Problematic digital behaviors among gamers: the links between problematic online gaming, gambling, shopping, pornography use, and social networking

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Abstract

The aim of the current study was to investigate how problematic online gaming, gambling, shopping, pornography use, and social networking are associated with each other in bivariate and multivariate, network analytic analyses in an international gamer population. The effective sample comprised 4,416 gamers (age M = 23.31, SD = 6.72; 94% male). Participants filled out the specific problematic Internet use scales on online gaming, gambling, shopping, pornography, and social networking. The results showed that problematic online gaming yielded small-to-medium positive bivariate correlations with other problematic behaviors. However, the exploratory graph analysis showed that all Internet-based problematic behaviors were separate entities. Finally, problematic online gaming was the most predominant, followed by problematic online social networking, gambling, and pornography. Whilst gaming was the most prevalent Internet-based problematic behavior among gamers the results further suggested that the Internet-based problematic behaviors investigated may co-occur despite being considered separate entities.

Keywords: gaming disorder; gaming; gambling; exploratory graph analysis; network analysis; addictive behaviors; Internet addiction

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1. INTRODUCTION

Internet-based problematic behaviors have been extensively investigated since the diffusion of the Internet into the wider audience. Already back in the 1990s, researchers proposed the concept of "Internet addiction", or a condition associated with detrimental outcomes due to excessive Internet use (Griffiths, 1996; Young, 1998). Over the time, different terminology has been in use to describe this condition since Internet *addiction* has been found to be a misnomer (Starcevic, 2013). Although research on Internet addiction has been conducted for over two decades (e.g., Griffiths, 1996; Young, 1996) with studies focusing on problematic Internet use (PIU) that have been being published for at least two decades (e.g., Shapira et al., 2000), recently, the term "Internet use disorder" has been discussed in the literature (see the I-PACE model by Brand et al., 2016).

In terms of etiological processes associated with Internet addiction, researchers have attempted to determine the object of this particular condition, with early research (e.g., Griffiths, 1999, 2000) suggesting that the Internet is just a medium for other specific online addictions. The literature suggests that most people who spend excessive amounts of time online are not addicted to the medium itself (i.e., the Internet) as they use the Internet to fuel other specific online addictions related to specific online usages and services such gaming, gambling, shopping, pornography use, and social networking. Discussion on generalized vs specific Internet addictions has also been considered in the seminal work by Davis (2001) who proposed the cognitive-behavioral model of pathological Internet use. This model distinguishes between generalized and specific pathological Internet use. The former describes a more global set of behaviors enabled by the Internet, while the latter refers to a condition in which Internet is used to feed other activities which could also be carried out offline (e.g., pornography use, gambling). This model has been further developed by Brand and colleagues (2016) to also include the role of predisposing factors in those problematic behaviors.

Previous empirical research provided support to these theoretical frameworks and overall idea that excessive Internet users are engaged in specific activities when using the Internet (e.g., Griffiths & Szabo, 2014; Pontes et al., 2015) and smartphones (Lowe-Calverley & Pontes, 2020; Rozgonjuk, Elhai, et al., 2019). For instance, Pontes et al. (2015) surveyed 1,057 Internet users and found that users would significantly decrease their Internet use if their specific preferred online activities were to be restricted, with almost one in five participants reporting that they would not continue to use the Internet in case they were not able to access their most commonly used online activities. Furthermore, Montag et al. (2015) found that specific Internet-based problematic behaviors were correlated with general PIU across different cultures, with Müller et al. (2017) providing additional support to this idea. Additionally, a study by Baggio et al. (2018), implementing network analysis, has demonstrated that specific Internet-based problematic behaviors such as cybersex and gaming form separate clusters, connected via general PIU.

More relevant to the current study, the American Psychiatric Association (APA) has included Internet Gaming Disorder (IGD) to the section III of the fifth revision of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013) as a tentative disorder in need of further research. This was followed by the World Health Organization (WHO) formally recognizing Gaming Disorder (GD) as a formal psychiatric disorder in the 11th revision of the *International Classification of Diseases* (ICD-11; World Health Organization, 2018b). According to the WHO, GD refers to a pattern of gaming behavior that detrimentally affects one's everyday life for a period of at least twelve months (World Health Organization, 2018a). Importantly, the symptoms of GD include: (a) impaired control over gaming, (b) increasing priority assigned to gaming over other everyday activities, and (c) continuation or escalation of gaming despite negative

outcomes (Kircaburun et al., 2020). Although IGD and GD represent slightly different terminology reflecting the same construct, emerging research testing these two diagnostic frameworks (i.e., APA and WHO) found that they may generate different prevalence estimates (Montag, Schivinski, et al., 2019; for the operationalization of GD, see Pontes, Schivinski, Sindermann, et al., 2019). It is also worth highlighting that a person who plays video games (a gamer) may not necessarily experience problems in daily-life due to gaming.

