addictions as their primary research question. Often, associations between Internet addiction, smoking and alcohol abuse were examined aside to the main hypothesis. To better understand the potential link between substance and (non-)dependent addictions, we therefore laid our main-focus in the present work on the study of both nicotine and alcohol consumption in relation to Internet addiction. Moreover, we investigated these tendencies in a large sample of an under-studied population – namely online video gamers. Two-thirds of the relevant studies in this field have focused on students, a few on adolescents and the general population; gamers and gamblers have rarely been studied in this area (for an exception, see Kairouz et al. 2012). Given the inclusion of Internet Gaming Disorder in section III of DSM-5, we believe the investigation of this group of participants to be of special interest.

In detail, the present study aims to investigate the relationship between Internet addiction, frequency of...
alcohol consumption and smoking status (smoker, non-smoker, ex-smoker) alongside numbers of cigarettes smoked daily.

Given this research question, we hypothesized that higher tendencies towards Internet addiction would be associated with higher alcohol consumption, as observed in over half of previous studies targeting this assessment (e.g. Böthe et al. 2015, Evren et al. 2014, Harper and Hodgins 2016, Ko et al. 2008, Korkelia et al. 2010, Pallanti et al. 2006, Van Rooij et al. 2014, Yen et al. 2009). The link to nicotine addiction has been more controversial in earlier work, as a smaller number of studies (fewer than 50%) observed a positive association between smoking and PIU (e.g. Heo et al. 2014, Lee et al. 2014, Secades-Villa et al. 2015 and Seyrek et al. 2016). As a consequence, we refrained from a direct hypothesis here. 25% of the reviewed studies showed positive associations of PIU with higher consumption of alcohol and of cigarettes (the most recent four out of 16 studies: Chang et al. 2015, Lee et al. 2016, Muñoz-Miralles et al. 2016, Piguet et al. 2015). In several studies only a positive association of PIU and alcohol was observed and no relationship could be seen for smoking (Bouna-Pyrrou et al. 2015, Busch et al. 2013, Choi et al. 2009, Kairouz et al. 2012, Lind PA, Hickie IB, Martin NG 2016, Taranto et al. 2015). Some studies also found significant associations among PIU, drinking and smoking, in which alcohol was indirectly associated with PIU over tobacco use (Rücker et al. 2015), or was at least influenced by smoking (Alaçam et al. 2015). Thus, we also aimed to investigate the interdependence between alcohol use and Internet addiction in the context of the smoking status. Due to the heterogeneous results in the literature, we aimed to investigate this in a large target group, vulnerable for Internet Gaming Disorder, players of online video computer games with a focus on Counter-Strike. We hypothesized an association between substance-dependent and substance-independent addictive behaviors in male online gamers as shown by Andreassen et al. (2016).

Method

Participants and sociodemographic characteristics

Participants were recruited via advertisement on the website of the Electronic Sports2 League (at that time: http://www.esl.eu, now: http://www.eslgaming.com). The ESL represents the largest Internet platform for competitive online games in Germany and Europe, where MMORPGs, such as Counter-Strike are played. A link on the webpage led the visitors of the page to our questionnaire.

