Second Session at the Virtual Poker Table: A Contemporary Study of Actual Online Poker Activity

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Abstract

Technological advancements and worldwide television exposure led to a poker boom in the early 2000s, and poker (both live and online) has retained some of that popularity today. The present study examined online poker playing trends based on actual electronic betting records data for 2489 subscribers to a major global internet gambling operator from 2015 to 2017. We found that overall financial involvement (median total overall spend: €439.7) and time commitment (median number of sessions: 43) during the two-year study period were relatively moderate. We identified the top 1% by total overall spend as a subgroup of highly involved players with disproportionately higher financial involvement (median total overall spend: €272,581.4) and time commitment (median number of sessions: 1149). Our results were similar to those reported in LaPlante et al.'s (Comput Hum Behav 25(3):711–717, 2009. https://doi.org/10.1016/j.chb.2008.12.027) study of online poker betting records, suggesting that players' levels of involvement are similar to those from ten years ago despite numerous changes to the online poker environment. We also analyzed records of deposits and withdrawals, and we observed similar indicators of moderate gambling behavior within the overall sample (median two-year total amount deposited: €176.4). In contrast to popular beliefs about internet gambling, in our sample, most online poker play was arguably moderate. However, a small percentage of highly involved players play poker at extreme levels and require closer scrutiny.

Keywords Gambling · Internet gambling · Internet poker · Internet · Poker · Epidemiology

Introduction

Gambling involves risking something of value on the outcome of an event that is at least partially determined by chance. Online platforms have increased opportunities to gamble in more convenient, easily accessible formats (Hojnik, 2018; Lawn et al., 2020). For some, internet gambling comes with many related harms (e.g., see Håkansson & Widinghoff,

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2020). In the past, many researchers were only able to study gambling and its consequences via self-report (e.g., questionnaires and surveys) and by observing player behavior in specific or controlled environments (e.g., experiments, simulated casinos), methods which are vulnerable to potential response biases and low external validity, respectively (e.g., Braverman et al., 2014; Schram, 2005). Other studies have sought to overcome these limitations by using actual online gambling records provided by internet gambling operators (Finkenwirth et al., 2020; Gray et al., 2015; LaBrie et al., 2008; Luquiens et al., 2016; Tom et al., 2014). We use this methodological approach in the present study to examine the behavior of 2489 online poker players over a two-year period.

Poker in Focus

Poker players have been shown to spend more time gambling, gamble more frequently, and have higher scores on problem gambling indices when compared to other gamblers (Shead et al., 2008). Research also suggests that online poker players differ from non-online poker players (Barrault & Varescon, 2016). Studies that rely on self-reported data suggest that the typical online poker player is a young man in his twenties (Moreau et al., 2016), prefers to remain online instead of visiting land-based gambling venues (Dufour et al., 2020), plays more frequently—at least once a week—compared to the average land-based poker player, and is more likely to have gambling-related problems (e.g., higher Problem Gambling Severity Index [PGSI, Ferris and Wynne (2001)] and illusion of control scores) than his land-based counterpart (Dufour et al., 2020; Mihaylova et al., 2013). These distinctive characteristics and betting patterns of online poker players, as well as their potentially elevated risk of gambling problems, make this a particularly important population to examine empirically with valid and reliable contemporary data.

Analyzing Online Poker Play Behavior with Actual Betting Records

Instead of using surveys and questionnaires to study internet poker behavior, some researchers have used either summary statistics provided by an online poker operator (which were derived from the operator's database of hands) or a database of hands in the possession of the researchers themselves. For example, Siler (2010) analyzed hand histories of play at low, medium, and high stakes, and observed that players who were more selective with their starting hands and more aggressive with their betting tended to have higher win rates. Potter van Loon et al. (2015) analyzed a database of poker hands covering a twelve-month period and found that profitability in the first six months was predictive of profitability in the second six months.

In one of the first such poker studies to analyze electronic betting records, LaPlante et al. (2009) used data derived from an online gambling provider's database of players' activity and performance. The authors hypothesized that the majority of the sample of online poker players would show moderate gambling behavior, while a minority would show extreme behavior. By using aggregates of data (e.g., duration active on the site, number of playing sessions) provided by *bwin* Interactive Entertainment AG (bwin; a global online gambling operator), they studied a cohort of new players from 2005 to 2007 and observed that the top 5% of players (based on chips bought at poker tables) were distinct from the rest. Compared to other players, these "most involved players" devoted significantly more time and money to online poker. However, this study was published over a decade ago, and it is an open question whether those findings are relevant today.

Specifically, the online gambling landscape has changed since 2007. For example, there have been significant developments in poker strategy and the dissemination of that knowledge. Professional poker players have written countless books, released hours of instructional videos, and broadcast hours of streaming content on poker strategy and play. There is a common perception among poker players that the rate of new players taking up the game has decreased (e.g., Weisenthal, 2008, "the poker boom is dead") and that the average player today is stronger than the average player ten years ago (Negreanu, 2016). Online cardrooms today offer new game formats like Fast Fold, cash game tables where a player is given a new hand and seat at a new table immediately upon folding the previous one (found on sites like Full Tilt, PokerStars, 888poker) and lottery Sit & Go's, single-table tournaments where the winner wins a random amount (found on sites like America's Cardroom, Sportsbetting.ag, ignition Poker). Additionally, some states in the U.S. and countries around the world have *ring-fenced* their player pools, whereby players are restricted to playing other players within a certain country or jurisdiction, restricting access to a wider player pool and often decreasing game availability (e.g., until 2018, online poker players in Spain could only play against others in Spain).

