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How to cite

BAGGIO, Stéphanie et al. Co-morbidity of gambling and Internet use among Internet and land-based gamblers: classic and network approaches. In: International Gambling Studies, 2016, vol. 16, n° 3, p. 500–517. doi: 10.1080/14459795.2016.1242148

This publication URL: https://archive-ouverte.unige.ch/unige:157702
Publication DOI: 10.1080/14459795.2016.1242148

Comorbidity of gambling and Internet use among Internet and land-based gamblers: Classic and network approaches

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Acknowledgements

The Bern gambling survey was supported by the Mandat Interkantonales Programm Glücksspielsuchtprävention der Nordwest und Innerschweiz (AG, BE, BL, BS, LU, NW, OW, SO, UR, ZG), vertreten durch Sucht Schweiz.

The authors wish to thank Stanislas Spilka for his support regarding the ESCAPAD survey.

Disclosure statement

SB and KI have no conflict of interest.

SG has received research funding (2013-2016) from Australian Research Council, Victorian Responsible Gambling Foundation, National Association for Gambling Studies, NSW Office of Liquor Gaming & Racing, Australian Institute for Family Studies, Gambling Research Australia, Sportsbet, Echo/Star Entertainment, UK Responsible Gambling Trust, KPMG Australia, KPMG Tokyo, Cultural and Indigenous Research Centre Australia, Health Outcomes International, ORC International, Communio Canada, Manitoba Gambling Research Program, GP Consulting, Nova Scotia Provincial Lotteries and Casino Corporation.

AB has received funding (2013-2016) from The Swiss National Science Foundation and University of Lausanne.

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Comorbidity of gambling and Internet use among Internet and land-based gamblers: Classic and network approaches

This study investigated comorbidity of problem gambling and Problematic Internet Use (PIU) among adolescent Internet and land-based gamblers, with the classic approach using sum-scores of symptoms and a promising new method, namely the network perspective. This perspective allows testing how multiple disorders are associated, showing symptoms overlap and centralities. We used cross-sectional data from two population-based samples of adolescents aged 17 years in France (n = 2,240) and Switzerland (n = 944). Measures included Internet gambling, problem gambling, and PIU. The classic approach showed that Internet gambling was associated with increased levels of disordered gambling and PIU, but that correlations between disorders were weak (R^2 min = 3.2%, R^2 max = 17.6%). The network perspective showed that the comorbid network of Internet gamblers was more connected in comparison with land-based gamblers. Problem gambling and PIU appeared as separate disorders, but their relationship was increased among Internet gamblers in comparison with land-based gamblers. The network perspective appeared as a promising avenue for a better understanding of addictive disorders, but it should not replace the classic approach, which showed increased levels of addictive behaviours among Internet gamblers.

Keywords: Addiction; Adolescence; Gambling; Network perspective; Population health; Problematic Internet Use.

Comorbidity of gambling and Internet use among Internet and land-based gamblers: Classic and network approaches

INTRODUCTION

Excessive and problematic Internet use has increasingly been reported as a significant concern, particularly among youth who are highly engaged with this technology. Problematic Internet use (PIU) is a term commonly used to refer to excessive engagement in one or more online activity that leads to significant psychosocial and functional impairment (Liu, Desai, Krishnan-Sarin, Cavallo, & Potenza, 2011; Lopez-Fernandez, 2015). Mounting evidence of distress and dysfunction has led the DSM-5 Taskforce to officially call for further research on PIU (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). More specifically, the use of the Internet is also a medium for gambling practices (i.e., gambling for money using Internet-enabled devices). This phenomenon is a recent health concern among young people (Critselis et al., 2013). Notable differences exist between Internet and land-based gamblers, including people who experience problems related to these modes (Gainsbury et al., 2014). Internet gamblers are more likely to have addictive behavioural patterns, such as problem gambling (Gainsbury, Wood, Russell, Hing, & Blaszczynski, 2012; Jiménez-Murcia et al., 2011; Wardle, Moody, Griffiths, Orford, & Volberg, 2011) and increased involvement in gambling activities (LaPlante, Nelson, & Gray, 2014) as compared to land-based gamblers. Internet gamblers are also more likely to report consuming alcohol and illicit drugs compared to land-based gamblers (Griffiths, Wardle, Orford, Sproston, & Erens, 2009; Kairouz, Paradis, & Nadeau, 2012; Wood & Williams, 2011), which may represent a greater likelihood of comorbid addictive disorders. A study of 2,006 US high-school student gamblers found that involvement in Internet gambling, particularly among at-risk and problematic groups, was associated with heavy alcohol use and poor academic functioning, indicating Internet

gambling is related to distinct risks (Potenza et al., 2011). Recent studies controlling for gambling involvement (i.e., diversity of gambling forms) refuted the existence of such an association (LaPlante et al. 2014; Philander and MacKay 2014; Gainsbury, Russell, Blaszczynski, & Hing, 2015a). Indeed, the number of games played is predictive of gambling problem severity and thus may be a confounder. Some studies showed that when this variable is controlled for, the relationship between game-specific engagement and disordered gambling disappeared or decreased.

