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Is all Internet gambling equally problematic? Considering the relationship between mode of access and gambling problems

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ABSTRACT

Concerns exist that Internet gambling may increase rates of gambling harms, yet research to date has found inconsistent results. Internet gamblers are a heterogeneous group and considering this population as a whole may miss important differences between gamblers. The differential relationship of using mobile and other devices for gambling online has not been considered as compared to the use of computers. The true relationship of Internet gambling on related problems and differences between preferred modes for accessing online gambling may be obscured by confounding personal and behavioural factors. This paper thus uses the innovative approach of propensity score matching to estimate the consequence of gambling offline, or online through a computer, as compared to mobile or other supplementary devices by accounting for confounding effects of difference among groups of Australian gamblers (N = 4482). Gamblers who prefer to gamble online using computers had lower rates of gambling problems as compared to those using mobile and supplementary devices. Individual life cycle was useful to differentiate between groups, indicating age, marital, and employment status should be considered together to predict how people gamble online. This is the first empirical study to suggest that the mode of accessing Internet gambling may be related to subsequent harms.

1. Introduction

Debates around the legalization and regulation of gambling typically include consideration of the propensity for harm (Livingstone & Adams, 2011; Reith, 2011). Research suggests that increased availability and accessibility to gambling opportunities is related to increased levels of problems, although the impact is moderated by other factors (Reith, 2012). Technological advances, wide usage of new devices, and innovation led by the gambling industry has led to a plethora of new Internet gambling products available constantly via mobile and other non-computer devices. This has led to the situation where regulators attempt to devise policies that take into account forms of gambling that may not yet be developed (Orford, 2005). The current study aimed to explore the relationship between gambling online through computers as compared to supplementary devices (mobile, tablets, and interactive televisions) on gambling problems. Results should thus support prospective technology assessments in this social sensitive and technologically highly dynamic field.

Much of the research in the gambling field has considered gamblers as a homogeneous population or has studied a single gambling activity in isolation. These studies fail to reflect the heterogeneous nature of gambling and to account for subtypes of gamblers based on how they engage with gambling in various ways (Nower, Martins, Lin, & Blanco, 2013). Theoretical models of disordered gambling indicate that differences between subgroups of gamblers are important to understand, particularly to inform prevention and treatment efforts (Blaszczynski & Nower, 2002). Studies of Internet gambling initially reported greater levels of gambling problems among Internet as compared to land-based gamblers (Gainsbury, Wood, Russell, Hing, & Blaszczynski, 2012; Griffiths, Wardle, Orford, Sproston, & Erens, 2009; Kairouz, Paradis, & Nadeau, 2012; Wood & Williams, 2011; Wu, Lai, & Tong, 2014).

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A primary concern was that the Internet became a conduit for gambling, resulting in uptake among non-gamblers and easy access for those with a propensity for problems (Philander & MacKay, 2014). Subsequent studies suggest that gambling problems are related to involvement in both land-based and online forms, as well as gambling on a greater total activities, and greater expenditure (Gainsbury, Russell, Blaszczynski, & Hing, 2015; LaPlante, Nelson, LaBrie, & Shaffer, 2011; Philander & MacKay, 2014). As such, the relationship between gambling problems and modes of access remains unclear (Kairouz et al., 2012). Research is urgently needed that controls for confounding variables such as demographics and gambling behaviours to enable an accurate understanding of the relationship between mode of access of gambling and related problems. The current study aims to address this need.

Subgroups of gamblers have been identified based on their use of Internet and offline gambling and various gambling activities. Levels of problem gambling intensity vary between these groups (Gainsbury et al., 2015; Lloyd et al., 2010; Wardle, Moody, Griffiths, Orford, & Volberg, 2011), supporting the Pathways theoretical model of gambling (Blaszczynski & Nower, 2002). This is also consistent with the theory that the Internet is not inherently addictive, but that individual variables interact with gambling behaviour to determine level of involvement and subsequent problems (Shaffer, Hall, & Bilt, 2000). Therefore, a simplified dichotomy of Internet versus offline gambling is insufficient to conceptualise the relationship between Internet gambling and related problems. Internet gambling (also referred to as online, interactive, or remote) using mobile (including smartphones, tablets, and other wireless Internet devices) and other supplementary devices (e.g., interactive televisions, gaming consoles) potentially offers a very different gambling experience as compared to use of laptop and desktop computers. Understanding this differentiation and focussing on the specific impacts of supplementary devices becomes even more important as there is evidence that such devices may cause severe dependence patterns as nomophobia, that is, communication through virtual environments (King et al., 2013). Therefore, gambling via supplementary devices may have important implications for the theoretical understanding of gambling disorders. The current study aims to address this issue as well.

The use of supplementary devices for gambling has disrupted the gambling market and introduced an entirely new way to engage with this activity. Total revenues from mobile gambling are predicted to reach nearly 45% of total interactive gambling gross win in 2018, up from 18% in 2012 (H2 Gambling Capital, 2013). Mobile gambling customers differ from other Internet gamblers and have been found to have longer and more frequent sessions, greater average bet size, and generate a higher gross margin than gamblers using a computer (Bennett, 2013; Sports Agent Blog, 2012). Many of the risk factors for problem gambling associated with Internet gambling may be heightened for gamblers who use mobile and supplementary devices. These include the convenience and easy accessibility and availability of gambling, enhanced privacy, perceived anonymity, and the reduced salience of electronic funds (Gainsbury et al., 2012; MacKay & Hodgins, 2012; Svensson & Romild, 2011; Wood, Williams, & Parke, 2012). It may be theorised that the greater access and convenience provided to gamblers by supplementary devices may interact with existing risk factors and vulnerabilities to make it more difficult for gamblers to control their urges and impulses to gamble, making them more likely to gamble excessively and subsequently develop problems. Using supplementary devices may allow greater engagement in gambling, which is associated with higher rates of gambling problems (Gainsbury et al., 2014; LaPlante et al., 2011; Philander & MacKay, 2014). Despite the potential advantages of using supplementary devices, the vast majority of Internet gamblers state a preference of using computers (Gainsbury et al., 2012; Wood & Williams, 2011). Interviews with Internet gamblers revealed that those who prefer to gamble on their mobile do so for convenience, while those who prefer computers prefer the ease of use, better security, larger screen and greater speed of the Internet connection (Hing et al., 2014).

Conceptual models of disordered gambling suggest that problematic gambling develops as a result of a complex interaction of psychological, social, biological and environmental factors (Blaszczynski & Nower, 2002; Sharpe, 2002). Previous research has aimed to identify risk factors to determine when and why gambling becomes problematic. However, few studies have yet considered the complex interactions between sociodemographic variables. For example, younger males are repeatedly recognized as being at greater risk for gambling-related harm (Hayatbakhsh, Clavarino, Williams, Bor, & Najman, 2013; Welte, Barnes, Tidwell, & Hoffman, 2008). However, consumption behaviour is typically more accurately predicted by a more complex construct of family life cycle, which jointly considers age with marital and work status (Gourinchas & Parker, 2002). Conventional analysis on the effect of a variable is confounded by users' other individual variables and behaviours, which hinders an estimation of the true consequence of variable. Consideration of the interactions between sociodemographic variables and mode of accessing Internet gambling thus is important to further develop conceptual models of disordered gambling that are specifically relevant to new technological developments.