Useful data was collected from N=1,362 male online gamers (data cleaning is described below). The mean age of all participants was 20.54 years (SD=4.60), ranging from 13 to 55 years, of whom 94.0% speak German at home. Over half (56.7%) of the male online gamers are single and more than one third (35.6%) reported to be in a relationship. Thus, 92.3% were not married, and the remaining 7.7% consist of 3.1% married and 0.4% divorced participants; 4.2% gave no marital state. In terms of education – about one third (33.8%) – had a German 10th grade secondary school graduation (“mittlere Reife” or “Realschulabschluss”), 12.8% had a general qualification for university entrance called “Abitur”, 11.8% had a completed apprenticeship, 9.8% finished the German “Hauptschule”, i.e. they completed junior high school and 12.7% did not have a high-school degree yet. The remaining groups were diversified distributed between baccalauréate (“Fachabitur”) (7.3%), advanced technical college certificate (5.1%), university degree (2.3%), other (1.8%) and “unanswered” (2.6%). The study was conducted in accordance with the Declaration of Helsinki and all participants gave their (electronic) consent prior to their participation in the online study. Participation was completely anonymous.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Whole sample N=1,362</th>
<th>Non-smokers n_ex660</th>
<th>Smokers n_ex601</th>
<th>Ex-smokers n_ex101</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M(all) SD(all) SEM Min Max Skew</td>
<td>M (no) SD (no)</td>
<td>M (smo) SD (smo)</td>
<td>M (ex) SD (ex)</td>
</tr>
<tr>
<td>age</td>
<td>20.54 4.60 .13 13 55 1.88</td>
<td>19.29 3.71 21.58 4.74</td>
<td>22.53 6.47</td>
<td></td>
</tr>
<tr>
<td>IAT</td>
<td>37.45 12.64 .34 20 100 1.43</td>
<td>37.23 11.81 37.54 13.20</td>
<td>38.37 14.44</td>
<td></td>
</tr>
<tr>
<td>onset age of Internet use</td>
<td>12.48 3.37 .09 5 50 2.20</td>
<td>11.93 2.85 12.86 3.57</td>
<td>13.73 4.50</td>
<td></td>
</tr>
<tr>
<td>leisure online hours per week</td>
<td>22.54 17.75 .48 0 100 1.49</td>
<td>21.87 16.49 23.96 19.49</td>
<td>18.50 13.53</td>
<td></td>
</tr>
<tr>
<td>alcohol consumption</td>
<td>2.50 0.78 .21 1 4 -.019</td>
<td>2.41 0.83 2.62 0.72</td>
<td>2.40 0.70</td>
<td></td>
</tr>
<tr>
<td># beer</td>
<td>2.77 0.98 .03 1 4 -.45</td>
<td>2.62 1.03 2.95 0.90</td>
<td>2.70 0.90</td>
<td></td>
</tr>
<tr>
<td># spirits</td>
<td>2.38 0.92 .03 1 4 0.02</td>
<td>2.27 0.94 2.50 0.89</td>
<td>2.31 0.85</td>
<td></td>
</tr>
<tr>
<td># mixed alc.</td>
<td>2.36 0.95 .03 1 4 0.04</td>
<td>2.35 0.97 2.39 0.93</td>
<td>2.18 0.91</td>
<td></td>
</tr>
<tr>
<td># cig/day (smo)</td>
<td>14.56 10.13 .41 1 120 3.46</td>
<td>- - 14.56 10.13</td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td># cig/day (ex)</td>
<td>13.67 13.19 1.31 1 96b 3.13</td>
<td>- - - - 13.67 13.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: M (Mean), SD (Standard Deviation), SEM (Standard Error of the Mean), a range end (smo): 50 cig.: 3x, 60 cig.: 1x, 100 cig.: 1x, 120 cig.: 1x; b range end (ex): 50 cig.: 3x, 96 cig.: 1x; c mean (ø) of alcohol consumption frequencies regardless of the type of alcohol; frequency (#) of alcohol consumption collected on a 4-point Likert scale, from 1=never to 4=regularly

2 Electronic sports refers to social and competitive gaming in a sport-like setting.
Table 2. Pearson correlation coefficients of variables of interest and age for whole sample and subsamples

<table>
<thead>
<tr>
<th>Internet, alcohol and nicotine related variables</th>
<th>Whole sample ( N=1,362 )</th>
<th>Non-smokers ( n=660 )</th>
<th>Smokers ( n=601 )</th>
<th>Ex-smokers ( n=101 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAT</td>
<td>-1.138**</td>
<td>-1.120**</td>
<td>-1.158**</td>
<td>-0.208*</td>
</tr>
<tr>
<td>( \sigma (\text{alcohol}) )^3</td>
<td>-1.130**</td>
<td>-0.036</td>
<td>-0.237**</td>
<td>-0.447**</td>
</tr>
<tr>
<td># beer</td>
<td>-0.072**</td>
<td>-0.079*</td>
<td>-0.129**</td>
<td>-0.237*</td>
</tr>
<tr>
<td># spirits</td>
<td>-0.108**</td>
<td>-0.004</td>
<td>-0.202**</td>
<td>-0.454**</td>
</tr>
<tr>
<td># mixed alcoholic drinks</td>
<td>-0.144**</td>
<td>-0.004</td>
<td>-0.232**</td>
<td>-0.367**</td>
</tr>
<tr>
<td># cigarettes per day</td>
<td>-</td>
<td>-2.42**</td>
<td>-</td>
<td>0.673**</td>
</tr>
</tbody>
</table>

Note. Correlation (2-tailed) is significant at the .01 level (**), at the .05 level (*); \( \sigma \) mean (\( \sigma \) of alcohol consumption frequencies regardless of the type of alcohol; ^3 frequency (\( \sigma \)) of alcohol consumption collected on a 4-point Likert scale, from 1=never to 4=regularly.