To our knowledge, no studies have specifically compared the relationship between problem gambling and PIU among Internet versus land-based gamblers. The current study filled this gap and investigated the comorbidity of problem gambling and generalized PIU (i.e., their co-occurrence) among Internet versus land-based adolescents gamblers. Adolescence is a vulnerable developmental period for engaging in risk behaviours and the development of addictions (Derevensky & Gupta, 2004). Prevalence estimates of problem gambling and PIU are typically higher among adolescent than adult populations (Bakken, Wenzel, Götestam, Johansson, & Oren, 2009; Derevensky & Gupta, 2004; Grant, Chambers, & Potenza, 2005; Johansson & Götestam, 2004; Liu et al., 2011).

Relationship between problem gambling, PIU, and Internet gambling

Despite different behavioural presentations, there is evidence that the psychological and social processes underlying various behavioural addictions are similar (Fong, Reid, & Parhami, 2012). Individual behavioural addictive disorders may represent different expressions sharing common etiologies (Yau et al., 2014). However, the specific intrapsychic and external factors that contribute to excessive and pathological behaviours have not been conclusively established (Fong et al., 2012; Grant, Potenza, Weinstein, & Gorelick, 2010). Subsequently,

we currently have a very limited understanding the processes and underlying mechanisms of behavioural addictions (Fong et al., 2012).

Although the manifestations of behavioural addictions differ in terms of the activity used excessively, these disorders appear to share clinical characteristics (Brezing, Derevensky, & Potenza, 2010). Few studies have investigated the relationship between problem gambling including online or land-based gambling) and PIU (Lehmann, Akré, Berchtold, Flatz, & Suris, 2016). It has been argued that although problem gambling and PIU shared common etiologies and consequences, they are distinct and thus should be considered as separate disorders (Dowling & Brown, 2010). Indeed, Dowling et al. (2010) concluded that there was no overlap between problem gambling and PIU. However, in this study using a sample of university students, only eight participants were classified as at-risk or problem gamblers and 16 participants were classified as at-risk Internet users. This limits the extent to which the findings can be generalized to other populations. On the contrary, Tozzi, Akre, Fleury-Schubert, & Suris (2013) reported an increased PIU among at-risk/problem gamblers. An Australian study found that gamblers at-risk for or experiencing gambling problems were more likely to experience problems with online games if they also experienced psychological distress, suggesting that maladaptive behaviours (either excessive online gaming or gambling) may be used by people to cope with or escape from distressing emotions (Gainsbury, King, Russell, Delfabbro, & Hing, 2016). A study of 1884 US high-school students found that problem gambling severity was greater among respondents at risk for or experiencing PIU (Yau et al., 2014). This finding is similar to reports that problem gambling and PIU are more likely to co-occur among adults (Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000; Young, 1998). Other studies indicate that Internet gambling is more likely to be associated with PIU (Critselis et al., 2013; Tsitsika et al., 2011), using measures of generalized PIU, that

is, maladaptive cognitions and a global set of behaviours not associated with a particular content, as opposed to specific PIU (overuse of content-specific online activities, such as gaming or gambling) (Davis, 2001). As the minimal research findings are inconsistent, further research is needed to understand the relationship between these two proposed behavioural addictions.

Evaluation of the relationship between disorders

The relationship between different disorders—not only problem gambling and PIU—is usually investigated using binary variables (presence/absence of the disorder). Then, overlap between groups is at focus to see whether the disorders covary, which is possible to discern using bivariate or multivariate analyses (Dowling & Brown, 2010; Tozzi et al., 2013). Thus, the disorder is seen as a latent construct that causes the symptoms (Cramer, Waldorp, van der Maas, & Borsboom, 2010), modelled with a summary derived from sum-scores or binary diagnostics based on pre-established cut-offs. Several issues have been highlighted about this approach (we are going to call it the *classic approach*), such as the assumption of the disorder being a single condition, constituted with interchangeable and independent symptoms (Cramer et al., 2010; Fried et al., 2015; Schmittmann et al., 2013) and the high heterogeneity of the category of "disordered people" (Fried & Nesse, 2015). Regarding comorbidities, overlapping symptoms and fuzzy boundaries are not taken into account (Cramer et al., 2010).

A recent framework overcomes these gaps: the *network approach*. This conceptualization hypothesizes that a disorder is a cluster of related symptoms. In other words, it consists of networks of symptoms supposed to be directly related through causal relations (Cramer et al., 2010). Therefore, the disorder is no longer a latent variable or a summary, but a system composed of the symptoms themselves (Schmittmann et al., 2013). In this perspective, the

network model represents symptoms as nodes and their relationships as edges. Each symptom has strength, i.e., a specific centrality depending on its association with other symptoms (Costantini et al., 2015). Therefore, network models allow symptoms to have unequal weight, and some symptoms may be more central than others. This perspective also allows for testing comorbidities and assessing how multiple disorders are associated (Cramer et al., 2010), such as symptoms overlap (bridge symptoms).

The present study aimed to investigate the comorbidity of problem gambling and generalized PIU among Internet and land-based gamblers, comparing the classic approach and the network perspective. We hypothesized that 1) Internet gamblers will have higher levels of both disorders compared to land-based gamblers, and 2) problem gambling and PIU are more likely to co-occur and to have strong relationships for Internet gamblers as compared to land-based gamblers.