These changes in poker and online poker—the additional skill development resources, the new game formats, and the changes in regulations and legislation—mean that the experiences of new poker players these last few years might have differed from those of new players back in 2005 or 2006, especially with respect to the tables and tournaments available and the level of opposition therein. Measures of poker activity, such as time that players stayed active in online poker, stake levels and financial commitment, and win/loss rates might reflect these changes. Thus, a study of more recent newly subscribed online poker players and its comparison to results observed by LaPlante et al. (2009) over a decade ago is important to advance our understanding of today's poker landscape and the potential effects of these changes.

The Present Study

With increasing legalization and regulation, online poker availability has expanded its reach since LaPlante et al. (2009), leading us to ask if and how these changes might have impacted online poker players. The current study provides a contemporary examination of typical and extreme online poker gambling behavior by assessing two years of the actual online poker gambling activity of more recent subscribers to an online poker site. We focused on comparisons with LaPlante et al. (2009) in the present study because: (1) the European Union countries included in both of our datasets were very similar and (2) bwin was acquired by GVC Holdings PLC (from whom we received the data for the current study). We expected a comparable overall player pool. Similar to the work by LaPlante and colleagues, we focus on the experience of new subscribers to an online poker site between February 1, 2015 and January 31, 2017 (exactly ten years after LaPlante et al.'s study). We highlight a group of players with play patterns indicating extreme and potentially excessive engagement (e.g., high total amount of cash committed to pots and/or tournaments). In a novel exploratory analysis, we examine the descriptive characteristics of deposit and withdrawal metrics among new subscribers to an online poker site. To our knowledge, no existing studies have examined online poker players' deposit and withdrawal behaviors, so we do not have any empirical basis to formulate a confirmatory hypothesis for this research question. We pre-registered this study on the Open Science Framework website before analyzing the data. Readers can access this preregistration at https://osf.io/d7ctr. We prepared

two transparent change documents for this preregistration, which are also available at the same website.

Research Questions

Despite online poker operators' additional game formats and offerings, the actual mechanics of online poker play (e.g., the layout of the cash game and tournament lobbies, the graphics for the table and cards, the locations of the buttons, the speed of play) did not change fundamentally from 2005 to 2015. Based on a brief review of inflation rates, we surmised that in most countries the value of money changed at most by a factor of 1.25 over the ten years (e.g., Statistics Finland, €1.00 in 2005 was worth €1.20 in 2015). Because the mechanics of poker and the value of money did not change appreciably from 2005 to 2015, we believed that there were limits to how much online poker could change over those years. More specifically, we believed that the values of measures of poker activity in this study would be similar to corresponding values in LaPlante et al. (2009).

In this study, we have seven measures of poker activity. Five of them—duration of time a player is active on the site, number of poker sessions during a two-year period, number of sessions per day, net loss during a two-year period, and percent lost)—are exact duplicates of measures in LaPlante et al. (2009). The other two are slightly different constructs from their corresponding measures in the previous study. For this study, we calculate the amount of money committed to cash game pots and tournament fees, and the average amount of money committed per session. LaPlante et al. (2009) calculated the total amounts of chips purchased and the average amount purchased per session. We believe that all seven measures are exact or close enough to their counterparts to ask Research Question 1: *How do the values of the seven measures of poker activity in this study compare to the corresponding values found in LaPlante et al.* (2009) *?*[1]

LaPlante et al. (2009) observed significant correlations between several measures of poker activity. Some of these significant results follow logically from the definitions of the measures (e.g., duration of time playing poker and number of poker sessions). However, studies since have shown that simple relationships between measures of poker activity or between measures of gambling activity in general should not be considered automatic or assumed. For example, in a scatterplot of win rate per 100 hands versus number of hands played for a group of cash game no limit hold'em players, Siler (2010) presented a tapered, cone-shaped data cloud where it was not clear that a measure of a linear or even monotonic relationship (e.g., a Pearson or Spearman correlation) was appropriate. In another example, a recent study of new players in another game of skill, daily fantasy sports, Wiley et al. (2020) observed that percent lost and net loss were not significantly correlated. Poker strategy arguments also question the value of assuming simple relationships between measures of poker activity or between measures of gambling activity in general. The conventional wisdom found in books and forums is that differences in players' judgment and decision making are stronger and more immediate determinants of the signs and magnitudes of players' individual win/loss rates and of longevity in the game (i.e., length of time as an active poker player) than other considerations or factors. With these ideas in mind, we offer Research Question 2: *Which of the seven measures of poker activity in this study are correlated with each other?* Our analyses associated with this research question can be found in our online supplement.

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[1] For additional details about our a priori assumptions related to these research questions, please view our research preregistration.

Previous analyses of actual gambling players records show that distributions of various measures of gambling activity are usually highly positively skewed (e.g., LaPlante et al., 2009; Tom et al., 2014). We predict that we will see a similar distribution, so we offer Research Question 3: *If we construct a centile plot of the distribution of Total Overall Spend (i.e., the amount of money the players spend playing online poker) will we observe a clear majority of players with smaller monetary values for Total Overall Spend and a remaining minority with larger monetary values for Total Overall Spend (e.g., a 95%/5% or 99%/1% split)?*

There are many different reasons why a player might have a playing history that puts them in this most involved minority. They might have: (1) started more sessions; (2) been more active in more hands and pots; and/or (3) been a higher stakes player. We expect such players to have inflated values for some of our measures of poker activity. This leads to Research Question 4: *With respect to measures such as number of sessions, cash committed to hands and tournaments, and average amount of cash activity per session, is the extreme minority (e.g., 5% or 1%) distinctly more extreme than the remaining majority?*