Despite the obvious diagnostic discrepancies across the two current diagnostic frameworks, IGD and GD have been found to be associated with various daily life adversities and functional impairment. For instance, higher levels of disordered gaming have been shown to be consistently associated with mood disorders, depression, stress, and anxiety (Bonnaire & Baptista, 2019; Pontes, 2017), as well as other psychiatric disorders, such as obsessive-compulsive disorder and attention deficit hyperactivity disorder (Pearcy et al., 2017). Moreover, a recent meta-analytic study provided further support to the notion that disordered gaming is significantly associated with a wide range of detrimental health-related outcomes that impairs the quality of life of gamers (Männikkö et al., 2020). In terms of individual differences related to personality traits, a recent meta-analysis reviewing the relationship between disordered gaming and personality across 21 empirical studies found that disordered gaming has been examined in relation to 24 distinct personality traits, with some of these traits (e.g., high neuroticism and low conscientiousness) posing as risk factors for disordered gaming (Şalvarlı & Griffiths, 2019).

Interestingly, mostly similar findings have been reported in the literature investigating both specific and generalized Internet-based problematic behaviors. For example, problematic Internet and smartphone literature has consistently linked depression and anxiety with problematic digital technology use (Elhai et al., 2017; Hussain et al., 2017; Rozgonjuk et al., 2018). A large cross-cultural empirical study investigating key risk factors for problematic smartphone use in relation to specific Internet-based behaviors (Lopez-Fernandez et al., 2017) found that greater levels of social networking use, video game use, online shopping, viewing television shows online, downloading contents, chatting and messaging online predicted higher levels of problematic smartphone use, accounting for about 24% of its total variance. Relatedly, neuroticism and impulsivity have been linked to problematic Internet and smartphone use (Kim et al., 2016; Peterka-Bonetta et al., 2019; Rozgonjuk et al., 2019). In relation to more specific problematic behaviors, depression and anxiety have been found to be associated with online gambling (Barrault & Varescon, 2013), pornography viewing (Borgogna et al., 2018), online shopping (Claes et al., 2016), and social networking use (Baker & Algorta, 2016). Additionally, Marmet et al. (2019) demonstrated how gambling, online sex, smartphone use, gaming, and internet use explain a relatively high variance in social anxiety disorder, major depression, ADHD, and borderline personality disorder, likely highlighting shared commonalities between these constructs. In terms of individual differences, higher levels of neuroticism and/or impulsivity have been linked to online gambling (Trivedi & Teichert, 2018), pornography viewing (Wéry et al., 2018), online shopping (Lee, 2018), and social networking use (Marengo et al., 2020). For an overview on neuroscientific findings in this area, please see review studies by Becker & Montag (2019) and Wegmann et al. (2018).

The aforementioned empirical findings further suggest that these Internet-based problematic behaviors may overlap to some extent. There is a paucity of studies investigating the associations between different problematic Internet-based behaviors. Thus, one potential methodological approach that may be helpful in illuminating how these specific activities – their corresponding symptoms – are potentially intertwined with each other, is by implementing a network analytic approach. This perspective is useful as different psychological disorders and their symptoms might influence each other (Borsboom &

Cramer, 2013). By partialling out the variance of other variables, one may be able to have a clearer picture of how two given symptoms are conditionally related to one another. A recent example in the field of Internet-based problematic behaviors was provided by Rozgonjuk, Sindermann, Elhai, Christensen, et al. (2020) in their study where the authors demonstrated how the symptoms of different problematic social media platforms uses are linked to each other. Similarly, applying a network analytic approach in the current study – including different Internet-based problematic behaviors' symptoms – enables to explore whether clusters of separate entities could be observed or if there are pan-behavioral symptoms that form their own links and clusters, which is key to advance the field by helping disentangle previous scholarly debates regarding the uniqueness of key Internet-based behavioral addictions (see Griffiths & Pontes, 2014).

Based on the aforementioned rationale, the aims of the current study are to study a large international sample of online gamers and investigate (a) the extent to which symptoms and tendencies of Internet-based problematic behaviors such as problematic online gaming, gambling, shopping, pornography, and social networking may be associated with each other; (b) whether symptoms of Internet-based problematic behaviors form distinct entities; and (c) which of these behaviors elicit the highest problematic behavior symptom scores. With regards to these aims, the following hypotheses were devised:

H1: *The summed scores of problematic online gaming, online gambling, problematic online shopping, problematic online pornography, and problematic online social networking will positively correlated with each other.* It has been found that these behaviors tend to be generally correlated with a general problematic Internet use across different cultures (Montag et al., 2015; Müller et al., 2017). Furthermore, in general, problematic Internet use has been viewed as an overarching umbrella tying these conditions together (Baggio et al., 2018). Therefore, it may be assumed that these conditions are correlated due to an underlying cause: activities that may be fueled by a medium, the Internet (Davis, 2001; Griffiths, 1999; Griffiths & Szabo, 2014; Montag et al., 2015; Pontes et al., 2015).