METHOD

Participants and procedures

The data included two large-scale national surveys conducted in France and Switzerland. Formal ethics approval was granted for both studies.

1) The seventh ESCAPAD survey (Survey on Health and Behaviour) is a cross-sectional survey conducted by the French Monitoring Centre for Drugs and Drug Addiction in association with the National Service department to estimate drug-use prevalence in France. It was conducted in March 2011 in all civilian or military centres across the national territory and overseas during National Defense Preparation Day, which is mandatory for all seventeen-year-old French adolescents. The survey has obtained the Public Statistics general interest seal of approval from the National Council for Statistical Information and the approval of the

ethics commission of the National Data Protection Authority; the questionnaire follows the recommendations of the European Monitoring Center for Drug and Drug Addiction.

A total of 32,249 French adolescents were surveyed, with a response rate exceeding 98%. The final sample comprised 27,402 French adolescents aged 17 living in metropolitan France (Spilka, Le Nézet, & Tovar, 2012). This study focused on the 2,440 teenagers who gambled and used the Internet (both activities) during the previous seven days (8.9%). Missing values were listwise deleted, which left a final sample of n=2,122 (87.0%). We tested whether participants excluded due to missing values were different from other participants. There were no significant differences in the variables included in the study.

2) The Bern gambling survey was a large survey conducted in 2011 among first- and second-year post-compulsory education adolescents living in Switzerland aged 17 to evaluate gambling problems (Suris, Akré, & Berchtold, 2012). They constituted a representative sample of adolescents living in the canton of Bern (one of the largest canton in Switzerland). The Ethics Committee of the canton of Vaud approved the study's protocol. Six high schools, seven vocational schools (apprenticeship), and two schools of general education were included. All registered students in first and second years were invited to participate (n=3,272). A total of 89 students did not want to participate (2.7%), and 49 were excluded because they had not completed the questionnaire correctly (1.5%), so the final sample included 3,134 participants (response rate = 95.8%). This study focused on the participants who reported gambling and Internet use during the previous twelve months (n=944, 30.1%, one participant with missing value was excluded).

Measures

1) ESCAPAD survey

Internet addiction. Internet addiction was assessed using the Problematic Internet Use Questionnaire (PIUQ) for the previous seven days (Demetrovics, Szeredi, & Rózsa, 2008), and more specifically, its 12-item short form validated on a French sample (Kern & Acier, 2013), using a five-point scale ranging from "never" to "very often." A sum-score of Internet addiction was also computed ($\alpha = .85$) to keep the whole variability of the scale and because of the lack of consensual cut-off score (Laconi, Rodgers, & Chabrol, 2014).

Problem gambling. Problem gambling was assessed using the Problem Gambling Severity Index (PGSI, Ferris & Wynne, 2001), a component of the Canadian Problem Gambling Index. It was assessed with nine questions on a four-point scale and for the period of the previous twelve months. A sum-score was also computed ($\alpha = .74$) to maintain the whole variability of the scale and because of the low number of participants who may be classified as problem gamblers.

Internet gambling. Participants were asked whether they had gambled on the Internet at least one time during the previous twelve months (including all forms of games). Participants who answered "yes" were recorded as Internet gamblers (including "mixed" gamblers, who were also land-based gamblers), whereas all the others were recorded as land-based gamblers.

Covariates. Age, gender, and parental professional level (highest level among mother and father were taken into consideration, including the following categories: "farmer," "manual worker," "employee," "intermediate occupation," "executive," "independent," and "without profession/unknown." The two categories "without profession" and 'unknown' were combined because only one participant mentioned "without profession." The number of games played was also recorded for gambling behaviour.

2) Bern gambling survey

Internet addiction. Internet addiction was assessed using the 20-item Internet Addiction Test (IAT) for the previous twelve months (Khazaal et al., 2008; Widyanto & McMurran, 2004) using a six-point scale. A sum-score of Internet addiction was also computed (α = .92, 0-100, with a higher score indicating higher Internet addiction).

Problem gambling. Problem gambling was assessed over the previous twelve months using the South Oaks Gambling Screen Revised for Adolescents (SOGS-RA) (Winters, Stinchfield, & Fulkerson, 1993), which includes twelve questions. Participants answered "yes" or "no" to each criterion. A sum-score was also computed (α = .79, 0-12).

Internet gambling. Participants were asked whether they had gambled on the Internet during the previous twelve months (including all forms of games). Participants who answered "yes" were recorded as Internet gamblers, whereas all the others were recorded as land-based gamblers.

Covariates. Age, gender, and perceived family income ("higher than average," "average," and "lower than average") were assessed. The number of games played was also recorded for gambling behaviour.

Statistical analyses

All analyses were performed separately for the two samples.