Questionnaires

Information about Internet usage. Data on problematic Internet usage (PIU) was assessed via the Internet addiction test (IAT) by Young (1998b), which has been tested for psychometric properties (see Widyanto and McMurran 2004). Our German version has been used in several earlier studies including Montag et al. (2010, 2011) and Sariyska et al. (2014, 2015). The questionnaire comprises 20 items rated on a five-point Likert scale (from 1=seldom to 5=always, 1=never to 4=regularly). After visual inspection, the 20-items questionnaire showed an excellent reliability for our sample \( \alpha=.904 \) (N=1,362).

Information about smoking and drinking habits. All participants were asked about their alcohol consumption and their current smoking status (smoker, non-smoker, ex-smoker). Participants self-assessed how often they consume beer, spirit drinks and mixed alcoholic beverages on a four-point Likert scale (ranging from 1=never to 4=regularly). Moreover, if they mentioned smoking or having quit smoking, we additionally collected information on the quantity of cigarettes smoked per day (for smokers the current number of cigarettes was assessed and for ex-smokers the amount before they quit smoking).

Statistical analyses

For the statistical analyses we used the SPSS version 23.0.0.0 for MAC. As the sample size of all subsamples is far bigger than 30, we decided to implement all statistical analyses using parametric tests according to the central limit theorem. After visual inspection, the distribution of all variables of interest was assumed to be nearly normally distributed. As the results for both analyses were similar, only the parametric tests are reported. In detail, we used Pearson’s \( r \) correlations, partial correlations and ANCOVAs (controlling for age), when appropriate.

Data cleaning

Data inspection revealed that 369 participants, i.e. 21.3% of the initial sample size \( N=1,731 \) had to be excluded. Our approach is a very conservative one and the main results do not change with the in- or exclusion of these participants. Only meaningful data sets were used for our final data inspection. Inclusion criteria were: being male (only 3.58% of the original sample were female and therefore needed to be excluded due to statistical reasons), stating a reasonable age (10+), and a corresponding Internet onset age (higher than the current age), spending at most 112 hours online per week online (to have 8 hours per day spare/sleep time), the sum of private and work hours spent should equal the total online hours (+/- 1 SD), giving a complete data set regarding frequencies of alcohol consumption, smoking or having been smoking a maximum of 120 cigarettes per day (see table 1 for details) and declaring the adequate smoking status depending on the amount of smoked cigarettes, e.g. zero cigarettes smoked per day ≠ smoker, but non-smoker. After excluding participants due to age, gender, Internet usage and drug variables, \( N=1,362 \) participants remained for the final analysis. Note that especially the cut-off for daily smoked cigarettes is somewhat arbitrary (and perhaps too high), but the mentioned correlational results below do not change in a meaningful way with a lower cut off.

Results

Age influencing both IAT and substance related variables as shown in table 2 (frequency of alcohol consumption and amount of cigarettes consumed). Age displayed strong correlations with all variables of interest across the whole sample and subsamples. The negative correlation between age and the IAT in form of Pearson’s \( r \) increased in the subsamples from non-smoker, smoker to ex-smoker in that order. The greatest associations were found between age and nicotine consumption in ex-smokers (\# of cigarettes per day). Age was negatively associated with the IAT score and all alcohol related items, which is in contrast to a study combining students from all over Europe (Durkee et al. 2012) stating no relationship between age and Internet addiction3, and another study from Taiwan even showing a positive association between age and IGD (Ko et al. 2005). Given the importance of age as a potential confounding variable for our research questions, we corrected all statistical tests hereafter for age (ANCOVAs, partial correlations).

Alcohol consumption and Internet addiction. To obtain an overall picture of the relationship between alcohol related variables and problematic Internet use, we calculated the mean of frequency over all three types of alcohol consumption ([freq. beer + freq. spirits + freq. mixed alcoholic beverages]: 3), for each participant. Means for the alcohol drinking variables can be seen in table 1. As we collected three items

3 Internet addiction has been robustly and inversely associated with age in many studies. More and more digital natives get in touch with online devices at a very early age, so that these (perhaps) generation effects might not be visible in a few years from now.
has been achieved after data trimming to narrow the distance between two outliers (smoking of 100 and 120 cigarettes) and the remaining sample as follows: 100 was reduced to 61 and 120 to 62 cigarettes (the next highest person stated to smoke 60 cigarettes daily). In general, we do not want to overemphasize the presented correlation, because after taking a look at the scatterplot and the exclusion of the six highest numbers of daily

as an exception). The remaining information in table 3 will be discussed below.