H2: *The responses to problematic online gaming, online gambling, problematic online shopping, problematic online pornography, and problematic online social networking items will form distinct clusters of Internet-based problematic behavior symptoms*. While these behaviors may co-occur, the items of these scales form separate clusters of specific behaviors. There is evidence for this assumption stemming from Baggio et al. (2018) who found that gaming and cybersex (two different activities) formed distinct clusters, and were connected by the medium (i.e., the Internet). Hence, the present study acknowledges that there may occur functional overlap (e.g., intermittent reinforcement) between gaming and gambling, and gaming and social networking.

H3: *Problematic online gaming scores will be the highest in comparison to other self-reported Internet-based problematic behaviors scores*. Because this study is using a sample of gamers, it seems logical to expect that the most prevalent problematic behavior will be related to problematic online gaming. Investigating this hypothesis constitutes a quality assurance of the data set within the present investigation.

It is envisaged that the results of this study will yield important theoretical as well as practical implications. With regards to theoretical implications, this study will provide important empirical evidence to the generalized vs specific Internet-based problematic behaviors debate. Although no generalized measure for problematic Internet use was administered in the present study, unique clusters for specified problematic behaviors would be more salient for the latter concept. From a practical standpoint, the study will outline the potential problematic behaviors, which could co-occur in people who exhibit daily life adversities due to disordered gaming symptoms. This is an important goal since knowing

about co-occurrence of problematic behaviors may be helpful in prevention and intervention of problematic gaming (but also other Internet-based problematic behaviors).

2. METHODS

2.1. Sample and Procedure

The data were collected within a larger project via an international online survey platform since 2019, which was promoted worldwide to encourage responsible gaming behavior and awareness about problematic gaming behavior [PLATFORM BLINDED FOR REVIEW]. Although the data was also collected during 2020 and 2021, we only included participants sampled in 2019 due to potential confounding effects of the global pandemic. The survey was conducted in English language and was not bound to a specific country. Therefore, there were participants from different countries. The respondents had access to the platform via an online link advertised across several sources including for instance webpages, specialized forums, online news channels and aggregators, and the like. As a characteristic of online data collection, it is not possible to estimate how many respondents had access to the link nor its source. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study. The study project was approved by the Institutional Review Board of [UNIVERSITY BLINDED FOR REVIEW].

The original sample of the current study comprised participants who responded to the items of scales of interest (described in subsection 2.2. Measures), amounting to N = 5,905 participants. During data cleaning, respondents were excluded based on the following criteria: were not in the age range of 12-80 years; had not played video games over the past 12 months; reported playing a video game that did not actually exist (this item was used as a careless response detection question); spent more than 119 hours per week on gaming (indicating to less than 7 hours of sleep on an average week day); reported spending more than 48 hours of gaming on weekend (Saturday and Sunday); self-declared to be professional gamers; reported not having sufficient proficiency in English language.

The effective sample, therefore, comprised N = 4,416 respondents (age M = 23.31, SD = 6.72, where age ranged from 12 to 80. A total of 4,142 (94%) of respondents were male, and 2,152 (49%) reported to be employed. About 1,700 (38%) gamers reported being in a relationship. In terms of education, 366 (8%) participants had not graduated from high school, 1,616 (37%) had high school as their highest level of education, whereas 880 (20%) people had graduated from a college. Regarding education levels, 1,108 (25%) study participants had a Bachelor's, 420 (10%) Master's, and 26 (1%) people had a PhD degree. The sample was highly heterogenous regarding the country of origin reported by participants, but the highest proportions of respondents came from Russia (761; 17% of total sample), France (666; 15%), Spain (492; 11%), Poland (270; 6%), Argentina (201; 5%), United Kingdom (198; 4%), Mexico (191; 4%), and Chile (170; 4%). Despite the cultural variation, all participants in the effective sample reported being proficient in English.

2.2. Measures

In addition to socio-demographic variables, all participants were asked to respond to items measuring the frequency of specific Internet-based problematic behaviors (Müller et al., 2017): problematic online gaming (A1), online gambling (A2), problematic online shopping (A3), problematic online pornography (A4), and problematic online social networking (A5). The four items were as following (note that [doing the *behavior*] is generally used to indicate each specific Internet-based behavior): "*1. How often do you find that you spend more time [doing the behavior] than you intended?*"; "*2. How often do you neglect household chores to*

spend more time [doing the behavior]?"; "*3. How often do you feel preoccupied with [doing the behavior] when offline or fantasize about [doing the behavior]?*"; "*4. How often do you choose to spend more time [doing the behavior] over going out with others?*" The anchors for each item ranged from 1 = *never* to 5 = *very often*. The scores were summed for each specific behavior scale. Cronbach's alphas/McDonald's omegas with the current study's effective sample data for each scale were: α = .79/ω = .79, (A1), α = .85/ω = .86, (A2), α = .81/ω = .81, (A3), α = .82/ω = .82, (A4), and α = .83/ω = .83 (A5).