Propensity score matching (PSM) is such a statistical approach that estimates the effect of an action (e.g., using PC for gambling or not) by controlling for confounding factors that predict executing the action (c.f. Gum, Thamilarasan, Watanabe, Blackstone, & Lauer, 2001). Differing from prior studies, our research implements PSM analysis and estimates the consequence of different gambling behaviours by accounting for confounding effects of demographic difference among groups. Using the smallest group of supplementary device gamblers as a benchmark, only those offline- and PC gamblers are drawn for comparison which have similar probabilities to execute this gambling behaviour (i.e. propensity scores). This enables us to single out the effects of access mode (offline, internet via PC or via supplementary devices) on gambling behaviour and corresponding problems.

Despite the extent to which mobile phones, tablets, and other devices have impacted gambling, no research has specifically examined the use of these devices and their relationship with subsequent problems. The current study attempts to establish whether problem gambling severity differs between individuals who gamble via different modes (land-based, computers, or mobile and supplementary devices) to further the understanding of the risk factors for gambling harms. Given the lack of previous research that differentiates between different modes of access for Internet gambling this study was largely exploratory. However, it was hypothesised that gamblers who prefer supplementary devices may have higher rates of gambling problems - due to the high accessibility and convenience that these devices provide, enabling greater gambling involvement than other modes of access, which is related to gambling problems. This research advances previous studies by using a novel statistical technique, propensity score matching, to identify the incremental effect of executing a specific behaviour (gambling offline, via computers, or mobile and supplementary devices) on behavioural consequences (problem gambling severity).

2. Methodology

2.1. Participants

Data were drawn from an online survey. A total of 6682 respondents started the survey and 4724 completed the survey

(completion rate = 64.4%). Demographic information was provided by 5051 respondents. The sample was mostly male (86.3%), employed full-time (59.1%) and married (46.0%).

Of the 6682 respondents in the sample, 4482 respondents specified their preferred mode of gambling. These were split into land-based modes (here referred to as Offline gamblers), those who use personal computers (here referred to as PC gamblers) and those who bet online using supplementary devices, such as mobile phones or tablets (here referred to as Supplementary device gamblers) based on their answers to two questions. First, respondents were asked whether they preferred Internet gambling to land-based gambling. Those who responded "No" were considered to be Offline gamblers, those who responded "I like Internet and land-based gambling equally" or "I prefer Internet gambling to land-based gambling" were considered to be Internet gamblers. Those who reported that they did prefer Internet gambling to land-based gambling answered a subsequent question about their preferred medium for Internet gambling. Those who reported that a computer was their preferred medium were classified as PC gamblers and those who selected any other option (mobile phone, wireless device, television or other) were classified as Supplementary device gamblers. Summing up, the grouping classification is based on preferred methods and gamblers in each group could still gamble using other methods.

2.2. Procedure

An online survey was used in order to gain a sufficient number of Internet gamblers. This platform was specifically chosen to eliminate the potential confounding variable of lack of Internet use. Therefore, all participants were considered active Internet users, such that not using Internet gambling would not be attributed to not using the Internet for other activities. The survey was advertised via banner advertisements containing links to the survey on various Australian websites, including those of Internet and land-based gambling operators, gambling help and treatment sites and sporting organization websites. Advertisements were also placed on sites such as Facebook and Google. Recruitment notices encouraged participation to enable respondents to get feedback on their gambling, which was provided through the interactive survey. Most respondents (58.9%) reported hearing about the survey on Internet gambling websites. The self-selected nature of this sample is noted as a limitation, as is the potentially unrepresentative nature of the land-based gamblers, given that those who do not regularly access these sites would not have seen advertisements. As such, the results comparing land-based and other groups of gambler should be interpreted with this limitation in mind.

The research was approved by two university human research ethics committees.

3. Dataset and measures

3.1. Measures

The online survey was adapted from that used by Wood and Williams (2011). Most questions were single or multiple fixed choice, with a small number of questions allowing some elaboration. The main relevant sections of the survey are outlined below.

3.1.1. General gambling behaviour

Respondents were asked about their participation in nine commercial forms of gambling during the last 12 months as different forms of gambling are known to have different associations with gambling problems (e.g., Gainsbury et al., 2014). These forms were those legal in Australia: instant win scratch tickets, lottery tickets and keno, betting on sports events, horse or dog race wagering, bingo, games of skill, poker, electronic gaming machines, Internet casino games and land-based casino table games. Respondents were asked whether they drank alcohol or used illicit drugs when gambling using a five-response option scale (never-always) as substance use is highly comorbid with gambling and comorbidities exist between behavioural and substance addictions (Petry, 2010).

3.1.2. Internet gambling behaviour

Respondents completed the aforementioned questions that were used to determine whether the respondents were classified as PC gamblers or Supplementary device gamblers.

3.1.3. Problem gambling

The Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001) was completed as a measure of experience of problem gambling. This scale is widely used and was found to have good reliability in the sample (Cronbach's alpha = 0.93). Examples of the items for the scale include "Have you bet more than you could really afford to lose?" and "When you gambled, did you go back another day to try to win back the money you lost?". For each of nine items, respondents state how often they have experienced the particular item in the last 12 months, with the following response options: Never (coded as 0), Sometimes (1), Most of the time (2), Almost always (3). The scores were then summed and respondents were categorized based on their scores on this scale using the verified PGSI categories: 0 = non-problem gambler, 1–2 = low-risk gambler, 3–7 = moderate risk gambler and 8–27 = problem gambler.

Where respondents had not answered all of the PGSI items (~1% of the sample), two approaches were considered. Where four or more of the nine items were not answered (N = 6), the PGSI was considered incomplete and thus no PGSI score was calculated. Where only one or two items were missing (no respondents missed three items) missing answers were replaced with the most common response given to the other items. In all cases, this was 0 (Never) or 3 (Almost always). For those whose missing values were replaced 3, the missing value replacement made no differences as they were all already classified as problem gamblers. For those whose values were replaced with 0, it is possible that any other value would have changed their PGSI category; however, given the small number of respondents involved in this missing value replacement any misclassifications were unlikely to affect the results.

3.1.4. Gambling attitudes

Gambling attitudes were measured as personal beliefs about gambling are likely to influence engagement and the development of problems (Moore & Ohtsuka, 1999; Sharpe, 2002). Three items were included in order to capture the following information: perceived relative harms and benefits of gambling (five response options ranging from "The harms far outweigh the benefits" to "The benefits far outweigh the harms"), morality of gambling ("Do you believe gambling is morally wrong" with the response options "yes", "no" or "unsure/don't know") and the legality of gambling (one question with four response options: "All types of gambling should be legal", "All types of gambling should be illegal", "Some types of gambling should be legal and some should be illegal" and "Don't know/unsure"). Responses were coded with numerical scores.

3.1.5. Demographics

Respondents were asked about their sex, age, marital status, employment status, state/territory of residence, education level

and household income. Instead of referring to age alone, we calculated family life cycle as a construct which has been popular in consumer expenditure research for over 50 years (Wells & Gubar, 1966; Wagner & Hanna, 1983). Family life cycle combines variables such as age and marriage-partnership on consumption (Fritzsche, 1981; McLeod & Ellis, 1982; Wagner & Hanna, 1983). In this paper, we include family life cycle to study the interaction effect of age and marriage status on the selection of gambling approaches as previously discussed. The stages used are presented in Table 1.