Smoking including amount of cigarettes and Internet addiction. As one can see \(n_{\text{non}} = 660\) of the investigated samples were characterized as non-smoker, \(n_{\text{sмо}} = 601\) as smoker and \(n_{\text{ex}} = 101\) as ex-smoker. By means of an ANCOVA (inserting age as a covariate) we analyzed whether smoking status has a significant effect on Internet addiction tendencies and the IAT.

ANCOVAs revealed that smoking status has no significant effect on the IAT. Estimated means of IAT for non-smokers, smokers and ex-smokers, respectively, are \(M_{\text{non}} = 36.71\ (SEM=0.50)\), \(M_{\text{sмо}} = 37.97\ (SEM=0.52)\) and \(M_{\text{ex}} = 39.21\ (SEM=1.25)\).

Of note, the IAT score correlated significantly with the number of cigarettes consumed daily in the group of smokers (\(r = 0.125, df = 598, p < 0.01\)), but not with the daily smoked cigarettes of the ex-smokers group. It needs to be mentioned that the present correlation

Table 3. Partial correlation coefficients between alcohol consumption with Internet addiction test scores corrected for age for the whole sample and separately for all three smoking status subgroups

<table>
<thead>
<tr>
<th>sample size</th>
<th>M(ALC)</th>
<th>#beer</th>
<th>#spirits</th>
<th>#mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>whole sample ((N=1,362))</td>
<td>.097**</td>
<td>.034</td>
<td>.080**</td>
<td>.126**</td>
</tr>
<tr>
<td>ex-smoker (n_{\text{ex}}=101)</td>
<td>.167</td>
<td>-.044</td>
<td>.108</td>
<td>.321**</td>
</tr>
<tr>
<td>smoker (n_{\text{sмо}}=601)</td>
<td>.102*</td>
<td>.033</td>
<td>.074</td>
<td>.132**</td>
</tr>
<tr>
<td>non-smoker (n_{\text{non}}=660)</td>
<td>.073</td>
<td>.031</td>
<td>.069</td>
<td>.088*</td>
</tr>
</tbody>
</table>

Note. Correlation (2-tailed) is significant at the .01 level (**), at the .05 level (*); #beer/ #spirits/ #mixed = frequency of beer/spirits/mixed alcoholic beverages consumption

smoked cigarettes (resulting in cigarettes \(\leq 42\): \(r = 0.074, p = 0.073\)), the correlation is much smaller and not significant anymore.

IAT and alcohol consumption, given smoking status. To investigate whether the association between alcohol consumption and IAT was dependent on smoking status, we split the dataset into three subsamples based on smoking status: non-smokers, smokers and ex-smokers \((n_{\text{non}} = 660, n_{\text{sмо}} = 601, n_{\text{ex}} = 101)\). As well as investigating the whole sample \((N=1,362)\), each group was examined separately to search for associations between IAT and frequencies of alcohol consumption (mean-consumption-frequency of all three types of drinks, beer, spirits and mixed alcoholic beverages).

We revealed significant partial correlations (controlling for age) between the IAT score and the frequency of consuming mixed alcoholic beverages in the whole and all smoker-status-subsamples (table 3, figure 1). Similar, albeit weaker, effects approaching

![Figure 1](image-url)
Annoyance by criticism, Guilty feeling and Eye-opener), questionnaire for detecting alcoholism (Cutting down, Discussion

mean of alcoholic drinking habits (called the .05-significance level were identified for the effects with any of the Internet related items. Beer consumption levels had no significant association with either ALC or IAT association was also visible in the group and consumption of spirits in the whole sample. The CIUS, CERI, CERV4 addiction (e.g. SPQ, CAGE, AUDIT or YIAT, CIAS, in measures for alcohol consumption and Internet heterogeneity of findings have to do with variations (not being significant) to \( r=.004 \) n.s. IA: .004 n.s. SA: .101*

Discussion

Alcohol consumption and Internet addiction. The aim of the present study was to investigate Internet addiction in the context of nicotine and alcohol consumption. In line with the literature, we identified a link between alcohol consumption and IAT scores. It must be acknowledged that, given the large sample size, even minor effects achieved significance. Therefore, some of the seen effects are of limited practical importance, with the exception of the somewhat larger correlation of PIU and the frequency of consumption of mixed beverages in the group of ex-smokers discussed below.