Classic approach

First, we used traditional statistics to compare Internet gamblers and land-based gamblers. We performed bivariate analyses between the two groups (Internet gamblers and land-based gamblers) and problem gambling, PIU, and socio-demographic covariates using Chi-square (socio-demographic covariates), t-test (age for ESCAPAD survey), and quasi-Poisson regressions (problem gambling and PIU). We performed quasi-Poisson regressions of problem gambling and PIU on Internet gambling controlling for socio-demographic

characteristics. We also control for the number of games played for gambling behaviour, because it may affect the relationship between Internet gambling and problem gambling. We also reported Spearman correlations between problem gambling and PIU, for the whole sample and separately for Internet and land-based gamblers. We compared whether the correlations of Internet and land-based gamblers were significantly different using Fisher r to z's transformations.

Network perspective

Then, the networks of problem gambling and PIU (comorbid networks) were investigated among Internet gamblers and land-based gamblers separately. We computed Spearman correlations between the symptoms (excepted for the network of SOGS-RA, we used tetrachoric correlations) and represented graphically the comorbid network for each group using undirected networks. For the figures, we excluded the weakest edges lower than .20, to optimize the representation (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012). To assess whether there was a significant increased association between the two disorders for Internet gamblers compared to land-based gamblers, we used the symptoms' centrality measure. This measure represents the connectedness of a given symptom in the network (Fried, Epskamp, Nesse, Tuerlinckx, & Borsboom, 2016) and is computed by summing the absolute values of the correlations between a symptom and all the others in order to provide an indication of the symptom's importance in the network. For our purpose, we used the overall centrality of the network in order to have an indicator of the strength in the whole network. We computed four centrality measures: 1) centrality for problem gambling, 2) centrality for PIU, 3) centrality for the comorbid network, and 4) centrality for the comorbid network using only the correlations between the two disorders and not the correlations within a disorder. To test whether there were significant differences in the strength of the networks,

we used permutation tests, since network metrics do not satisfy the assumptions of parametric statistics. We selected 10,000 samples and assigned the groups (Internet gamblers and land-based gamblers) randomly in order to define the distribution of the centrality's scores under the null hypothesis. Then, we defined the p-value for the observed centrality network using its centrality score (Good, 2005).

Basic statistical analyses were performed using Stata 14. R 3.2.0 was used for quasi-Poisson regressions, permutation tests, and networks analyses (package Qgraph version 1.3.1).

RESULTS

Descriptive statistics and bivariate associations are summarized in Table 1. A total of 17.8% of participants reported Internet gambling in the ESCAPAD survey, and 11.2% in the Bern gambling survey.

Insert Table 1 about here

Classic approach

Bivariate associations showed that Internet gamblers had higher levels of PIU and problem gambling than land-based gamblers in both samples. The results were similar when controlling for covariates, i.e., age, gender, familial variable (parental professional level or perceived family income), and number of games played ($p < .001$, results not shown in Table 1).

The correlations between problem gambling and PIU were moderate ones: $r = 0.21$ ($p < .001$, $R^2 = 4.4\%$) in the ESCAPAD survey and $r = 0.38$ ($p < .001$, $R^2 = 14.4\%$) in the Bern gambling survey. The correlations were significantly higher for Internet gamblers rather than land-based gamblers in the ESCAPAD survey (Internet gamblers: $r = 0.29$, $p < .001$; land-

based gamblers: r = 0.18, p < .001; z = -2.05, p = .020) but not in Bern gambling survey (Internet gamblers: r = 0.42, p < .001; land-based gamblers: r = 0.32, p < .001; z = -1.11, p = .133). Overall, the correlations remained low or moderate (R^2 min = 3.2%, R^2 max = 17.6%).

Network perspective

The networks of problem gambling and PIU are represented in Figure 1 for Internet gamblers and Figure 2 for land-based gamblers. Only edges greater than 0.20 are shown in the comorbid networks. The graph of Internet gamblers showed a higher number of correlations greater than 0.20 between the two disorders. For land-based gamblers, no correlations between the two disorders were higher than 0.20, for both surveys.

Insert Figures 1 & 2 about here

Table 2 reports the sum-score of symptoms' centrality for problem gambling networks, PIU networks, and comorbid networks. The results showed that the centrality was significantly higher in the comorbid network of Internet gamblers in comparison with land-based gamblers (p < .05). On the contrary, the sum scores of symptoms' centrality were not significantly different when the disorders were considered separately, except for PIU in Bern gambling survey (p = .006).

Insert Table 2 about here

DISCUSSION

This study aimed to investigate the relationship between problem gambling and generalized PIU among Internet versus land-based gamblers, among two large population-based samples of adolescents. We used the classic approach, and also a new and promising method, namely the network approach, which allows for studying the relationship between disorders.

Consistent with our hypothesis, the classic approach showed that Internet gambling was associated with increased PIU and problem gambling in both samples and with Internet gamblers having more problems than land-based gamblers, in line with most of the previous studies on this topic (Critselis et al., 2013; Gainsbury et al., 2012; Jiménez-Murcia et al., 2011; Tsitsika et al., 2011; Wardle et al., 2011). The results remained unchanged when controlling for socio-demographic characteristics. Therefore, there seems to be a deleterious association of Internet gambling with both disorders. This result was inconsistent with Dowling et al.'s (2010) findings, but Dowling et al.'s study suffers from some weaknesses that limit its extent. Recent studies reported that gambling involvement such as number of games played should be taken into account when studying the relationship between game-specific engagement and disordered gambling (LaPlante et al. 2014; Philander and MacKay 2014; Gainsbury et al., 2015a). We controlled for the number of games played in both studies, and the association between Internet gambling and problem gambling was still significant. Therefore, it added evidence of the relationship between Internet gambling and behavioural addictions.