Methods

Data Acquisition and Participants

Using a secure data transfer protocol, Entain plc (Entain; formerly, GVC Holdings PLC) provided us with de-identified data sets with daily aggregates of sports betting, online casino, and poker activity (on both cash game tables and in tournaments) for 72,494 individuals, each of whom first registered in February 2015. Entain also provided demographic data at the individual level and transactional data describing attempted and completed cash deposits into, and withdrawals out of, the players' gambling accounts. Out of the 72,494, the data delivery contained poker activity data for 4667 individuals. To create a two-year study period, as in LaPlante et al. (2009), we set the start and end dates for our study period to February 1, 2015 and January 31, 2017, respectively. Consistent with their methods, we removed 2160 players who played poker—cash, tournament, or both—on three or fewer different days during the study period.[2] From the remaining 2517 players, we then removed 13 whose first day was on or after January 1, 2017 (i.e., players who were only active during the last month of the study period). From the remaining 2504 players, we removed 8 players who only played freeroll tournaments (i.e., did not use any money—either their own cash or promotional funds provided by the site) and did not actually gamble. From these 2496 players, we removed 7 who did not have at least one completed deposit during the two-year time period. Our final analytic sample contained $n = 2489$ players.

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[2] Although this exclusion is quite large, it serves the purpose of distinguishing more regular online poker players (who, from a public health standpoint, we were more interested in) from others who were likely just experimenting with Entain's online poker platform, with no intention of engaging with the service in the long term. Without this exclusion, these online poker "experimenters" would substantially bias the results.

Data and Measures

We received five data sets for these 2489 players, including: (1) player demographics, (2) daily aggregates of cash game activity, (3) daily aggregates of tournament activity, (4) records of deposits, and (5) records of withdrawals (see Appendix Tables 1A through 1J for detailed descriptions of each measure derived from these data sets). The Cambridge Health Alliance (CHA) IRB evaluated our study plans and confirmed that the study did not qualify as human subjects research because all data were de-identified. Data were transferred via secure FTP from Entain to CHA's Division on Addiction.

Using the delivered cash game and tournament data, we constructed aggregates and other summary statistics covering the whole study period. Using these summary statistics, we constructed seven measures of poker activity designed to be analogs to measures used in LaPlante et al. (2009). These measures include duration, number of sessions, total overall spend, sessions per day, average spend per session, net loss, and percent lost. Table 1 provides the final list of all measures we included in our analyses and observations. For additional details on the differences in the two studies' measures, see Supplementary Appendices A & B. Of particular note is the difference between Total Wagered in LaPlante et al. (2009), which measured chips purchased (i.e., cash transferred from a player's account to their stack or seat at the table) and total overall spend in this study, which included cash game chips committed to pots as calls, bets, and raises (i.e., cash transferred from a player's stack to the middle of the table). Players tend to bet the same chips multiple times in the same session. For example, a player might move all-in on one hand, not get called, have their chips returned to them, and then move all-in on a later hand. Thus, total overall spend will tend to be greater than total wagered.

Using the delivered deposit and withdrawal data, we constructed measures summarizing players' financial activity. These measures and their definitions can be found in the bottom two-thirds of Table 1. Additional details can be found in the final third of Appendix Table 1.

Analytic Procedures

We conducted four blocks of analyses. For each measure of poker, deposit, and withdrawal activity, we calculated seven percentiles: 0th (minimum), 25th, 50th (median), 75th, 95th, 99th, and 100th (maximum). Five of them are the standard five-number summary. We included the other two, the 95th and 99th, based on a reviewer's suggestion, to give more detail as to how right-skewed some of the measures' distributions were. Because we performed multiple statistical tests across the four blocks, we chose a significance level of $\alpha = 0.001$ to account for multiple comparisons. For the Mann–Whitney U-tests below, we report the related statistic W given by the function *wilcox.test*() in R.

The first block is *Demographics*. We generated the frequency distributions for players' countries of residence and gender. We calculated the mean, standard deviation, and five-number summary of age.

The second block is *Poker Activity*. We examined the distributions of the seven measures of poker activity (i.e., duration, number of sessions, sessions per day, total overall spend, average spend per session, overall net loss, and overall percent lost) over the whole sample. We obtained means, standard deviations, and the seven percentiles and then conducted Kolmogorov–Smirnov tests for normality to explore which variables have skewed

Table 1 Measures of poker activity, deposit activity, and withdrawal activity used in the analyses

Measures of poker activity	
Duration	Number of days between the first and last days of poker activity, inclusive. This variable has a direct analog with the same name in LaPlante et al. (2009)
Number of sessions	Number of cash games tables plus number of tournaments. This variable has a direct analog with the same name in LaPlante et al. (2009)
Sessions per day	Number of sessions divided by duration. This variable has a direct analog with the same name in LaPlante et al. (2009)
Total overall spend	Total amount put into pots in cash game hands plus total amount spent on tournaments. This variable has an analog called Total Wagered in LaPlante et al. (2009)
Average spend per session	Total overall spend divided by number of sessions. There is a similar variable called Euros per Session in LaPlante et al. (2009)
Net loss	Total overall spend minus total amount won from cash game pots minus total amount won as prizes in tournaments. This variable has a direct analog with the same name in LaPlante et al. (2009)
Percent lost	100 times net loss divided by total overall spend. There is a similar variable with the same name in LaPlante et al. (2009)
Measures of deposit activity	
Number of attempted deposits	Number of attempted deposits, both successful and failed
Number of failed deposits	Number of attempted deposits classified as failed
Number of completed deposits	Number of attempted deposits classified as completed. If someone attempts a deposit, has the deposit fail, attempts again with the same payment method and deposit amount, and succeeds, then that would count as one failed deposit and one completed deposit
Percentage of failed deposits	100 times number of failed deposits divided by number of attempted deposits
Total amount deposited	Sum of the amounts deposited via completed deposits
Number of deposit days	Number of unique dates with completed deposits
Deposits per deposit day	Number of completed deposits divided by number of deposit days
Average amount deposited per deposit day	Total amount deposited divided by number of deposit days
Number of unique payment methods	Number of unique payment method/payment type combinations (e.g., Visa/debit card) from all of the attempted deposits (both completed and failed)
Number of unique credit cards [used for deposits]	Number of unique types of credit cards (e.g., Visa, Mastercard) used in completed deposits