Survey skips were used as some questions were not relevant to all respondents. For example, a respondent who stated that they never gambled online were not asked about their Internet gambling behaviour. Mean time to complete the survey was 12 min 23 s (SD = 9.0 min). Most of the sample (90.0%) completed the survey in 20 min or less.

4. Matching procedure

In order to control for demographic factors, respondents in the supplementary device category were matched to those in the other categories. Matching is a form of control of demographic differences. The matching procedure used here was propensity score matching (PSM) (c.f. Caliendo & Kopeinig, 2008). As outlined in Fig. 1, we first (1) separated the dataset into three types of gambling approaches based on their stated preference (land-based referred to as offline gamblers, online via computer, referred to as PC gamblers; online via mobile and supplementary devices, referred to as 'supplementary'); (2) conducted a multinomial logit analysis to identify the effects of various demographic factors on gamblers' choice of gambling approach; (3) calculated the propensity scores of individual respondents based on the results of Multinomial logit analysis; (4) specified the propensity-matched respondents among groups through use of nearest neighbour matching on the basis of comparing propensity scores; (5) detected the true consequence of use of different gambling approaches via the comparison of respondents who are identical in demographic features otherwise differing across groups.

As respondents who use different gambling approaches were found to be significantly different in terms of demographic features, through PSM, we controlled for demographic covariates by identifying three groups of respondents who use different gambling techniques but have no significant differences across their demographic features – that is, the groups are matched on demographic profiles as a form of control. In this way, a more accurate estimate of the relationship between using different gambling techniques and gambling-related problems can be detected. Those who are not matched represent the observations that cannot be directly compared and are therefore excluded from the matched analyses. Please note that matching procedure as outlined above necessarily eliminates representativeness: thus, descriptive comparisons of the matched subgroups have to take this limitation into account.

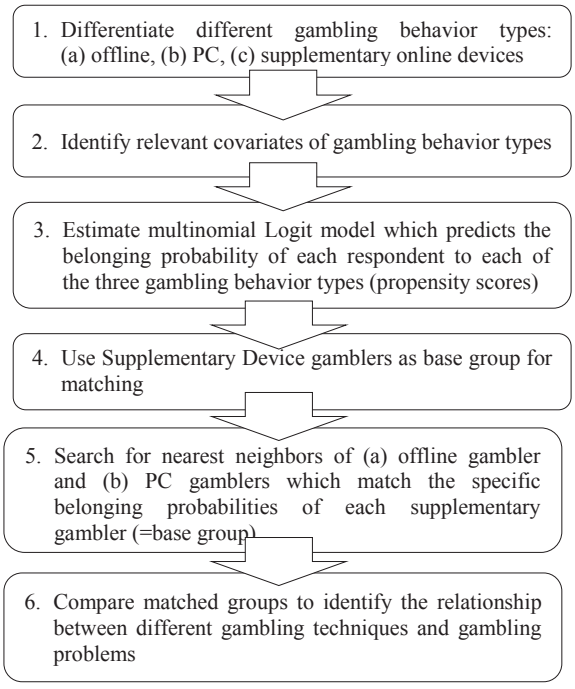

Fig. 1. Flow of research and data analysis.

Matched observations have nearly the same propensity score profile as the supplementary device gamblers identified in our survey. Thus, comparisons between the groups can inform us about the specific differences between using supplementary devices and adhering to either (a) offline or (b) Internet gambling behaviour patterns. If we compare (a) offline and (b) Internet gamblers in the matched group (which have the same demographic features across groups), this comparison is restricted to a subgroup of

Table 1
Family life cycle categories.

Family life cycle (FLC) category	Attributes (the respondent is)
FLC1	Less than 30 years old and never married
FLC2	Less than 30 years old and living with partner, or married
FLC3	Less than 30 years old and widowed, divorced or separated
FLC4	Between 30 and 40 years old and never married
FLC5	Between 30 and 40 years old and living with partner, or married
FLC6	Between 30 and 40 years old and widowed, divorced or separated
FLC7	Between 40 and 50 years old and never married
FLC8	Between 40 and 50 years old and living with partner, or married
FLC9	Between 40 and 50 years old and widowed, divorced or separated
FLC10	Over 50 years old and not retired and never married
FLC11	Over 50 years old and not retired and living with partner, or married
FLC12	Over 50 years old and not retired and widowed, divorced or separated
FLC13	Over 50 years old and retired and never married; Or over 65 years old and never married
FLC14	Over 50 years old and retired and living with partner, or married; Or over 65 years old and retired and living with partner, or married;
FLC15	Over 50 years old and retired and widowed, divorced or separated; Or over 65 years old and retired and widowed, divorced or separated

persons who have a similar opportunity to become supplementary device gamblers.

5. Results

5.1. "Prima facie" comparison of groups

Of 4979 respondents who specified their gambling mode of access preference, 1470 (29.5%) chose offline, 3213 (64.5%) chose primarily PC, and 296 (5.9%) chose online via supplementary devices (including mobile). Table 2 summarizes players' main characteristics according to their gambling approaches. The three gambler groups differed significantly in terms of their age, gender, marriage, employment status, state of living, income, drug use, and gambling attitude, as shown in Table 2.

The first comparison (Table 3) showed that the preferences for particular gambling activities differed between the groups. For instance, compared to offline gamblers, supplementary device gamblers tended to bet more on sporting events, horse or dog racing, games of skill and casino games. Offline gamblers played table games at a casino to a much smaller extent (21%) than persons who gamble with supplementary devices (43%).

Mindful of the caveats outlined, we performed a prima-facie comparison of the stated gambling problems as indicated by the PGSI scores across three groups of offline, PC, or supplementary device gamblers. Fig. 2 exhibits the distribution curves of PGSI-scores which indicated major differences especially in respect to the lower range of the curves (i.e. in the proportion of respondents with especially low PGSI-scores). This was further substantiated by a comparison at the level of problem groups (Table 4): A χ^2 test showed significant and substantial difference across the target groups: Offline gamblers had a large proportion of non-problem gamblers (PGSI-scores below 3) while supplementary devices gamblers in contrast had higher proportions of moderate gamblers (PGSI scores between 3 and 8). Findings indicate more problem gamblers in the group of supplementary device gamblers (21.6% of respondents in this group) as compared to the other groups (17.7%/16.1%), however this difference is not significant. Furthermore, these findings are to be interpreted as correlations and are not indicative of causality.

6. Propensity score matching

As a first step, we built a propensity score model for belonging to one of the three groups. Hereto, we conducted a multinomial logistic regression with the above mentioned antecedents and covariates of gambling behaviour as possible explanatory variables. The 'nnet' package (Ripley, 2014) of the software package R was used for estimation.

The multinomial logit model (Table 5) revealed a variety of individual demographics and features that account for the gamblers' utilization of different gambling technical platforms, such as gender, income, employment statues, family life cycle, alcohol and drug use and gambling attitudes. The model exhibited a good interpretation power of McFadden Pseudo r-square for 21.9% (Residual Deviance: 5398.059; AIC: 5542.059). An interpretation of McFadden Pseudo R^2 between 0.20 and 0.40 is typically understood as representing an excellent fit of the research model (McFadden, 1979).