However, the two disorders seemed to be separated from one another, even for Internet gamblers, with weak correlations between disorders. This result was in line with Dowling et al.'s (2010) conclusions, which considered PIU and problem gambling as separate disorders, although called for further replication studies with larger samples. The correlation between problem gambling and PIU was significantly higher only in one of the two samples, yielding inconsistent results regarding the associations between the disorders. These inconsistent results between samples need further investigations in order to achieve a better understanding.

Our second hypothesis was partially supported. The network perspective highlighted that PIU and problem gambling were more closely related to each other for Internet gamblers in comparison with land-based gamblers. On the contrary, the relationship between the two disorders for land-based gamblers was weaker. We hypothesize that there were fuzzy boundaries between problem gambling and PIU for Internet gamblers (Cramer et al., 2010). Internet gambling seemed to be associated with an increased correlation between the two disorders rather than within each disorder, whereas the correlations between problem gambling and PIU were higher for Internet gamblers rather than land-based gamblers. However, the correlations for each separate disorder were quite similar.

Overall, the classic approach showed that Internet gambling was associated with higher comorbidity, suggesting higher severity of PIU and problem gambling among Internet gamblers. However, it failed to test how the disorders were associated. The network approach allows for testing the relationship between problem gambling and PIU, showing that their association was stronger among Internet gamblers in comparison with land-based gamblers. Nevertheless, alone, the network approach did not permit testing of whether Internet gambling increased levels of behavioural addiction. Furthermore, the network approach did not allow controlling for other variables such as socio-demographic characteristics, contrary to the classic approach. It is possible to compute and compare separate models of comorbidities between disorders for subgroups, but taking other variables (e.g., controlling for socio-demographic variables and number of games played) into account is not yet possible. Therefore, it seemed that both approaches are needed to achieve a better understanding of addictive disorders, each one having different strengths that compensate the problems of the other. The use of two different population-based samples with different measures of problem gambling (CGPI and SOGS-RA) and PIU (PIUQ and IAT) over different time periods (seven

days and twelve months) was the strength of the study. Therefore, the results are not dependent on a specific tool or time periods. The study demonstrated that there were quite similar results using different measures and samples, and thus that our conclusions were robust.

This study suffers from some limitations. First, there were some limitations regarding variables' assessment. PIU is proposed but not yet recognized as a disorder (Nathan A. Shapira et al., 2003). For this reason, the results of this study should be interpreted cautiously. Second, Internet gambling was defined as having gambled at least one time during the previous twelve months. Therefore, we do not know whether Internet gamblers were "pure" Internet gamblers. They may also have patterns of land-based gambling, which may influence the likelihood of experiencing gambling problems (Gainsbury et al., 2015b). Indeed, mixed gamblers had a higher diversity of gambling, and thus the group of Internet gamblers is more likely to have more severe patterns of gambling. However, even controlling for the number of games played, which is a measure of diversity of gambling forms, the relationship between Internet gambling and problem gambling was still significant. Internet gambling is a portal to many of the games played on land, and thus another way of gambling involvement, with gamblers more heavily involved in gambling (Wood and Williams 2011). The low percentage of Internet gambling did not allow for studying only "pure" Internet gamblers, and the questions were not designed to differentiate between "pure" and mixed Internet gamblers. Thus, investigations including more precise measures of Internet gambling and concurrent Internet and land-based gambling should be used for a better understanding of gambling behaviours. Again regarding variables' assessment, in the ESCAPAD study, problem gambling and PIU were assessed for the previous seven days, whereas the outcomes were assessed for the previous twelve months. Because of the different time periods, we cannot be

sure that the problems co-occurred. Finally, the use of self-reported measures may cause response bias, such as participants underreporting PIU and problem gambling, or misinterpretation of the criteria. Further investigations should use different assessments, such as clinical interviews.

Other limitations were related to the data collection and samples. The cross-sectional nature of the data did not allow us to determine causality. We do not know whether Internet gambling is a cause or a consequence of increased problem gambling and PIU. Another shortcoming was that the study focused on adolescents. Gambling practices are allowed for 18-year-old people in France and Switzerland. Studies including older participants are needed to see whether these findings can be extended to other populations. Additionally, the Bern gambling survey was located in the canton of Bern among post-compulsory students, and therefore the results cannot be generalized to the entirety of Switzerland or adolescents who do not continue after compulsory school (10% of young Swiss adolescents). Future research should also consider the relationship between specific PIU and problem gambling and evaluate the potential confound of measuring general PIU in the context of problematic Internet gambling.