2.3. Statistical analyses

The data were analyzed within the R language and environment for statistical computing and graphics, version 4.0.3 (R Core Team, 2019). Cronbach's alphas and McDonald's total omegas were computed with the *psych* package v 2.1.3 (Revelle, 2021). Spearman correlation coefficients (*p*-values adjusted with the Holm's method) were computed for estimates of associations between the summed scores. Absolute correlation coefficients could be interpreted as representing small (r = |.10-.30|), medium (r = |.30- .50|), or large (r = |.50-1.00|) effect sizes (Cohen, 1992).

In order to investigate the item-level relationships between the specific Internet-based problematic behaviors examined, we used Exploratory Graph Analysis (EGA) (Golino & Christensen, 2020; Golino & Epskamp, 2017). EGA is a network analytic approach where, firstly, associations (e.g., correlations) between variables are estimated, followed by the implementation of a community detection algorithm that allows for empirical identification of clusters in multidimensional data (Christensen, 2020; Golino & Christensen, 2020). The network was estimated using the Gaussian Graphical Model (GGM; Epskamp, Waldorp, et al., 2018), implementing the Graphical Least Absolute Shrinkage and Selection Operator in combination with Extended Bayesian Information Criterion (EBIC) model selection (GELASSO; Epskamp, Borsboom, et al., 2018). In addition, GGM includes edges (graphical depiction of associations between a pair of variables), which are partial correlations between the nodes (graphical representations of variables), controlled for other nodes in the network. For dimension identification, we used the Louvain community detection algorithm, since it has been demonstrated to perform well with ordinal data (Christensen, 2020). We used the the *EGAnet* package version 0.9.8 (Christensen & Golino, 2019; Golino & Christensen, 2020) to replicate EGA networks for 1,000 times with random sample permutations.

In addition to network stability statistics (e.g., the frequency of similar networks across replica networks, etc.), it is possible to retrieve network loadings for each item across each estimated dimension. A network loading is the sum of connections to a node (also known in the literature as node strength) that is computed for each item's associations within its empirical dimension and between every other dimension. The average network loading is computed using bootstrap analysis. Christensen & Golino (2020) have suggested that network loadings with values of |.15|, > |.25|), and > |.35| could be considered as small, medium, and large in effect sizes, respectively. If a network loading for a given item has values greater than |.15|, this could suggest that the item may be multidimensional (Christensen & Golino, 2020). We used the package qgraph v 1.6.9 (Epskamp et al., 2012) to visualize the median EGA network.

Finally, in order to compare different Internet-based problematic behaviors, we used summed scores to conduct within-subjects analysis of variance (ANOVA) with the *nlme* package v 3.1-149 (Pinheiro et al., 2019). In addition, we used the *multcomp* package v 1.4-15 (Hothorn et al., 2008) to compute *post-hoc* tests (*p*-values adjusted with the Holm method). Finally, Cohen's *d*-s were computed as effect size estimates for scale score differences (Lakens, 2013). Effect sizes could be considered as very small (d = |.10|), small (d = |.20|), medium (d = |.50|), large (d = |.80|), very large (d = |1.20|), or huge (d = |2.0|)

(Cohen, 1988; Sawilowsky, 2009). The package *ggplot2* v 3.3.3 (Wickham, 2009) was used to visualize the differences between scale score sum means.

3. RESULTS

3.1. Descriptive statistics and correlations

Descriptive statistics and bivariate Spearman correlations between the key variables used in the study are presented in Table 1.

Problematic online gaming was found to be positively associated with all other Internet-based problematic behaviors with, generally, medium effect sizes (r scores ranging from .269 to .389). Online gambling yielded small effects despite its significant links with problematic online shopping (r = .231), problematic social networking (r = .226), and problematic online pornography (r = .193). Problematic online shopping generated small-effect associations with problematic online gaming (r = .269) and online gambling (r = .231), and medium-effect associations with problematic online social networking (r = .358) and problematic online pornography (r = .317). Problematic online pornography was positively associated with problematic online social networks use (r = .358). Age had a small negative correlation with online gaming (r = -.044), online gambling (r = -.086) and online social networks use (r = -.157), and a small positive correlation with online shopping (r = .040).

[TABLE 1 HERE]

3.2. Item-level network of Internet-based problematic behaviors

The results of bootstrapped EGA showed that a network with five dimensions/clusters was the most prevalent (median dimensions = 5, SE = .159; 5-dimensional solution occurred in 97.4% of replica networks). Network loadings are presented in Table 2, while a median EGA network is included in Figure 1. Network loadings showed that items of respective Internet-based problematic behaviors scales form their own dimension. Furthermore, the network loadings on the respective dimensions were medium (> |.25|) or large (> |.35|) in terms of effect sizes (Christensen & Golino, 2020). Finally, there were no loadings that had another value (that is, in addition to loading to its core dimension) higher than |.15|, which could suggest potential multidimensionality of an item. The results evidence that each item was specific to their respective scale. However, item 4 of gaming also had an additional loading that amounted to |.15| which loaded on to the online gambling dimension with the value.