The odds ratios inform us about the relative probability of belonging to a group based on the presence of a sociodemographic characteristic. For example, the chances of belonging to the group of PC gamblers instead of being an offline gamblers was twice as large in case of retirement (Odds Ratio of retired = 2.258) or for persons between 40 and 50 years old who are widowed, divorced, or separated (Odds Ratio of FLC9 = 2.215). In contrast, the chance of utilizing supplementary devices was very low for married persons over 50 years old (Odds Ratio of FLC11 = 0.255) but it increased nearly threefold (Odds Ratio of FLC12 = 0.634) if such a person is divorced or separated.

The above results imply that individual demographics and covariates acted as confounding variables. As such, it is unclear whether the gambling problems were caused by the use of different gambling techniques or actually by the individual differences across three groups. For instance, the supplementary device gambler groups may consist of more frequent gamblers facilitated by having higher household incomes.

Based on the results of multinomial logistic regression, we calculated the propensity scores of all the samples at three targeted groups respectively. The observations which have similar of the same propensity scores but belong to different groups were identified as the matched pairs through the use of R and its nearest neighbour search package 'FNN'. Due to missing values in explanatory variables, some observations could not generate reliable propensity scores, which were therefore excluded. Matched pairs could be found for 224 of the 296 observations of the base group of supplementary gamblers.

After performing propensity scores matching to control confounding variables, we managed to significantly reduce between-group differences across all socio- and psycho-demographic variables. Table 6 shows that we achieved three identical gambler groups in terms of their demographic and personal features. Thus, the statistical technique was able to appropriately control for the differences in demographics that relate to different device usages.

Comparison of the sociodemographic characteristics of the three groups before (Table 2) and after matching (Table 6) demonstrated that the sociodemographics of the base group remained nearly constant. This indicated a reliable and constant data source despite removing 25% non-matchable supplementary device gamblers. Major changes were observed for the matched groups: The matched group of offline gamblers now consisted more on men (94% vs. 71%) and was characterized by twice as high drug usage patterns (0.22 vs. 0.11) as compared to the unmatched (total) group of offline gamblers. The sociodemographics of the group of PC gamblers also differed; While the unmatched (total) group of PC gamblers was characterized by lower educational levels (37% primary school), the matched (sub-)group consisted more of persons with completed undergraduate degree (25.4%), accompanied with a larger household income than in the unmatched (total) group.

7. Comparison of matched groups

Table 7 summarizes the resulting differences in utilized gambling categories. While the matched offline gamblers (Table 7) utilized nearly the same gambling categories as the unmatched (total) offline gamblers (Table 3), there were major differences in the subgroup of matched PC-gamblers: Here, fewer respondents were engaged in Lottery tickets (−39%) and Instant win scratch tickets (−13%).

Supplementary device gamblers were found to engage in significantly more different gambling activities (Mean = 4.18, SD = 1.51) than both matched PC gamblers (Mean = 2.95, SD = 1.43, Scheffe test $p < 0.001$), and matched offline gamblers (Mean = 3.34, SD = 1.60, Scheffe test $p < 0.001$). Compared to supplementary device gamblers, PC gamblers were less likely to play instant win scratch tickets, lottery tickets, sporting event games, bingo, games of skill, and casino games, as shown in Table 7.

Table 2
Socio-demographic characteristics of gambling types.

Variables	Offline gamblers (n = 1470)	PC gamblers (n = 3213)	Supplementary device gamblers (n = 296)	Inferential statistic
Demographics				
Age, mean(SD)	43.6 (15.8)	46.2 (14.5)	38.3 (13.2)	**F(2,4976) = 47.22, p < 0.001**
Men, no. (%)	1051 (71.4)	2981 (92.7)	273 (92.2)	**χ2 (2, N = 4979) = 399.20, p < 0.001**
Marital status				
Divorced or separated (%)	163 (11.1)	302 (9.4)	29 (9.8)	**χ2 (2, N = 4955) = 3.22, p = 0.019**
Living with partner (%)	218 (14.9)	554 (17.3)	57 (19.3)	χ2 (2, N = 4955) = 5.75, p = 0.050
Married (%)	609 (41.6)	1573 (49.2)	98 (33.2)	**χ2 (2, N = 4955) = 43.85, p < 0.001**
Never married (%)	449 (30.7)	718 (22.4)	108 (36.6)	**χ2 (2, N = 4955) = 55.01, p < 0.001**
Widowed (%)	24 (1.6)	50 (1.5)	3 (1.0)	χ2 (2, N = 4955) = 0.62, p = 0.072[a]
Employment status				
Employed full-time (%)	778 (53.9)	1892 (60.9)	216 (75)	**χ2 (2, N = 4873) = 47.50, p < 0.001**
Employed part-time (%)	201 (13.9)	287 (9.1)	26 (9.0)	**χ2 (2, N = 4873) = 24.96, p < 0.001**
Full-time student (%)	114 (7.9)	111 (3.5)	13 (4.5)	**χ2 (2, N = 4873) = 40.80, p < 0.001**
Homemaker (%)	34 (2.3)	37 (1.1)	1 (0.3)	**χ2 (2, N = 4873) = 12.15, p < 0.001**
Retired (%)	147 (10.1)	488 (15.5)	12 (4.1)	**χ2 (2, N = 4873) = 46.47, p < 0.001**
Unemployed and seeking work (%)	71 (4.9)	81 (2.5)	9 (3.1)	**χ2 (2, N = 4873) = 17.06, p < 0.001**
Other (%)	97 (6.7)	247 (7.8)	11 (3.8)	**χ2 (2, N = 4873) = 7.31, p = 0.020**
State				
ACT	24 (1.7)	44 (1.4)	2 (0.6)	**χ2 (2, N = 4680) = 1.78, p = 0.040**[a]
NSW	442 (31.8)	606 (20.1)	85 (29.6)	**χ2 (2, N = 4680) = 76.10, p < 0.001**
NT	14 (1.0)	51 (1.6)	2 (0.6)	**χ2 (2, N = 4680) = 4.33, p = 0.011**[a]
QLD	446 (32.1)	1347 (44.7)	107 (37.2)	**χ2 (2, N = 4680) = 64.01, p < 0.001**
SA	217 (15.6)	370 (12.3)	32 (11.1)	**χ2 (2, N = 4680) = 10.43, p = 0.005**
TAS	21 (1.5)	61 (2.0)	9 (3.1)	χ2 (2, N = 4680) = 3.58, p = 0.160
VIC	175 (12.6)	451 (14.9)	40 (13.9)	χ2 (2, N = 4680) = 4.39, p = 0.110
WA	47 (3.3)	77 (2.5)	10 (3.4)	χ2 (2, N = 4680) = 2.77, p = 0.240
Education level				
Primary school or below (%)	531 (36.2)	1194 (37.2)	100 (33.7)	χ2 (2, N = 4966) = 1.63, p = 0.440
Some technical school, college or university (%)	185 (12.6)	370 (11.5)	32 (10.8)	χ2 (2, N = 4966) = 1.44, p = 0.480
Completed technical school/TAFE/diploma/trade certification (%)	302 (20.6)	753 (23.4)	67 (22.6)	χ2 (2, N = 4966) = 4.76, p = 0.090
Completed undergraduate university degree (%)	261 (17.8)	563 (17.5)	62 (20.9)	χ2 (2, N = 4966) = 2.11, p = 0.340
Professional degree (Law, Medicine, Dentistry); Masters; PhD (%)	186 (12.6)	325 (10.1)	35 (11.8)	**χ2 (2, N = 4966) = 6.93, p = 0.003**
Household income				
Less than $20,000	203 (14.0)	233 (7.4)	21 (7.1)	**χ2 (2, N = 4878) = 52.64, p < 0.001**
Between $20,000 and $50,000	402 (27.7)	718 (22.8)	52 (17.7)	**χ2 (2, N = 4878) = 19.76, p < 0.001**
Between $50,000 and $100,000	483 (33.3)	1190 (37.9)	113 (38.5)	**χ2 (2, N = 4878) = 9.31, p = 0.009**
More than $100,000	359 (24.8)	997 (31.7)	107 (36.5)	**χ2 (2, N = 4878) = 29.18, p < 0.001**
Alcohol use, mean(SD)	1.57 (1.41)	1.55 (1.24)	1.85 (1.23)	**F(2,4852) = 6.61, p = 0.001**
Drug use, mean(SD)	0.11 (0.53)	0.17 (0.61)	0.25 (0.72)	**F(2,4852) = 7.89, p < 0.001**
Gambling attitude – benefits, mean(SD)	−1.0 (1.10)	−0.5 (1.18)	−0.38 (1.21)	**F(2,4296) = 86.08, p < 0.001**
Gambling attitude – morality, mean(SD)	0.67 (0.65)	0.86 (0.45)	0.83 (0.51)	**F(2,4322) = 58.46, p < 0.001**
Gambling attitude – legality, mean(SD)	0.22 (0.51)	0.34 (0.54)	0.40 (0.54)	**F(2,4325) = 27.64, p < 0.001**