To our knowledge, this is the first study to examine in large population-based samples of adolescents the differences between Internet and land-based gamblers in terms of comorbid behavioural addictions. The study showed that Internet gambling was associated with increased behavioural addictions (PIU and problem gambling), as well as a stronger relationship between disorders in comparison with land-based gambling. Both the classic approach and network perspective were useful to understand the comorbidity between these two disorders. The network perspective appeared to be a promising avenue for a better

understanding of addictive disorders to take into account the increased correlation between the two disorders, but it should not replace the classic approach. Given the popularity of Internet use and the easy access of online gambling, it is important to be aware of the potential public health concerns posed by these activities. Adolescent Internet gamblers should be the focus of public health efforts because of their increased potential for disordered behaviours. Since Internet gamblers are more likely to experience problems related to gambling and Internet use, prevention and treatments should focus on both disorders. In substance use research, numerous studies showed that polydrug use is associated with an unique set of consequences and detrimental effects (Collins et al. 1998), including difficulties in engaging and following drug-abuse treatment (John et al. 2001; Petry 2001). Interventions often focus on a single primary substance, and this approach has been described as a barrier to successful treatment outcomes (Brecht et al. 2008). We can hypothesize that behavioral addictions suffer from the same issues, and that intervention should be designed to take into account both problem gambling and PIU. Interventions should also focus on adolescents, because it is important at this age to prevent further problems developing in adulthood. Adolescents should be aware that Internet may facilitate the development of patterns of problem gambling and PIU.

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Table 1. Descriptive statistics and bivariate associations of Internet gambling with socio-demographic covariates and gambling/Internet disorders

		Overall	Land-based gamblers	Internet gamblers	p-value
ESCAPAD survey	n (%)	2,122	1,744 (82.2)	378 (17.8)	
	Socio-demographic covariates				
	Age[1]	17.39 (0.01)	17.39 (0.01)	17.40 (0.01)	.693
	Gender[2]				
	Male	66.7 (1,415)	64.7 (1,1128)	75.9 (287)	<.001
	Female	33.3 (707)	35.3 (616)	24.1 (91)	
	Parental professional level[2]				
	Farmer	3.0 (64)	2.9 (51)	3.4 (13)	
	Manual worker	9.3 (197)	9.9 (172)	6.6 (25)	
	Employee	12.8 (272)	13.1 (228)	11.6 (44)	
	Intermediate occupations	27.3 (579)	26.8 (468)	29.4 (111)	.219
	Executive	24.7 (525)	24.5 (427)	25.9 (98)	
	Independent	19.7 (418)	19.4 (338)	21.2 (80)	
	Without profession/unknown	3.2 (67)	3.4 (60)	1.9 (7)	
	Problem gambling (1-4)[3]	10.26 (2.28)	10.13 (2.15)	10.83 (2.73)	.001
	No. of games played (1-4)[3]	1.61 (0.68)	1.51 (0.02)	2.06 (0.04)	<.001
	Problematic Internet use (1-5)[3]	20.96 (7.32)	20.60 (7.06)	22.66 (8.19)	<.001
Bern gambling survey	n (%)	944	838 (88.8)	106 (11.2)	
	Socio-demographic covariates				
	Age[2]				
	≤ 15 years old	6.5 (61)	6.6 (55)	5.7 (6)	
	16-17 years old	61.2 (578)	61.6 (516)	58.5 (62)	.695
	≥ 18 years old	32.3 (305)	31.9 (267)	35.9 (38)	
	Gender[2]				
	Male	63.5 (599)	62.3 (522)	72.6 (77)	.037
	Female	36.4 (345)	37.7 (316)	27.4 (29)	
	Perceived family income[2]				
	Lower than average	7.1 (67)	6.2 (52)	14.2 (15)	.002
	Average	52.1 (492)	53.7 (450)	39.6 (42)	
	Higher than average	40.8 (385)	40.1 (336)	46.2 (49)	
	Problem gambling (0-12)[3]	0.91 (0.06)	0.69 (0.05)	2.70 (0.27)	.006
	No. of games played (1-4)[3]	1.37 (0.88)	1.18 (0.02)	2.89 (0.10)	<.001
	Problematic Internet use (0-100)[3]	22.45 (14.51)	20.69 (0.43)	36.40 (2.05)	<.001

[1] Means and standard deviations are given, t-test for independent groups was computed.

[2] Percentages and n are given, Chi square were computed.

[3] Means and standard deviations are given, Quasi-Poisson regressions were computed.

Table 2. Sum-scores of symptoms' centrality in network models and permutation tests