Table 1 (continued)

Measures of withdrawal activity	
Number of attempted withdrawals	Number of withdrawals, both completed and reversed
Number of reversed withdrawals	Number of withdrawals classified as reversed
Number of completed withdrawals	Number of withdrawals classified as completed. If someone attempts a withdrawal, has the withdrawal reversed, attempts again with the same payment method and withdrawal amount, and succeeds, then that would count as one reversed withdrawal and one completed withdrawal
Percentage of reversed withdrawals	100 times number of reversed withdrawals divided by number of attempted withdrawals
Total amount withdrawn	Sum of the amounts withdrawn via completed withdrawals
Number of withdrawal days	Number of unique dates with completed withdrawals
Withdrawals per withdrawal day	Number of competed withdrawals divided by number of withdrawal days
Average amount withdrawn per withdrawal day	Total withdrawal amount divided by number of withdrawal days

distributions. Based on past experience with gambling data, we expected to see skewed distributions. Therefore, we opted for non-parametric tests of association. We calculated Spearman correlations between the poker activity measures and tested the correlation for each pair of measures for statistical significance. As an unplanned exploratory analysis, we then used Mann–Whitney *U*-tests to compare the men and women in our sample on the seven measures. The Spearman correlations and the Mann–Whitney *U*-tests can be found in an online supplement.

The third block is *Financial Activity*. We completed exploratory analyses of the distributions for the measures of deposit and withdrawal activity listed in Table 1. When examining the measures of deposit activity, we used data from all 2489 players in the analytic sample. When examining the measures of withdrawal activity, we used data from the 876 players who attempted to make at least one withdrawal during the study period. First, we calculated the seven percentiles, means, and standard deviations of all 18 financial measures. Then, we calculated two Spearman correlation matrices, one for the ten measures of deposit activity and one for the eight measures of withdrawal activity, and tested the correlations in both for statistical significance. After noticing that 43 players had only reversed withdrawals (i.e., and no completed withdrawals), we removed the 43 from the pool of withdrawers and recalculated the Spearman correlations as an unplanned sensitivity analysis. The univariate statistics for the 2489 depositors and all 876 who attempted a withdrawal are included here. The three matrices of Spearman correlations (i.e., one for deposits, two for withdrawals) are available in an online supplement.

The fourth and final block is *Most Involved Players*. We identified the most involved players based on total overall spend. We created a centile plot to illustrate the distribution of total overall spend and then used the numbers from that plot to determine the size of the most involved minority. We treated the "elbow" of the curve in the centile plot as an indicator for what percentage of the sample should be considered the most involved minority of players, following the centile plot analysis approach used in previous studies of actual gambling records (e.g., LaBrie et al., 2008). For each of the seven measures of

poker activity listed in the second block, we calculated separate means, standard deviations, and medians for the most involved and remaining less involved players. We then used Mann–Whitney *U*-tests to identify the variables where the distributions of the less involved and the most involved differed significantly.

Results

Demographics

The sample contained 2238 males (89.9%) and 251 females (10.1%). The players had a mean age (as of registration) of 29.6 years and a standard deviation of 9.0 years. Over 75% of the sample was under the age of 35 (five-number summary: 18–23–27–34–69).

Out of the 2489 players, we received data on country of residence for 2485. Of these 2485 players, the largest two contingents were from France ($n = 691$, 27.8%) and Germany ($n = 662$, 26.6%). The percentages for other countries were all below 6.0%.

Poker Activity

We calculated the mean, standard deviation, and seven percentiles for each measure of poker activity (see Table 2). Kolmogorov–Smirnov tests indicated that none of the seven variables were normally distributed (all *p* values below 0.001).

Based on the medians, the typical poker player's Duration of play during the two-year study period was between 2 and 3 months. The median Net Loss was €52.3, which equates to under €3 a month over the two-year study period, or under €30 per month if we assume only 2 or 3 months of poker activity based on the median Duration. For comparison, Table 2 contains corresponding medians from both LaPlante et al. (2009) and a document listing corrected values from that manuscript's Table 1 (Division on Addiction, 2021, retrieved 2021-05-14). The medians in this study are smaller than their counterparts. For example, the medians of total overall spend, average spend per session, and net loss are roughly half the corresponding medians in the previous study. However, we consider our results comparable in size and magnitude from a practical standpoint.

Financial Activity

Table 3 contains descriptive statistics for deposit activity. A majority of the players had at least one failed deposit,[3] and a majority completed at least 80% of the deposits they attempted. The median amount deposited was under €240, and the median number of deposit days was 6.0, which averages to about one deposit day of under €40 every 4 months. Of the 2489 players, 1449 (58.2%) used only a single method for depositing funds. Over half of the players (1570 out of 2489, 63.1%) did not use a credit card to deposit funds.