Bold inferential statistics suggests significant differences existing between the three groups.
[a] The result may be inaccurate due to small sample size.

Table 3
Prima facie comparison of utilized gambling categories.

Gambling categories	Offline gamblers (n = 1470)	PC gamblers (n = 3213)	Supplementary device gamblers (n = 296)	Inferential statistic
Instant win scratch tickets, mean(SD)	0.46 (0.49) a	0.43 (0.49) a	0.43 (0.49) a	$F(2,4959) = 1.93$, $p = 0.145$
Lottery tickets, mean(SD)	0.56 (0.49) a	0.62 (0.48) b	0.64 (0.48) b	$F(2,4914) = 7.69$, $p < 0.001$
Sporting events, mean(SD)	0.38 (0.48) a	0.70 (0.45) b	0.84 (0.36) c	$F(2,4880) = 276.1$, $p < 0.001$
Horse or dog racing, mean(SD)	0.60 (0.48) a	0.92 (0.25) b	0.90 (0.29) b	$F(2,4874) = 52.01$, $p < 0.001$
Bingo, mean(SD)	0.05 (0.22) a	0.03 (0.17) b	0.06 (0.24) a	$F(2,4821) = 8.39$, $p < 0.001$
Games of skill, mean(SD)	0.10 (0.30) a	0.12 (0.32) a	0.18 (0.39) b	$F(2,4848) = 7.42$, $p < 0.001$
Electronic gaming machines, mean(SD)	0.59 (0.49) a	0.52 (0.49) b	0.57 (0.49) c	$F(2,4841) = 10.4$, $p < 0.001$
Table games at a casino, mean(SD)	0.21 (0.41) a	0.30 (0.45) b	0.43 (0.49) c	$F(2,4827) = 35.8$, $p < 0.001$
Internet casino, mean(SD)	Not meaningful*	0.04 (0.19) a	0.05 (0.22) a	$F(1,4843) = 0.83$, $p = 0.360$

Non-play in the last 12 months is coded as 0, play in the last 12 months is coded as 1.
a,b,c = homogeneous subgroups as identified by Scheffe tests (Mean with the same letter are not significantly different).
*Not meaningful due to a very small number of offline gamblers who engage in Internet Casino gambling.

The above described gambling patterns of matched PC gamblers were linked with fewer gambling problems in this group. As shown in Table 8 and Fig. 3, matched PC gamblers had the highest proportion of non-problem and low risk gamblers (84.9%), compared to offline gamblers (55.7%) and supplementary device gamblers (44.5%). Meanwhile, matched PC gamblers had the lowest proportion of problem gamblers (8.8%). In contrast, supplementary device gamblers had the highest percentage of problematic gamblers (22.2%), followed by offline gamblers (19.2%). Latter values nearly mirrors the differences found in the non-matched sample (Table 4).

8. Discussion

The current study is the first to test the relationship between using mobile and supplementary devices as compared to computers to gamble online in terms of problem gambling severity. We thereby close a gap identified by previous literature (Kairouz et al., 2012) using an innovative method of propensity score matching. We were able to differentiate between gamblers by considering their preferred mode of gambling, indicating that the previously used dichotomy of Internet vs. offline gambling is far too limited to appropriately understand differences between subgroups of Internet gamblers. This is consistent with research examining subgroups based on a wider range of personal and gambling behavioural variables (Gainsbury et al., 2014; LaPlante et al., 2011; Wardle et al., 2011) and the largely accepted Pathways conceptual model of disordered gambling (Blaszczynski & Nower, 2002).

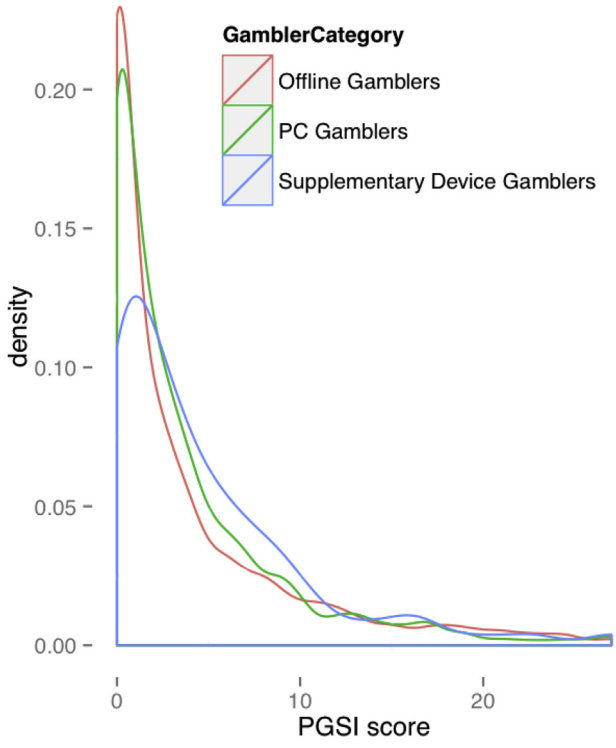

Fig. 2. Prima facie comparison of gaming addiction distributions (The figure shows that PC gamblers and offline gamblers have similar distribution in terms of PGSI score while supplementary device gamblers exhibits more serious problem due to having high PGSI scores).