However, most of the small correlation coefficients observed in the present study are unsurprising, given the results of previous work. Table 4 presents studies investigating the link between Internet addiction and alcohol consumption also using Pearson’s correlation coefficient analysis (making it easier to compare our findings). As one can see from this small subset of studies, the range of correlations is from \( r=.004 \) (not being significant) to \( r=.376 \). Reasons for the heterogeneity of findings have to do with variations in measures for alcohol consumption and Internet addiction (e.g. SPQ, CAGE, AUDIT or YIAT, CIAS, CIUS, CERI, CERV4). Moreover, the various types of Internet use, e.g. pornography instead of online gaming, and different statistical methods used, such as chi-square tests, regression or factor analyses, canonical correlation, relative risks or adjusted odds ratios mostly below 2, make it challenging to compare the results quantitatively with ours.

Interestingly, a relationship between Internet addiction and frequency of alcohol consumption could only be observed for the consumption of spirits or mixed drinks. Why was no such association observed between Internet addiction and beer consumption despite the great samples size? This relationship might not have been observed in the present study, because beer in Germany is often considered to be a “social drug”. In order to develop a better understanding of the non-association between beer consumption and Internet addiction, future work might want to include questionnaires assessing motivation to drink specific types of alcohol, such as in a bar for social reasons. Nevertheless, our data suggest that the more frequently one consumes other alcoholic beverages, especially spirits or mixed alcoholic drinks (such as Alcopops and cocktails), the higher their Internet addiction tendencies.

Smoking and Internet addiction. Smoking status (non-smoker, smoker, ex-smoker) on its own had no influence on the IAT. However, for smokers significant correlations with the IAT were identified with respect to the number of cigarettes smoked. The more cigarettes smokers consumed, the higher their probability towards cyber dependency (in form of the IAT score). But: We already mentioned in the result section that the here described correlation is driven by few participants

Table 4. Literature investigating the relationship of Internet addiction and alcohol consumption represented by Pearson correlation coefficients

<table>
<thead>
<tr>
<th>Author</th>
<th>Content/results of the study</th>
<th>Pearson’s ( r ) (IA and ALC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choi et al. (2015)</td>
<td>Risk factors for IA were: being male, using the smartphone, being anxious and wisdom/knowledge</td>
<td>IA: .004 n.s.</td>
</tr>
<tr>
<td></td>
<td>Risk factors for SA were: being female, using the Internet, drinking alcohol and being anxious</td>
<td>SA: .101*</td>
</tr>
<tr>
<td>Harper and Hodgins (2016)</td>
<td>IP (Internet pornography); freq. of IP use per month and AUDIT (furthermore, the study demonstrated that: high IP use correlates with gambling and especially with video gaming)</td>
<td>.19**</td>
</tr>
<tr>
<td>Korkela et al. (2010)</td>
<td>IA relates to adult entertainment, playing games, chatting, discussion</td>
<td>.18**</td>
</tr>
<tr>
<td>Pallanti et al. (2006)</td>
<td>IAT related to potentially dangerous substance dependence (alcohol, smoking, caffeine, drugs and prescribed drugs abuse) measured by the SPQ</td>
<td>.376**</td>
</tr>
<tr>
<td>Shin et al. (2011)</td>
<td>IA might have their roots in earlier life stages as it is correlated with both types of insecure attachments</td>
<td>Literature .14 n.s.</td>
</tr>
<tr>
<td></td>
<td>IA associated with anxiety, anxious and avoidant attachment, depression and phobia; the latter three predict IA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALC only associated with anxious attachment, depression and anxiety; the aforementioned two predict ALC use</td>
<td></td>
</tr>
</tbody>
</table>

Note. IA = Internet addiction, ALC = alcohol use; AUDIT = Alcohol Use Disorders Identification Test; SA = smartphone addiction; SPQ = Shorter PROMIS Questionnaire.

The .05-significance level were identified for the mean of alcoholic drinking habits (called M(ALC)), and consumption of spirits in the whole sample. The M(ALC)-IAT association was also visible in the group of smokers. Beer consumption levels had no significant effects with any of the Internet related items.