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[3] Deposits can "fail" for several reasons, including reasons that are benign such as incorrectly entered credit/debit card information, and others that might warrant cause for concern such as deposit amounts that exceed self-imposed limits or government regulations. However, because we did not have access to information related to why the deposit failed, we advise readers to interpret this measure with caution.

Table 2 Summary statistics for the measures of poker activity for the whole sample ($N=2489$)

	Minimum	25th Percentile	Median	75th Percentile	95th Percentile	99th Percentile	Maximum	Mean	Standard Deviation	2005 median
Duration	4.0	21.0	79.0	348.0	688.6	719.1	731.0	202.9	232.6	196.0
Number of sessions	4.0	20.0	43.0	133.0	830.4	2,705.3	10,529.0	197.1	575.4	60.0
Sessions per day	0.0	0.2	0.8	2.3	7.3	16.8	176.5	2.0	5.1	0.6
Total overall spend	0.9	114.1	439.7	1,936.6	19,852.4	152,282.1	3,742,545.0	9,728.0	108,348.5	808.0
Average spend per session	0.0	3.2	7.9	23.1	126.6	526.3	3,270.9	36.4	136.9	13.2
Net loss	−50,775.9	14.4	52.3	186.0	1,260.5	4,570.7	20,378.6	249.9	1,707.7	110.7
Percent lost	−854.7	6.2	13.7	25.9	62.9	95.6	100.0	17.3	34.7	20.4

We calculated the 2005 medians using the data sets available in the package "Sitting at the Virtual Poker Table: February 2005 through February 2007" found on The Transparency Project (https://thetransparencyproject.org)

LaPlante et al. (2009) used "Total [Euros] wagered" instead of total overall spend and "euros per session" instead of average spend per session

Table 3 Summary statistics for the measures of deposit activity for the full sample ($N=2,489$)

	Minimum	25th percentile	Median	75th percentile	95th percentile	99th percentile	Maximum	Mean	Standard deviation
Number of attempted deposits	1.0	3.0	11.0	35.0	155.0	380.7	1,211.0	36.9	83.8
Number of failed deposits	0.0	0.0	2.0	8.0	42.0	138.2	850.0	10.1	31.9
Number of completed deposits	1.0	3.0	7.0	25.0	111.6	281.2	1,168.0	26.7	62.4
Percentage of failed deposits	0.0	0.0	16.7	36.0	66.7	80.8	96.4	22.1	22.5
Total amount deposited	5.0	51.0	174.6	745.0	4,497.3	15,800.3	112,337.9	1,148.3	4,376.9
Number of deposit days	1.0	2.0	6.0	18.0	77.0	160.0	416.0	17.7	31.9
Deposits per deposit day	1.0	1.0	1.1	1.3	2.3	3.8	11.8	1.3	0.6
Average amount deposited per deposit day	2.8	15.0	24.5	51.0	203.6	691.6	3,114.8	62.7	160.5
Number of unique deposit methods	1.0	1.0	1.0	2.0	4.0	6.0	10.0	1.7	1.1
Number of unique credit cards	0.0	0.0	0.0	1.0	1.0	2.0	2.0	0.4	0.6

Table 4 Summary statistics for the measures of withdrawal activity ($n = 876$)

	Minimum	25th Percentile	Median	75th Percentile	95th Percentile	99th Percentile	Maximum	Mean	Standard deviation
Number of attempted withdrawals	1.0	1.0	3.0	8.0	31.0	83.5	299.0	8.7	22.2
Number of reversed withdrawals	0.0	0.0	0.0	1.0	13.0	31.2	298.0	2.4	12.3
Number of completed withdrawals	0.0	1.0	2.0	6.0	21.0	56.8	213.0	6.3	15.3
Percentage of reversed withdrawals	0.0	0.0	0.0	17.1	97.1	100.0	100.0	15.4	28.5
Total amount withdrawn	0.0	80.3	290.3	951.4	5,824.3	20,671.1	120,446.6	1,510.2	5,826.9
Number of withdrawal days	0.0	1.0	2.0	6.0	19.0	52.2	175.0	5.5	12.0
Withdrawals per withdrawal day	0.0	1.0	1.0	1.0	1.5	2.0	3.0	1.0	0.3
Average amount withdrawn per withdrawal day	0.0	47.7	100.0	233.5	901.1	2,793.8	10,000.0	259.9	603.6

Table 5 Data for the top six centile groups by total overall spend

Centile group number	Number of players	Minimum total overall spend	Maximum total overall spend	Sum of total overall spend
95	25	15,605.97	19,825.44	430,097.3
96	25	19,870.41	27,286.54	568,337.1
97	25	27,329.15	41,772.04	847,935.7
98	25	41,797.70	70,113.45	1,358,184.9
99	25	72,802.37	152,036.53	2,360,943.7
100	25	154,083.30	3,742,545.01	15,245,175.6

Table 4 contains the summary statistics for withdrawal behavior. Out of the 876 players (35.2% of the sample) who attempted to make at least one withdrawal during the study period, 591 (67.5%) had no reversed withdrawals, and 43 (4.9%) had only reversed withdrawals. The remaining 242 (27.6%) each had at least one completed withdrawal and at least one reversed withdrawal.

Most Involved Players

We ranked the 2489 players by total overall spend, and then used those rankings to partition the players into 100 centile subgroups. Table 5 shows the minimum and maximum total overall spend and the sum of total overall spend for the top six centile groups. The sum of the 2489 players' total overall spend was roughly €24 million, and the top centile group of 25 players was responsible for over €15 million of it. The player with the next highest total overall spend (i.e., the player in the 99th centile group with the highest total overall spend) had a total overall spend of just over €150,000. Based on these results, it did not seem appropriate to combine the 99th and 100th centile groups to make the "most involved" partition. We partitioned the players into a most involved group of 25 players ("most involved 1%") and a remaining group with the other 2464 ("remaining 99%").