Considering an individual's life cycle by combining their age, marital and occupational status provided differentiated insights into groups. For example, people over the age of 50 were three times more likely to gamble online using supplementary devices if they are separated or divorced, compared to those who are married, and are less likely to use supplementary devices for gambling if they are working. This may be related to unmarried and retired older people being out of the house and away from computers more often, thus being more likely to use supplementary devices and potentially having free time in which to gamble. This is consistent with qualitative reports that online gamblers choose their mode of access based on convenience and where they are when they want to bet (Hing et al., 2014). Age significantly differentiated the three groups based on gambling mode of access, indicating that this is an important variable to consider. Although mobile and supplementary devices are well distributed in the population, younger people may be more comfortable and proficient with these as there is higher use of these devices amongst younger age groups (ACMA, 2013).

Controlling for sociodemographic covariates (matched group), Internet gamblers who gambled via supplementary devices or offline gamblers were more than twice as likely to be classified as problem gamblers and more than four times as likely to be moderate risk gamblers compared to gamblers who preferred PCs. Individuals who gambled online using supplementary devices had the lowest rates of non-problem gambling, with four-fifths of these gamblers reporting at least some negative consequences of gambling. Gamblers who used supplementary devices not only have higher problem gambling severity scores and were more likely to be classified as having problems, but they behave differently in terms of gambling, engaged in a greater number of activities. Matched PC gamblers exhibited lower levels of problem gambling severity than matched offline gamblers. This may indicate that the higher levels of gambling problems are not related to gambling online generally, but are moderated by how the Internet is being accessed. This is consistent with research findings that Internet gambling by itself is not predictive of problem gambling severity in

Table 4
Prima facie comparison of gaming addiction categories.

	Non-problem	Low risk	Moderate risk	Problem gamblers	Percentage
Offline gamblers (n = 1195)	496 (41.5%)	231 (19.3%)	256 (21.4%)	212 (17.7%)	100%
PC gamblers (n = 2726)	775 (28.4%)	745 (27.3%)	767 (28.1%)	439 (16.1%)	100%
Supplementary device gamblers (n = 236)	47 (19.9%)	58 (24.5%)	80 (33.9%)	51 (21.6%)	100%
Test of equal proportions	$\chi 2$ (2, N = 1318) = 4.59, p < 0.001	$\chi 2$ (2, N = 1034) = 71.35, p < 0.001	$\chi 2$ (2, N = 1103) = 58.57, p < 0.001	$\chi 2$ (2, N = 702) = 2.39, p = 0.301	

Omnibus Chi Square test χ^2 (6, N = 4157) = 101.00, p < 0.001.

prevalence studies when overall gambling participation and other variables are controlled (Gainsbury et al., 2014, 2015; Philander & MacKay, 2014).

Findings support the overarching hypothesis that gamblers who prefer supplementary devices may have higher rates of gambling problems. Results may indicate that greater accessibility and convenience of accessing gambling opportunities can lead to greater gambling engagement (as confirmed by higher engagement of this group in gambling) and subsequently greater expenditure and development of gambling problems. Individuals who are more involved in gambling are likely to have higher problem gambling scores (Gainsbury et al., 2014; LaPlante et al., 2011; Philander & MacKay, 2014). Therefore, these individuals may seek out and prefer supplementary devices to facilitate this engagement.

Another possible explanation for this phenomenon might be that the choice of PC-usage precedes the decision to engage in gambling. In this way, gambling might not constitute a key activity of PC-usage for the matched group. Instead, the PC-usage might be based on income, educational level, or employment patterns. This is consistent with statistics indicating that greater household income is related to increased likelihood of having Internet access at home (ABS, 2014). By engaging in gambling as a recreational

Table 5
Multinomial logit model of gambling group membership.

Predictor	PC gamblers			Supplementary devices gamblers		
	Beta	Odds ratio	P-value	Beta	Odds ratio	P-value
(Intercept)	−1.260	0.284	<0.010	−4.45	0.012	<0.001
Gender	**1.688**	**5.408**	**<0.001**	**1.476**	**4.375**	**<0.001**
State (ref ACT)						
NSW	−0.090	0.914	0.771	1.606	4.983	0.125
NT	0.648	1.911	0.154	1.436	4.202	0.268
QLD	0.426	1.531	0.164	1.970	7.170	0.059
SA	−0.102	0.903	0.747	1.537	4.650	0.147
TAS	0.506	1.659	0.232	**2.419**	**11.234**	**<0.050**
VIC	0.500	1.648	0.116	1.982	7.255	0.060
WA	0.076	1.079	0.840	1.632	5.115	0.146
Employment status (ref full-time)						
Employed part-time	0.019	1.019	0.891	−0.231	0.794	0.403
Full-time student	−0.250	0.779	0.206	**−0.788**	**0.455**	**<0.050**
Homemaker	0.394	1.482	0.219	−0.609	0.544	0.563
Other	0.285	1.329	0.074	−0.619	0.539	0.100
Retired	**0.814**	**2.258**	**<0.001**	−0.835	0.434	0.163
Unemployed and seeking work	**−0.431**	**0.650**	**<0.050**	−0.412	0.663	0.299
Education level	−0.042	0.959	0.103	−0.026	0.974	0.603
Household income	**0.055**	**1.056**	**<0.001**	**0.104**	**1.109**	**<0.001**
Alcohol use	**−0.120**	**0.887**	**<0.001**	−0.027	0.973	0.658
Drug use	**0.211**	**1.235**	**<0.010**	**0.241**	**1.272**	**<0.050**
Family life cycle (ref FLC1)						
FLC2	0.284	1.328	0.145	−0.045	0.956	0.883
FLC3	0.219	1.245	0.812	N.A.		
FLC4	**0.516**	**1.676**	**<0.050**	0.331	1.392	0.304
FLC5	**0.725**	**2.064**	**<0.001**	−0.053	0.949	0.854
FLC6	−0.061	0.941	0.886	0.060	1.062	0.925
FLC7	**0.493**	**1.638**	**<0.050**	−0.352	0.703	0.429
FLC8	**0.543**	**1.721**	**<0.001**	**−1.030**	**0.357**	**<0.001**
FLC9	**0.795**	**2.215**	**<0.010**	−1.167	0.311	0.130
FLC10	0.119	1.126	0.642	**−1.753**	**0.173**	**<0.050**
FLC11	0.228	1.257	0.146	**−1.366**	**0.255**	**<0.001**
FLC12	0.077	1.080	0.717	−0.456	0.634	0.227
FLC13	0.126	1.134	0.794	0.409	1.506	0.669
FLC14	−0.135	0.874	0.591	**−1.330**	**0.265**	**<0.050**
FLC15	0.087	1.091	0.788	−0.144	0.866	0.839
Gambling attitude – benefits	**0.254**	**1.289**	**<0.001**	**0.363**	**1.437**	**<0.001**
Gambling attitude – morality	**0.383**	**1.467**	**<0.001**	0.177	1.193	0.242
Gambling attitude – legality	0.039	1.039	0.625	**0.311**	**1.365**	**<0.050**

N.A.: no data is available at this particular sub-group.
Baseline group = offline gambling.
Bold text indicates statistically significant differences between each comparison group and the baseline group.

Table 6
Demographic features of matched samples.