[TABLE 2 HERE]

[FIGURE 1 HERE]

As suggested by network loadings in Table 2, the median bootstrapped EGA network in Figure 1 also showed that all items belonged to their respective scale, indicating that associations within problematic online shopping, online pornography, and problematic online social networking are somewhat similar. Item 1 ("*How often do you find that you spend more time* [doing the *behavior*] *than you intended?*") was more strongly correlated with items 2 ("*How often do you neglect household chores to spend more time* [doing the *behavior*]*?*") and 3 ("*How often do you feel preoccupied with* [doing the *behavior*] *when offline, or fantasize about* [doing the *behavior*]*?*"). In addition, item 4 ("*How often do you choose to spend more time* [doing the *behavior*] *over going out with others?*") showed the strongest links with Item 2.

The same exact patterns, however, could not be observed in problematic online gaming and online gambling. For instance, problematic online gaming items did not yield

strong relationships between items as observed within other clusters. Considering the associations between different problematic behaviors, items 4 appeared to be correlated (although weakly) across different Internet-based problematic behaviors. Hence, spending more time online over going out with others was mostly strongly related to each other across different specified Internet-based problematic behaviors within the current sample (except for problematic online shopping).

3.3. Comparing Internet-based problematic behaviors

The one-way within-subjects ANOVA yielded a statistically significant difference between at least two Internet-based problematic behaviors scale scores, $F(4, 17660) = 1981.98$, $p < .001$. The results of the *post hoc* tests (*p*-values adjusted with the Holm method) as well as effect size estimates (Cohen's *d*-s) for differences between scale scores are presented in Table 3. Scale means with 95% confidence intervals are in Figure 2.

[TABLE 3 HERE]

The findings obtained indicated that problematic online gaming scores were significantly higher than the scores of other Internet-based problematic behaviors scores (means and standard deviations for the scales can be found in Table 1). In general, the effect sizes of differences between problematic online gaming and Internet-based problematic behaviors scores were medium (problematic online social networking and problematic online gaming, $d = |.705|$) to large (problematic online shopping and problematic online gaming, $d = |1.271|$).

Furthermore, problematic online gambling scores were higher than problematic online pornography use ($d = |.136|$) and problematic online shopping scores ($d = |.427|$), yielding very small to small effect sizes, respectively. Problematic online social networking scores were higher than online gambling scores with small effect size ($d = |.139|$).

Problematic online social networking scores were higher than problematic online pornography ($d = |.275|$) and problematic online shopping ($d = |.567|$), with small to medium effect sizes, respectively. There was a small-effect difference between problematic online shopping and problematic online pornography ($d = |.292|$), with latter being higher.

[FIGURE 2 HERE]

4. DISCUSSION

This study had several aims. Firstly, we investigated the bivariate relationships between summed scores of problematic online gaming, online gambling, problematic online shopping, problematic online pornography, and problematic online social networking. Secondly, these constructs were further examined at the item-level by implementing a network analytic approach in combination with a community detection algorithm. Finally, we also investigated which of these Internet-based problematic behaviors were the most prevalent (reflected in summed scale scores) in the sample recruited. To address these research aims, three specific hypotheses were developed.

It was first hypothesized that the investigated Internet-based problematic behaviors would be associated with each other (H1). The current results supported this hypothesis as all variables were associated with each other in the bivariate correlational analysis conducted. It should be noted, however, that the sizes of associations ranged from small (lowest correlation was $r = .193$ between problematic online pornography and online gambling) to medium (highest correlation was $r = .389$ between problematic online gaming and problematic online social networking). These results are in line with the hypothesis that Internet-based problematic behaviors are inter-correlated via some general pathways. The finding that

problematic online gaming and social networking were strongly related, corroborates previous empirical research suggesting that social media addiction and IGD exert similar effects on peoples' psychological health (Pontes, 2017) and emerging research reporting cross-sectional associations between these two problematic online behaviors (Wartberg et al., 2020; Wong et al., 2020).

Moreover, since previous works have found the association between more general problematic Internet use and some of these activities (Montag et al., 2015; Müller et al., 2017), there are similarities between these behaviors and psychopathology (Baker & Algorta, 2016; Barrault & Varescon, 2013; Borgogna et al., 2018; Claes et al., 2016) as well as personality traits (Lee, 2018; Marengo et al., 2020; Trivedi & Teichert, 2018; Wéry et al., 2018). It could be that people with certain traits and predispositions may gravitate towards problematic tendencies in general. This, to some extent, would also be in line with the more prominent theoretical frameworks developed for behavioral addictions, such as the I-PACE model (Brand et al., 2016, 2019) and the cognitive-behavioral model of pathological Internet use (Davis, 2001). Since most of the variance between these Internet-based problematic behaviors were not accounted for by all the bivariate relationships reported, examining their associations at the item-level in a network analytic approach may be helpful.