Table 6 contains the mean, standard deviation, and median for the seven measures of poker activity for the most involved 1% and for the remaining 99%. For six out of the seven measures, the distributions of the 1% and the 99% were significantly different (Mann–Whitney U-tests, p values below 0.001). Those in the most involved 1% played more and stayed active on the site longer. The means and medians for number of sessions, total overall spend, and average spend per session were each an order of magnitude or larger for the most involved 1% than for the remaining 99% (e.g., Average Spend per Session; mean: €540.9 vs. €31.2; median: €318.2 vs. €7.7).

However, the difference in total overall spend did not translate directly into greater losses. The medians for net loss for the most involved 1% and the remaining 99% were not significantly different. A potential reason for this exception could be the performance heterogeneity of the most involved 1%. Specifically, closer examination of the composition of the two groups indicated that the 1% group contained the six players with the largest negative values on Net Loss (i.e., the biggest winners) and the four with the largest positive values on Net Loss (i.e., the four who lost the most money during the study period).

Table 6 Summary statistics for measures of poker activity for the most involved 1% and the remaining 99%

	Remaining 99% ($n=2464$)			Most involved 1% ($n=25$)			Group comparisons		
	Mean	Standard deviation	Median	Mean	Standard deviation	Median	W	p value	r
Duration	200.9	231.7	77.0	397.6	247.4	354.0	14,773.0	<0.001*	0.090
Number of sessions	180.7	522.6	42.5	1806.7	1889.1	1149.0	2917.0	<0.001*	0.156
Sessions per day	2.0	5.1	0.8	6.1	7.3	3.5	11,756.5	<0.001*	0.107
Total overall spend	3639.5	11,906.7	427.2	609,807.0	907,485.4	272,581.4	0.0	<0.001*	0.173
Average spend per session	31.2	108.5	7.7	540.9	683.1	318.2	1,674.0	<0.001*	0.163
Net loss	265.9	874.9	52.4	−1326.0	14,870.9	−46.0	32,382.0	0.658	0.009
Percent lost	17.5	34.8	13.9	1.1	4.1	0.0	53,816.0	<0.001*	0.129

* Statistically significant at $p<0.001$

Discussion

This study sought to conceptually replicate and extend LaPlante et al.'s (2009) observations about online poker by using betting records from a contemporary sample of 2489 new subscribers to an internet gambling service. Before conducting our analyses, we believed that the current study would have similar findings to those from LaPlante et al. (2009) despite the continually changing online gambling landscape. As expected, we observed that many demographics and poker activity measures' distributions and correlations were similar to those in the LaPlante et al. (2009) study, with only a few minor differences. Within this online poker cohort, the majority of players gambled at a moderate rate on Entain's site (e.g., a loss rate around €3 per month, spending under €10 per session), while the most involved 1% of players played more sessions that were likely either longer and/or at higher stakes. The replication of this key finding in this study is central to understanding contemporary poker gambling. Below, we summarize the findings of this study and provide context and interpretation of the results we observed. We also consider possible public health implications of our observations.

Demographics

Despite close to identical criteria for inclusion, the demographics of this study's sample are different from the demographics of LaPlante et al.'s (2009) study's sample in some ways. However, the two samples are not completely divergent. First, this study's analytic sample contained 2489 players, compared to the 3445 players in LaPlante et al.'s (2009) analytic sample. It is not clear if this decrease in new subscribers was indicative of overall trends in the online poker ecosystem (e.g., the demographics, mentalities, or mathematical acumen of the people likely to become new online poker players), indicative of trends specific to Entain's operations related to poker specifically (e.g., less media exposure, decreased marketing efforts, pursuance of gambling licenses), or due to random month-to-month variation in poker participation. The average ages of the two analytic samples were similar, but the more recent sample was slightly older (27.9 years in the 2009 study vs. 29.1 years in this one). This age composition is on par with other studies of online poker players (Dufour et al., 2015; Hopley et al., 2012; Palomäki et al., 2016), which suggests it is possible that new players are first getting into online poker at roughly the same ages today as ten years ago.

The distribution of the countries of residence in this study's analytic sample was much more concentrated in a select number of countries than the corresponding distribution from the 2009 study. Much like the difference in the raw number of new players, this might be due to changes in laws (e.g., countries ring-fencing their players) or changes in marketing schemes (e.g., poker celebrities in different countries signing endorsement deals with different online cardrooms).

Poker Activity

LaPlante et al., (2009, p. 715) stated that their results support the idea that "most… who gamble on the Internet do so moderately." Our contemporary analyses of actual poker activity from ten years later yielded results that substantiate this idea even more. First, the median duration of play within this cohort was two and a half months. In contrast, the corresponding median duration in LaPlante et al. (2009) was six and a half months. Anecdotal

evidence (e.g., Weisenthal, 2008) and numerous published books on poker strategy (e.g., Hull, 2013) suggest that poker competition is stiffer than it was in 2005, possibly convincing those looking for "easy money" to look elsewhere.