The .004 correlation is driven by few participants.
in our study. Therefore and together with the next observation, our data speak against a direct link between smoking and Internet addiction in our present sample. Of note, the positive association between the number of cigarettes smoked daily and Internet addiction could not be observed in participants who had quit smoking, therefore the question arises, if the present finding is only attributable to a certain smoking cohort. An alternative explanation for the absence of this effect among ex-smokers may be inaccurate recall of the number of cigarettes smoked prior to quitting. Beyond these (lack of) correlations/associations, our data show that when ex-smokers start to cope with their craving for nicotine with an alternative drug, they do it extensively – the link between alcohol consumption and Internet addiction is highest in ex-smokers. This is discussed further in the next section.

Investigating the link between alcohol consumption and Internet addiction, given smoking status. Non-smokers had a weaker association between tendencies towards Internet addiction and the consumption of Alcopops and cocktails (named #mixed in the results), whereas the relationship between these variables was greater for smokers. The largest relationship was observed for the group of ex-smokers (see figure 1). Our interpretation of these findings is that non-smokers tend to show the lowest correlations between IAT scores and alcohol consumption frequencies because they may have a lower tendency towards overseuse of a wide array of drugs and may in general act more moderately. Table 1 highlights the opposite effect: Persons vulnerable to alcohol or nicotine tend also to use the other drug more often. In our data, the smoking group has also the highest frequencies of alcohol consumption. This is in line with general observations from the literature demonstrating that alcoholism and nicotine dependence are strongly entwined (Miller and Gold 1998).

The high correlation between the Internet addiction score and consumption of mixed alcoholic beverages may represent a compensation effect for ex-smokers. As they quit smoking, they abandon their former habit and thus, they offset their need for nicotine (substance-dependent) with other forms of addiction, such as both alcohol (also substance-dependent) and a novel addiction, namely overseuse of the Internet (substance-independent). Ultimately, neuropsycho-biological explanations will help clarify why this compensation may “work” for ex-smokers. Nicotine and alcohol share a common final reward pathway (Pierce and Kumaresan 2006), which may also encompass the nature of Internet usage, as proposed by many studies, e.g. see striatal activation when online gamers are confronted with cues from their favorite game, World of Warcraft (Ko et al. 2009); see also theoretical model of Brand et al. (2014) and for a molecular framework to the study of Internet addiction the study by Montag et al. (2016).

Limitations

Some limitations need to be mentioned: The present study is cross-sectional; therefore, no causal mechanisms can be ascertained. Our interpretations need support from longitudinal studies. Moreover, most of the observed correlations are small and thus, the variance in Internet addiction scores accounted for by smoking and alcohol consumption is low. For instance, the highest correlations were observed between consumption of mixed alcoholic drinks and Internet addiction in ex-smokers with \( r = .321 \). This means that only about 10% (.321 x .321) of the variance between both constructs overlap.

Finally, although we requested frequencies of alcohol and nicotine consumption, we did not assess addiction in these areas. Therefore, future studies may want to include addiction measures to allow for a more detailed analysis of alcohol intake. The present study investigated a young sample of German male Internet gamers representing a younger age distribution than the ordinary population with self-reported data; hence, future studies also need to see, if our effects are transferable to other populations.

Conclusions

Although Internet addiction has often been investigated with respect to smoking and/or alcohol use, consumption of these drugs has mostly been considered as an aside, rather than a focused topic of study. Therefore, we were interested in focusing our research primarily on these associations. Indeed, we could observe that the number of cigarettes smoked in the group of current smokers is related to the degree of PIU. However, this association was not present among ex-smokers and, together with the absence of a general effect of smoking-status on Internet addiction and the mentioned statistical issue (few participants driving the effect in the group of smokers), weakens the significance of this effect. Besides this, we observed that alcohol consumption and Internet addiction are related, but associations are small and may only be visible in such a large sample. One possibility arising from the present study may be that alcohol-IAT associations are highly influenced by an individual’s smoking status. Simply speaking, quitting smoking may result in a greater affinity towards both Internet overseuse and increased consumption of (sweet) mixed alcoholic beverages, to satisfy the nicotine craving. Given the on-going debate surrounding the nature of Internet addiction, it is of importance to consider the role of comorbidities. Many studies have demonstrated links between ADHD and depression, e.g. Sariyska et al. (2015), but clearly overlap with other forms of addictive behaviors that are also in need of research to enable a final conclusion on the nature of Internet addiction and its subgroups, such as Internet Gaming Disorder.

Contributions

MM and CM co-designed the study. MM carried out the statistical analysis, drafted the first version of the manuscript and finalized it. CM and MM revised the final version of the manuscript.

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Internet addiction, alcohol consumption and the smoking status in male online video gamers

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