Regarding the second hypothesis (H2), we expected that each of the Internet-based problematic behavior investigated in the study would form distinct clusters of symptom severity at the item-level responses. The results of the EGA showed that, indeed, this was the case and that H2 was empirically supported. When all possible links were partialled out, the symptoms of these different Internet-based problematic behaviors were still present. Despite this, the community detection algorithm provided evidence that all of the observed symptoms clustered onto their respective scale. This means that even though the Internet-based problematic behaviors investigated in the current study were associated with each other, they could still be considered as distinct entities pertaining to their specific online activities. These findings are consistent with the contention regarding the specificity of some problematic Internet use behaviors (Brand et al., 2016; Davis, 2001; Montag et al., 2015), suggesting that the Internet serves as medium that feeds problematic behaviors (or is used for, e.g., mood regulation; Kardefelt-Winther, 2014). In addition, it could be observed that on symptom-level, items generally tended to correlate; in other words, if a person tended to spend more time on gaming, they also spent more time on, e.g., social networking and gambling. These results hint to a possible underlying factor which seems to introduce individual differences in engaging in excessive behaviors.

We further hypothesized that among the participants recruited, problematic online gaming scores would be the highest in comparison to other Internet-based problematic behaviors (H3) since all participants were gamers. Accordingly, the results obtained lent support to H3, with the effect sizes in score differences between problematic online gaming and other problematic online behaviors being the largest (in comparison to other *post hoc* pairwise comparisons). Although this result is unsurprising since the study investigated a sample of gamers, it still is a finding of significance. Earlier works investigated generalized PIU among gamers, likely shedding light mostly on tendencies towards GD (e.g., Montag et al., 2011). However, compared to other online behaviors, it is notable that problematic online social networking scores were significantly higher than the additional Internet-based problematic behaviors investigated except for problematic online gaming. This may indicate that the co-occurrence of this Internet-based problematic behavior is relatively prevalent. Moreover, as previously suggested, this finding is coherent with results found from studies suggesting a link between problematic online gaming and problematic online social networking (please cite). Nevertheless, problematic online shopping could be considered as

the least problematic online behavior among gamers, since these two the Internet-based problematic behaviors were not strongly associated.

This study contributes to the field of behavioral addictions in several ways. Firstly, we provide a methodologically sound and multifaceted view on the associations between different specific Internet-based problematic behaviors. We demonstrate how despite correlating with each other, each of these the Internet-based problematic behaviors form separate entities due to their unique focus on specific activities. Therefore, this study provides additional robust empirical support to the notion that the Internet is rather the fuel used for feeding problematic behaviors in a variety of areas. Secondly, to the best of our knowledge, this is the first study investigating a relatively wide range of Internet-based problematic behaviors among gamers. Although it might have been expected that gamers would exhibit higher levels of problematic online gaming, the novelty relates to the fact that the results obtained indicated that gamers scored relatively high on problematic online social networking and low on problematic online shopping (a recent work highlights how video game and social media design both can foster problematic behaviors; Montag, Lachmann, et al., 2019), further extending the findings by studies simply reporting an association between these two Internet-based problematic behaviors. Finally, the results of this study may be useful in the development of preventative and intervention initiatives in relation to disordered gaming. Since the results obtained highlighted how disordered gaming co-occur with other key Internet-based problematic behaviors, there may be a need to view GD as one facet of a myriad of Internet-based problematic behaviors (Pontes, Schivinski, Brzozowska-Woś, et al., 2019). Since the inclusion of the IGD in DSM-5 as well as GD in the ICD-11, research into the psychology of gaming has been greatly facilitate. It is envisaged that the current study will pave the way to subsequent research further investigating the dynamics of these relationships.

The potential limitations of this study include using a self-selected and gender-imbalanced sample, self-report measures, and the adoption of a cross-sectional design. Although the sample recruited was relatively large and included more than 4,000 individuals from several countries, it was nonetheless a convenience sample not randomly sampled. Accordingly, this may introduce some bias in the presented results. Secondly, self-reports provide useful information, but it should be taken into account that objectively measured data could provide a more detailed picture of gamers' behavior (Schivinski et al., 2018). It may be that self-reported problematic online behavior scales may not necessarily predict actual gaming, gambling, shopping, pornography use, and social networking behaviors. As could be observed in the problematic smartphone use literature, objectively measured data may introduce significant discrepancies between actual and self-reported data (Ellis et al., 2019; Rozgonjuk et al., 2018; Rozgonjuk, Pruunsild, et al., 2020). On the other hand, it should be noted that problematic use does not equal objective use, since the former aims to assess daily-life adversities due to excessive use. Therefore, there is always the subjective component of experiencing adversities due to excessive engagement in each problematic behavior. Third, because the current sample mainly included male participants, it could be interesting to investigate if the results would be similar in a female-only sample of gamers. Fourth, investigating relationship satisfaction in the context of gaming could further provide insights into how gaming could potentially also be associated with other problematic Internet-based behaviors. Fifth, although the presented sample covered a wide range of ages (12–80 years), the majority of the respondents were relatively young (average age of around 23 years); it may be relevant to further investigate differences in the associations between Internet-based problematic behaviors also in older cohorts. Finally, even though this may be of less relevance to the present study, since we did not conduct causal modeling, future research

should investigate how these different Internet-based problematic behaviors develop and (co-) evolve longitudinally.