Second, the summary statistics for average spend per session also pointed toward more moderate behavior. The median Average Spend per Session in this study was €7.9 per session. For context, a session's Spend of €7.9 could be a cash game player playing two hands in a session and moving all-in for each hand for roughly €4.00 each time (e.g., at a €0.02/€0.05 no limit hold'em table). The median Average Spend per Session is less than the median Euros per Session (€13 per session) reported in LaPlante et al. (2009). Based on the definitions of total overall spend and total wagered, we would actually expect average spend per session to be higher in this study than in LaPlante et al. (2009) if behavior were equivalent between the studies. However, instead we observed the opposite. This pattern could be indicative of a trend towards more microstakes play or a decrease in the number of higher-stakes games available on Entain's servers.[4]

We can compare the results for total overall spend to the "safer gambling limits" suggested by Currie et al. (2017) and more recently by Louderback et al. (2021). Currie and colleagues suggested the "safer" threshold for total amount wagered was $75 CAD (roughly €53) per month.[5] Louderback et al. (2021) developed an online-specific amount wagered limit of €167.97 per month. Based on a heuristic of two all-in hands per session and the idea that "all-in" is a proxy for the maximum amount a player would bet on a hand, we assume that overall spend here is roughly equivalent to two times what we would think of as amount wagered in other studies or forms of gambling. Currie and colleagues' $75 CAN per month is equivalent to a two-year total overall spend limit of €2544 (i.e., €53 per month times 24 months times 2), and Louderback and colleagues' €167.9 per month is equivalent to a two-year total overall spend limit of €8059 (i.e., €167.9 per month times 24 months times 2). In comparison, within our sample, the 75th percentile for total overall spend was €1936.60. If our assumption about the relationship between total overall spend and amount wagered is correct, then over 75% of this analytic sample is gambling within safer gambling limits. It is worth emphasizing that those who exceed these limits often do so dramatically, and these players might require careful attention from gambling operators to ensure that they are gambling safely. Another caveat is that these values for total overall spend are limited to Entain's site. Players might have played significantly more poker on other sites and thus exceeded safer gambling limits.

There is something to be said for observing trends in our results (e.g., overall moderation, less than a session of poker per day) that were also reported in LaPlante et al. (2009). It is possible that gambling landscapes and environments more generally tend to be resilient to extreme change, and that this may be especially true when most of the underlying rules of the games (e.g., the basic rules of no limit hold'em) do not change. Nelson et al. (2021) noted analogous similarities between sports betting behavior in 2015 and sports

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[4] Without having access to full hand histories, we can only make educated guesses about what stakes a median Average Spend per Session of €7.9 might imply. For example, if we believe that average no limit hold'em cash game players find themselves in two or three significant pots per session (e.g., raise to three times the big blind preflop, bet three-quarters of the pot on each of the remaining three streets), then a session's Cash Put into Pots around €8 implies hands where the player put around €2.5 or €3.0 into the pot. That would most likely happen at microstakes tables with blinds at €0.01/€0.02 and €0.02/€0.05. If all of these assumptions and estimations are correct, then our results here would mirror Fiedler (2011) in noting that most online poker is played at small stakes.

[5] The €53 figure is based on the Canadian dollar to Euro exchange rate (0.7073631730) on January 1, 2017.

betting behavior roughly a decade before that on the same major operator's website. A more theoretical example of behavior not fundamentally changing is the casino table game blackjack. A casino can make small tweaks to the rules (e.g., blackjack pays 6 to 5, dealer stands on soft 17), but the themes within the basic strategy table (e.g., hoping the dealer busts with a small card showing, hitting to get to a total above 17 against a 9 or face card) will remain the same (Wong, 1994).

Financial Activity

The results of our analyses of deposit and withdrawal data showed moderate behavior for most, but not all players (see next section on most involved players). The median total amount deposited was €176.4. As a comparison, a common starting stack at a low stakes table in a live poker room (i.e., a buy-in to start a single session of live cash game poker) is €200 to €300. A low stakes live game player will deposit more cash with a cashier or dealer in one night than over half of our cohort deposited over the two-year study period. We also found that most of the poker players in our sample did not use a credit card to deposit funds. This suggests that most online poker players gambled with their own money rather than cash advances or borrowed funds. It is also possible that the credit card companies were charging high fees for processing deposits, and that some players balked at taking that initial loss and starting a session in the negative before playing a single hand.

Finally, almost two-thirds of the players (64.8%) did not attempt to withdraw funds from their account. It is possible that poker players are inclined to leave money in their account (e.g., for the next session). This might be especially true for profitable players who might view their growing account balance or "bankroll" as a source of pride or part of their identity as a poker player (Johnson, 2017).

Most Involved Players

Even though the majority of online poker players in our sample engaged moderately and had limited financial investment as described above, a small group of players exhibited disproportionately high levels of engagement and monetary investment. We assessed whether the centile plot for the distribution of total overall spend would show a clear majority of players with smaller values and a remaining minority with larger values. This study's distribution of total overall spend has the same right-skewed shape as other distributions related to spending on gambling or similar activities (e.g., Deng et al., 2021; Tom et al., 2014; Wiley et al., 2020). Still, confirming this expectation—that we could separate the cohort into a majority and a minority—was a prerequisite for the comparisons that followed.

Notably, this sample of online poker players had a much smaller group of most involved players (i.e., the top 1%) than the LaPlante et al. (2009) sample from a decade ago (i.e., the top 5%). One possible explanation is that the difference between total wagered and total overall spend increases as the number of hands and the size of the stakes increase (i.e., with the most active players). This would mean that the differences between adjacent high-centile groups would be greater for total overall spend than for total wagered, leading to total overall spend having a curve with a flatter beginning and a later but steeper climb than that of total wagered. This situation would create the qualitative difference we observed between the 95th through 99th centile groups of the two studies' cohorts.