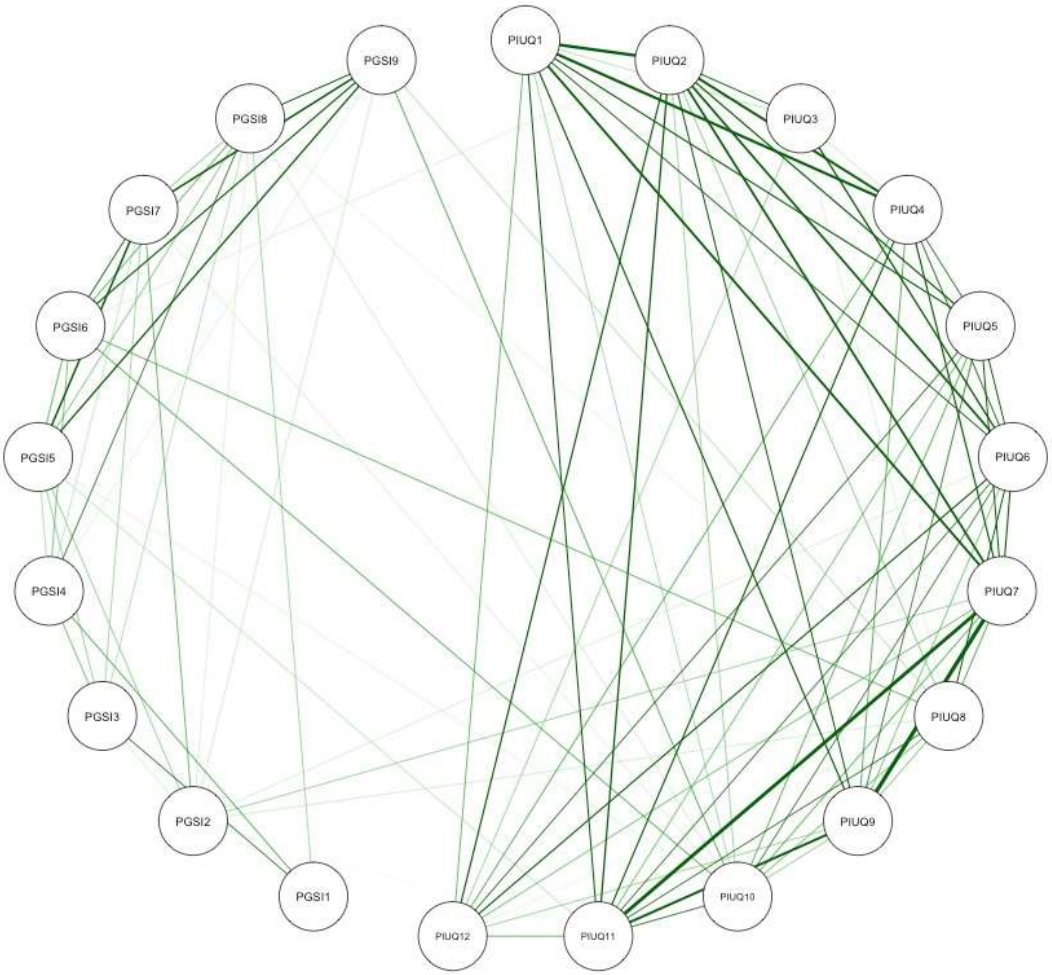
		Internet gamblers	Land-based gamblers	p-value
ESCAPAD survey	Problem gambling	19.05	18.48	.428
	PIU	43.30	40.58	.196
	Complete problem gambling/PIU	94.20	75.97	.011
	Partial problem gambling/PIU	31.85	16.91	.008
Bern gambling survey	Problem gambling	35.22	28.31	.304
	PIU	165.55	125.69	.006
	Complete problem gambling/PIU	298.95	203.07	.045
	Partial problem gambling/PIU	98.18	49.07	.020

PIU: Problematic Internet use.

Complete problem gambling/PIU: centrality for the comorbid network; partial problem gambling/PIU: centrality for the comorbid network using only the correlations between the two disorders and not the correlations within a disorder.

Figure 1. Correlation network between the symptoms of problem gambling and PIU among Internet gamblers (spearman correlations, $r \geq 0.2$)