Variables	Offline Gamblers (n = 224)	PC gamblers (n = 224)	Supplementary device gamblers (n = 224)	Inferential statistic
Demographics				
Age, mean(SD)	39.3 (13.8)	40.9 (14.6)	37.8 (12.6)	$F(2,669) = 2.83$, $p = 0.059$
Men, no. (%)	210 (93.7)	207 (92.4)	208 (92.8)	$\chi 2$ (2, N = 672) = 0.32, p = 0.85
Marital status				
Divorced or separated (%)	22 (9.8)	28 (12.5)	22 (9.8)	$\chi 2$ (2, N = 672) = 1.12, p = 0.57
Living with partner (%)	40 (17.8)	46 (20.5)	45 (20.0)	$\chi 2$ (2, N = 672) = 0.58, p = 0.74
Married (%)	86 (38.3)	75 (33.4)	73 (32.5)	$\chi 2$ (2, N = 672) = 1.92, p = 0.38
Never married (%)	75 (33.4)	72 (32.1)	84 (37.5)	$\chi 2$ (2, N = 672) = 1.54, p = 0.58
Widowed (%)	1 (0.4)	3 (1.3)	0 (0)	$\chi 2$ (2, N = 672) = 3.52, p = 0.17[a]
Employment status				
Employed full-time (%)	172 (76.7)	162 (72.3)	167 (74.5)	$\chi 2$ (2, N = 672) = 1.76, p = 0.55
Employed part-time (%)	19 (8.4)	20 (8.9)	20 (8.9)	$\chi 2$ (2, N = 672) = 0.03, p = 0.98
Full-time student (%)	11 (4.9)	16 (7.1)	10 (4.4)	$\chi 2$ (2, N = 672) = 1.77, p = 0.41
Homemaker (%)	1 (0.4)	0 (0)	1 (0.4)	$\chi 2$ (2, N = 672) = 1.00, p = 0.60[a]
Retired (%)	8 (3.5)	10 (4.4)	8 (3.5)	$\chi 2$ (2, N = 672) = 0.32, p = 0.85
Unemployed and seeking work (%)	8 (3.5)	8 (3.5)	9 (4.0)	$\chi 2$ (2, N = 672) = 0.08, p = 0.95
Other (%)	5 (2.2)	8 (3.5)	9 (4.0)	$\chi 2$ (2, N = 672) = 1.22, p = 0.54
State				
ACT	0 (1.7)	1 (0.4)	1 (0.4)	$\chi 2$ (2, N = 672) = 1.00, p = 0.60[a]
NSW	70 (31.2)	63 (28.1)	60 (26.7)	$\chi 2$ (2, N = 672) = 1.14, p = 0.48
NT	1 (0.4)	3 (1.3)	2 (0.8)	$\chi 2$ (2, N = 672) = 1.00, p = 0.60[a]
QLD	89 (39.7)	86 (38.3)	87 (38.8)	$\chi 2$ (2, N = 672) = 0.08, p = 0.95
SA	29 (12.9)	24 (10.7)	27 (12.0)	$\chi 2$ (2, N = 672) = 0.53, p = 0.76
TAS	2 (0.8)	7 (3.1)	6 (2.6)	$\chi 2$ (2, N = 672) = 2.86, p = 0.23
VIC	28 (12.5)	29 (12.9)	34 (15.1)	$\chi 2$ (2, N = 672) = 0.78, p = 0.67
WA	5 (2.2)	11 (4.9)	7 (3.1)	$\chi 2$ (2, N = 672) = 2.52, p = 0.28
Education level				
Primary school or below (%)	72 (32.1)	63 (28.1)	77 (34.3)	$\chi 2$ (2, N = 672) = 2.08, p = 0.35
Some technical school, college or university (%)	27 (12.0)	27 (12.0)	25 (11.1)	$\chi 2$ (2, N = 672) = 0.11, p = 0.94
Completed technical school/TAFE/diploma/trade certification (%)	46 (20.5)	47 (20.9)	43 (19.1)	$\chi 2$ (2, N = 672) = 0.23, p = 0.99
Completed undergraduate university degree (%)	40 (17.8)	57 (25.4)	51 (22.7)	$\chi 2$ (2, N = 672) = 3.86, p = 0.14
Professional degree (Law, Medicine, Dentistry); Masters; PhD (%)	39 (17.4)	30 (13.3)	28 (12.5)	$\chi 2$ (2, N = 672) = 2.48, p = 0.28
Household Income				
Less than $20,000	16 (7.1)	13 (5.8)	16 (7.1)	$\chi 2$ (2, N = 672) = 0.42, p = 0.80
Between $20,000 and $50,000	41 (18.3)	34 (15.1)	39 (17.4)	$\chi 2$ (2, N = 672) = 0.82, p = 0.66
Between $50,000 and $100,000	79 (35.2)	101 (45.0)	80 (35.7)	$\chi 2$ (2, N = 672) = 5.80, p = 0.054
More than $100,000	88 (39.2)	76 (33.9)	89 (39.7)	$\chi 2$ (2, N = 672) = 1.99, p = 0.36
Alcohol use, mean(SD)	1.91 (1.42)	1.72 (1.25)	1.83 (1.23)	$F(2,669) = 1.16$, $p = 0.31$
Drug use, mean(SD)	0.22 (0.71)	0.17 (0.62)	0.26 (0.73)	$F(2,669) = 0.93$, $p = 0.39$
Gambling attitude – benefits, mean(SD)	−0.37 (1.29)	−0.31 (1.22)	−0.37 (1.19)	$F(2,669) = 0.15$, $p = 0.85$
Gambling attitude – morality, mean(SD)	0.81 (0.51)	0.87 (0.46)	0.82 (0.52)	$F(2,669) = 0.81$, $p = 0.44$
Gambling attitude – legality, mean(SD)	0.37 (0.56)	0.35 (0.52)	0.41 (0.55)	$F(2,669) = 0.66$, $p = 0.51$

[a] The result may be inaccurate due to small sample size.

Table 7
Propensity-score matched Comparison of utilized gambling categories.

Gambling categories	Offline Gamblers (n = 224)	PC gamblers (n = 224)	Supplementary device gamblers (n = 224)	Inferential statistic
Instant win scratch tickets, mean(SD)	0.47 (0.50) a	0.30 (0.46) b	0.43 (0.49) a	$F(2,668) = 7.62$, $p < 0.001$
Lottery tickets, mean(SD)	0.59 (0.49) a	0.21 (0.41) b	0.63 (0.48) a	$F(2,660) = 54.44$, $p < 0.001$
Sporting events, mean(SD)	0.51 (0.50) a	0.61 (0.48) a	0.85 (0.35) b	$F(2,661) = 32.99$, $p < 0.001$
Horse or dog racing, mean(SD)	0.74 (0.43) a	0.90 (0.31) b	0.90 (0.29) b	$F(2,659) = 16.24$, $p < 0.001$
Bingo, mean(SD)	0.02 (0.16) a	0.01 (0.14) b	0.06 (0.25) c	$F(2,659) = 5.15$, $p = 0.006$
Games of skill against others, mean(SD)	0.10 (0.30) a	0.13 (0.36) b	0.18 (0.38) c	$F(2,663) = 3.17$, $p = 0.040$
Electronic gambling machines, mean(SD)	0.59 (0.49) a	0.49 (0.50) a	0.57 (0.49) a	$F(2,658) = 2.667$, $p = 0.070$
Table games at a casino, mean(SD)	0.28 (0.45) a	0.27 (0.44) a	0.46 (0.49) b	$F(2,659) = 10.89$, $p < 0.001$

Non-play in the last 12 months is coded as 0, play in the last 12 months is coded as 1.
a,b,c = homogeneous subgroups as identified by Scheffe tests (Mean with the same letter are not significantly different).