In conclusion, the findings presented in this study empirically evidence that even though different Internet-based problematic behaviors are correlated, they form separate entities. As expected, among gamers the most prevalent Internet-based problematic behavior was related to gaming, while the least prominent was related to online shopping behavior. Additionally, problematic online gaming had the strongest association with problematic social networking. Therefore, mental health practitioners may find it particularly useful when treating patients with GD diagnosis, as disordered gaming may be associated with social needs.

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Table 1. *Descriptive statistics and correlations for problematic Internet-based activities and age.*

	Descriptive statistics		Correlations				
Variable	**Mean**	**S.D.**	**1**	**2**	**3**	**4**	
1. Online Gaming	10.77	3.76					
2. Online Gambling	7.45	3.74	.299***				
3. Online Shopping	5.77	2.64	.269***	.231***			
4. Online Pornography	6.91	3.30	.318***	.193***	.317***		
5. Social Networking	8.00	3.59	.389***	.226***	.358***	.333***	
6. Age	23.31	6.72	-.044*	-.086***	.040*	-.008	-.157***

Notes: N = 4,416. * $p < .05$, ** $p < .01$, *** $p < .001$. Abbreviation: S.D. = Standard Deviation.

Table 2. *Network loadings for bootstrapped EGA items.*

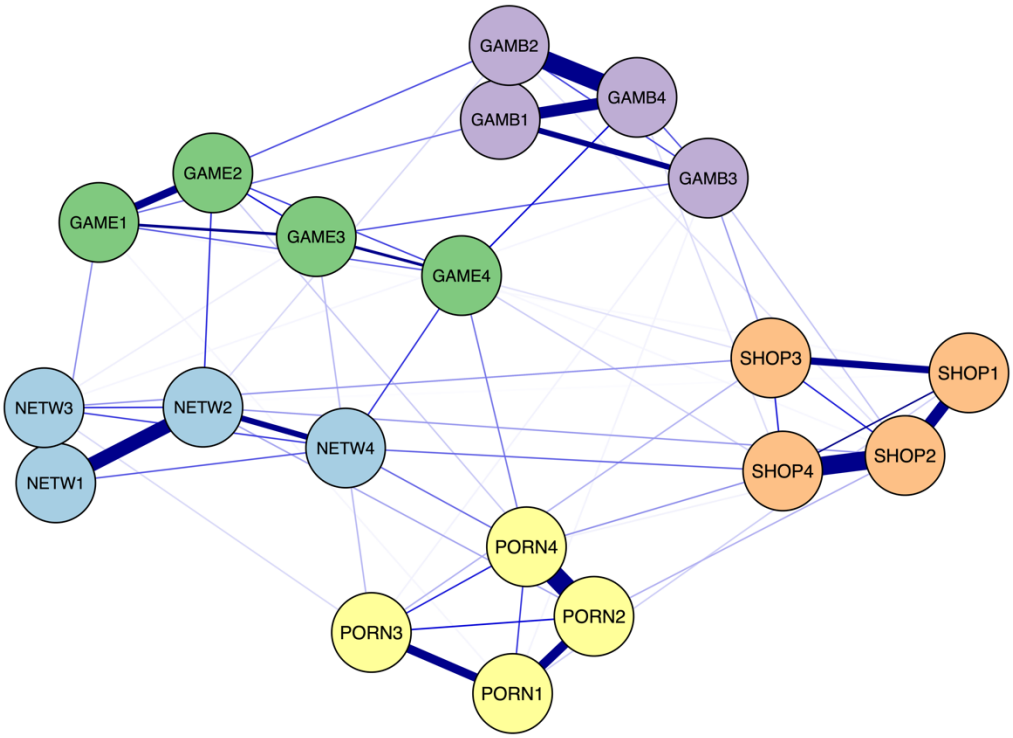
	Dimension				
Item	**1**	**2**	**3**	**4**	**5**
Online Gaming 3	**.317**	.068	.012	.029	.007
Online Gaming 1	**.312**	.056	.003	.004	.046
Online Gaming 2	**.306**	.081	.003	.023	.085
Online Gaming 4	**.253**	-.150	.020	.056	.081
Online Gambling 1	.086	**.446**	0	0	0
Online Gambling 2	.096	**.432**	.013	0	.015
Online Gambling 4	.116	**.395**	.013	0	0
Online Gambling 3	.071	**.256**	.064	.012	.004
Online Shopping 2	.003	.035	**.431**	.038	.043
Online Shopping 1	.003	0	**.390**	.021	.003
Online Shopping 4	.020	.013	**.383**	.046	.062
Online Shopping 3	.012	.039	**.313**	.031	.045
Online Pornography 2	.022	0	.032	**.448**	.036
Online Pornography 4	.055	0	.051	**.374**	.060
Online Pornography 1	.004	.005	.020	**.368**	0
Online Pornography 3	.029	.005	.031	**.340**	.016
Social Networking 1	.046	0	0	0	**.423**
Social Networking 2	.086	.014	.043	.037	**.381**
Social Networking 3	.007	.003	.047	.016	**.357**
Social Networking 4	.082	0	.062	.061	**.270**

Note. Each item's highest loading is outlined with **bold** text.