a. ESCAPAD survey



b. Bern gambling survey

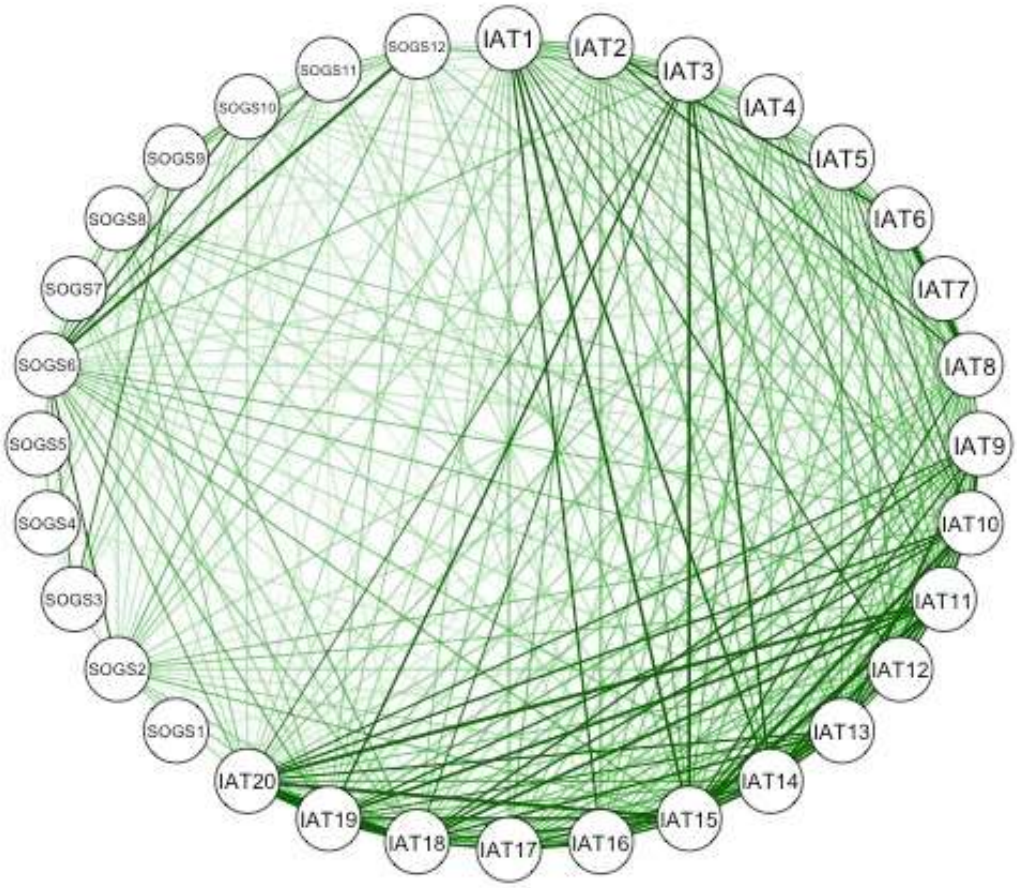
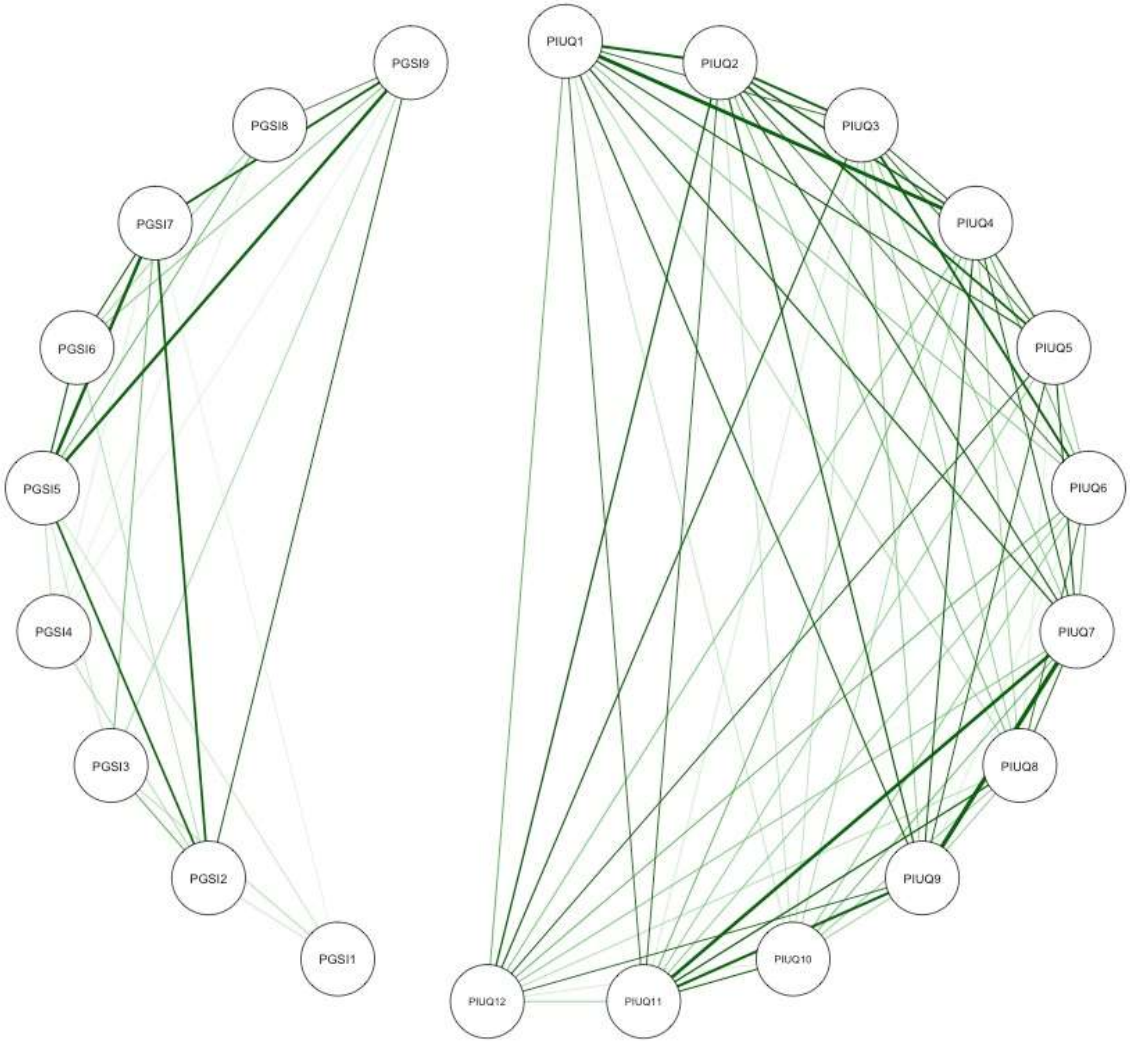


Figure 2. Correlation network between the symptoms of problem gambling and PIU among land-based gamblers (spearman correlations, $r \geq 0.2$)

a. ESCAPAD survey



b. Bern gambling survey