Table 8
Propensity-score matched Comparison of gaming addiction categories.

	Non-problem	Low risk	Moderate risk	Problem Gamblers	Percentage
Offline gamblers (n = 208)	76 (36.5%)	40 (19.2%)	52 (25.0%)	40 (19.2%)	100%
PC gamblers (n = 214)	89 (41.5%)	93 (43.4%)	13 (6.0%)	19 (8.8%)	100%
Supplementary device gamblers (n = 211)	41 (19.4%)	53 (25.1%)	70 (33.1%)	47 (22.2%)	100%
Test of equal proportions	$\chi 2$ (2, N = 206) = 26.00, p < 0.001	$\chi 2$ (2, N = 186) = 32.60, p < 0.001	$\chi 2$ (2, N = 135) = 48.90, p < 0.001	$\chi 2$ (2, N = 106) = 15.00, p < 0.001	

Omnibus Chi Square test χ^2 (6, $N = 633$) = 91.0, $p < 0.001$.

activity in addition to on other PC-related activities, gambling behaviour might be less problematic than going offline to a place where gambling is a key issue of action. This is consistent with analyses of several large population surveys, which provide a strong indication that when covariates are corrected, participation in Internet gambling itself is negatively related to problem gambling severity (Philander & MacKay, 2014). Visiting a gambling venue is a dedicated activity, similarly downloading and using an app on a supplementary device requires forethought and planning, as well as indicating an intention to regularly engage in gambling through that device. This is coherent with the finding that PC gamblers engaged in fewer gambling activities than both offline and supplementary device gamblers. This indicates that PC gamblers are less involved gamblers overall as compared to the other groups, which is likely related to their lower levels of gambling problems. Although online gambling is constantly available, it might be easier for people to control their gambling when they have to access a stationary computer, including laptops, rather than gambling through a portable device, which is accessible at almost any time or location.

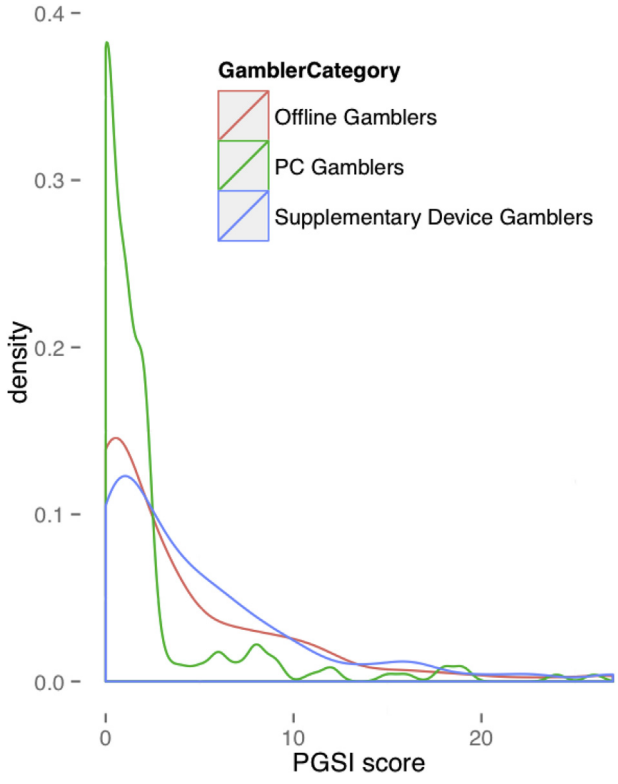

Fig. 3. Propensity-score matched comparison of gaming addiction distributions (The figure shows that most PC gamblers report a low value in terms of PGSI score and therefore exhibit very limited gambling problem, in comparison to other two groups).

In addition to the significant findings of this study, the analysis used an innovative methodology for the gambling field. Conventional t-tests cannot fully reveal the true relationship between technology interactions and people's gambling problems. This is because covariates interact with behaviour in complex ways. PSM isolates the incremental effect of executing a certain action (here: gambling via PC or supplementary devices) on behavioural consequences (here: types of games played and gambling problems). These findings have important implications for many types of gambling studies, including survey-based studies that collect self-report data, as well as behavioural analyses of datasets, particularly those that do not contain contextual and individual variables to identify relevant subgroups of gamblers. Future research should consider how variables interact, rather than examining risk factors in isolation, to gain a better understanding of the development of Internet gambling problems.

Notwithstanding these contributions, this study has limitations to be considered. The analysis is based on a self-selected survey conducted within Australia using self-report in response to an online survey. As such the sample is not representative of all gamblers and similar analyses could be conducted on other relevant datasets to verify the findings. Thus, no representative conclusions can be drawn for demographic subgroups who are inherently

unlikely to become supplementary device gamblers, e.g. women (only 6% observations remaining in matched sample). This survey was conducted in 2011, use of supplementary devices for gambling, particularly mobile phones, has increased since this time and users of these devices may represent early technology adopters, which may have influenced the results. Furthermore, the analysis was based on respondent's stated preference for mode of accessing gambling, but did not measure or control for the proportion of their gambling that was conducted via each mode of access. This is a minor limitation for the achieved group separation. For example, respondents in the PC or supplementary device groups might as well have been involved with offline or land-based gambling. However, in their self-assessment they state that such an access mode to gambling is less relevant for them. Thus it is reasonable to assume that gambling experiences focuses on their preferred & most often applied access mode. The analysis also did not consider the chronology of gambling and problems, so the current analysis did not allow causation to be interpreted. Use of supplementary devices was of interest for this study, however, PSM may be used on a range of outcome variables and future research should consider whether other relevant sub-groups of gamblers can be identified, particularly those that may benefit from targeted harm minimization interventions. Future research should consider the types of gambling activities used by various subgroups of gamblers to assess whether this has an impact on gambling problems and whether harms related to different gambling activities are mediated by the mode of access.

In addition to increasing the understanding of the relationship between Internet gambling and related problems, these results have important implications for regulators and policy makers. Currently, regulation typically differentiates between Internet and offline gambling, but does not differentiate between ways in which Internet gambling can be accessed. This study shows that the mode of accessing Internet gambling has may be related to subsequent harms experienced. Gambling policy often considers the extent to which specific types of gambling may represent a risk or impact problem gambling prevalence. In many jurisdictions, Internet gambling is prohibited due to concerns that this may increase the prevalence of gambling problems. The current results suggest that policy makers should consider whether gambling via supplementary devices specifically as the use of mobile apps or interactive televisions, rather than Internet gambling in general, warrants specific regulatory concern. Mobile apps should be sure to include a full and comprehensive range of features and resources to facilitate responsible gambling, such as the ability to set limits on time and money spent, and easy access to information about gambling at appropriate levels. Promotions for gambling via supplementary devices must include warnings about responsible gambling and regulators may consider limitations on promotional offers aimed to encourage gambling via these devices, such as inducements, free bets and credit betting. Attempts to identify gamblers that may be at-risk of experiencing problems should consider the ways in which individuals access gambling. As supplementary devices continue to evolve that may facilitate gambling (such as the use of Internet-enabled watches, Google Glass, and wearable technology) research should continue to examine the relation between technological access points and gambling harms. Thus, there is need for ongoing research in order to ensure that societal recommendations do not become outdated with ever-emerging new technology.

Disclosure

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