Table 3. *The comparison of Internet-based problematic behaviors.*

Comparison	Estimate	S.E.	*t*-statistic	Cohen's *d*
Online Gambling – Online Gaming	-3.321	0.059	-56.102***	-0.844
Online Pornography – Online Gaming	-3.854	0.059	-65.108***	-0.980
Online Networking – Online Gaming	-2.772	0.059	-46.836***	-0.705
Online Shopping – Online Gaming	-5.001	0.059	-84.493***	-1.271
Online Pornography – Online Gambling	-0.533	0.059	-9.006***	-0.136
Social Networking – Online Gambling	0.548	0.059	9.266***	0.139
Online Shopping – Online Gambling	-1.680	0.059	-28.391***	-0.427
Social Networking – Online Pornography	1.082	0.059	18.272***	0.275
Online Shopping – Online Pornography	-1.147	0.059	-19.385***	-0.292
Online Shopping – Social Networking	-2.229	0.059	-37.657***	-0.567

Notes: *** $p < .001$. Abbreviation: S.E. = Standard Error.


GAMB2
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PORN4
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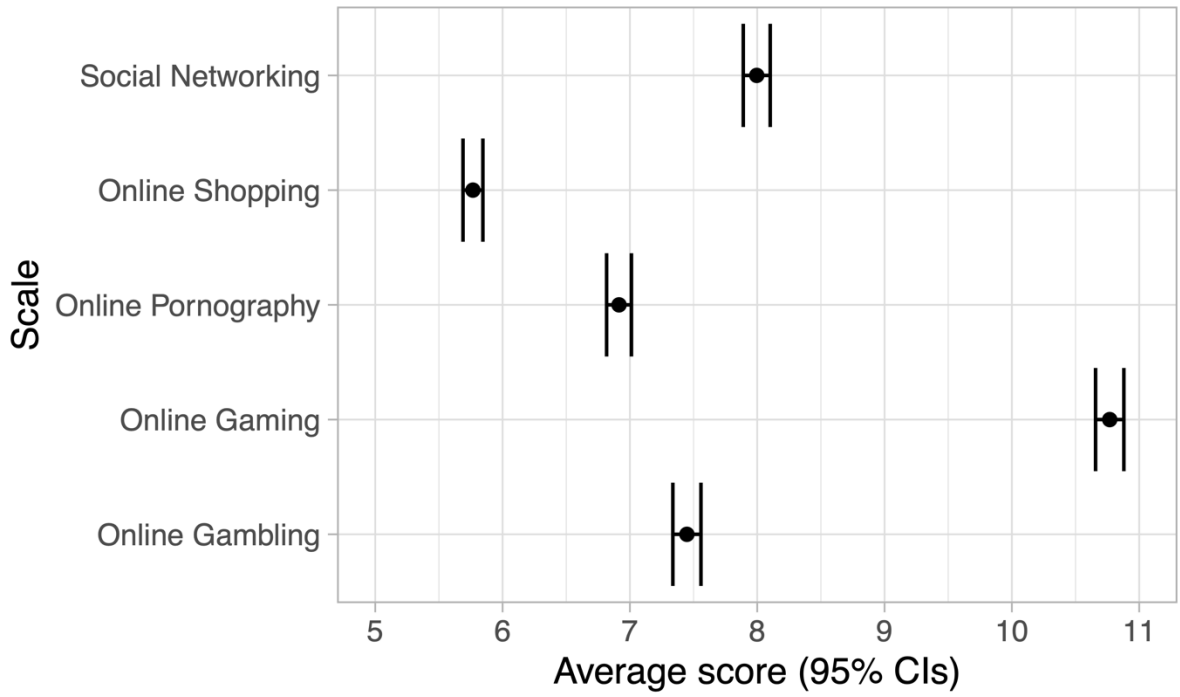
PORN1


Social Networking
Online Shopping
Online Pornography
Online Gaming
Online Gambling
Scale
5
6
7
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11
Average score (95% CIs)

Figure captions

Figure 1. Median bootstrapped exploratory graph analysis (EGA) network. *Notes*. SHOP = problematic online shopping; PORN = problematic online pornography viewing; NETW = problematic online social networking; GAME = problematic online gaming; GAMB = problematic online gambling. Colors of nodes denote to which community a given node belongs to. Edges denote associations between nodes (blue edges = positive correlations; the thickness of the lines represents correlation sizes).

Figure 2. Means and 95% confidence intervals for scale scores.