It is also possible that the difference in the sizes of the most involved groups was due to random fluctuation. Regardless, many of the themes from the 2009 paper remain. The most

involved groups had longer playing durations, more sessions, larger total amounts committed to pots or tables, and a lower percent lost compared to their corresponding remaining majorities. In the cases of total sessions/number of sessions and total overall spend/total wagered, in both papers the medians for the most involved groups were more than an order of magnitude larger than the corresponding medians for their remaining majorities.

One contrast between the results of the two papers is in net loss. The most involved 5% in LaPlante et al. (2009) lost money as a group (down an average of €2888), while the most involved 1% in this study were up a combined amount over €33,000 (an average profit over €1300, with a range from one player down just over €20,000 to another up over €50,000). It is not clear whether this represents random statistical fluctuation or an actual change in the makeup of the most involved subgroup within online poker's player pool. Regardless of the similarities or differences between the two studies' most involved groups, the stark differences between the values of poker activity measures for heavily involved poker players and for others in the player pool imply that heavily involved players deserve special scrutiny to determine if or when these higher values are signs of poker-related harm or something more benign (e.g., very high income, extensive financial means or inherited wealth, poker as a profession).

Limitations

This study is not without limitations. First, we are limited to observed online poker play from a single leading regulated online gambling operator. This study did not include any assessment of gambling behavior from other gambling operators. Thus, it is possible that the results described do not encompass the individuals' full online poker playing behavior, including on regulated and illicit websites. On a more macro level, comparisons between this study's results and those in LaPlante et al. (2009) may reflect changes in Entain's poker player pool over time and not the evolution of the online poker playing population as a whole. Second, laws and regulations governing online poker might continue to change in the future. The trends described here might not generalize or be immediately comparable to trends from studies of poker players in the future. Furthermore, the study period was pre-COVID-19, and preliminary studies (e.g., Hodgins & Stevens, 2021) have reported and discussed significant shifts in gambling behavior related to the pandemic (e.g., from the temporary shutdowns of brick-and-mortar casinos). Still, the results here can, at the very least, serve as a more recent anchor point if future researchers want to compare pre- and post-COVID-19 gambling, as they were not confounded by the pandemic's effects. Third and more significantly, measures based on total cash put into pots (i.e., total overall spend) are new to the literature (see online supplement for guidance on analyzing this variable in future research). To the best of our knowledge, no one has studied the relationship between cash put into pots and other measures of poker involvement, and there are no benchmarks for what dollar or Euro amounts would be considered excessive or problematic.

Although this is not a limitation of the study within its scope per se, we should note that this data did not come with a screener (e.g., the Brief Biosocial Gambling Screen; see Tom et al., 2014) or an indicator or proxy for (e.g., voluntary self-exclusion; see Nelson et al., 2022) suffering from problems in controlling one's play. While there is some overlap, there is a difference between excessive poker play and problematic (i.e., harmful) poker play. One is possible without the other, and vice versa. Readers should not take the 1% in the 1%/99% split based on total overall spend as any sort of prevalence rate for problematic poker play.

Future Research Directions

Several future research avenues should be considered based on our findings. First, disaggregating our findings to determine what types of poker play are associated with increased involvement is an important direction to pursue. For example, we could construct most involved groups based solely on cash game poker and solely on tournament poker and then see how much of an overlap there is with the most involved 1% in this study. Standard practice in the poker community is to not combine cash game and tournament performance, as the equations for variance of results, bankroll management, and even in-game strategy are vastly different. Similarly, classifying players as predominantly cash game, in-between, or predominantly tournament would enable comparisons of durations and net profits/losses within each group.

Woodside and Zhang (2012) used income level and number of casino visits to partition a group of extremely frequent casino gamblers. In future studies, researchers might try using variables such as average tournament buy-in size, number of cash game tables, or number of days of poker activity to partition a most involved group of poker players, the rest of the player pool, or both. Also, a data set that included both poker activity data and a measure of problem gambling severity would allow researchers to explore possible associations between measures of poker activity and performance among less and more involved players, and gambling harm outcome measures (e.g., a taxonomy of gambling-related harm; see Langham et al., 2015).

Second, especially with respect to highly involved cash game players, in future studies involving actual hand histories (i.e., hand-by-hand records that include cards dealt and betting actions taken), researchers might be able to trace higher values for poker activity measures (e.g., total overall spend) to specific tendencies and strategies (e.g., semi-bluff raises, wide three-betting ranges). Some of these quirks in strategy might be signs of risk for poker-related harm, whereas others might be signs of rational decision making or a more sophisticated understanding of poker. Such studies might lead to what some might consider a novel approach to mitigating poker-related harm—examining someone's playing tendencies, identifying parts of their game that are adversely affecting their mental state or results, and tailoring treatment and training to target those harmful parts. Based on the numbers of sessions among our most involved group (mean over 1800, median over 1100), we expect that sample sizes will be large enough that such examinations—either at the individual or most involved subgroup level—will be feasible.

Third, although we did narratively compare our results to results in LaPlante et al. (2009) (e.g., median ages, median number of sessions per day) and have included some statistical tests in the Supplementary Appendices, we refrain from stating that our results are definitively different or better (or worse). Equivalence tests (e.g., Lakens, 2017) might be one possible technique for testing whether the distribution of a poker measure has changed between the two studies' two-year study periods. However, for each measure this would require a judgment call as to what magnitude a change or shift would warrant being classified as significant—not from the context-free frequentist statistical standpoint, but from a practical standpoint based on the measure's units and values. Deriving what constitutes a significant shift in Net Loss, for example, would require proposing mathematical expressions for factors such as inflation and differences in cost of living. Such derivations are beyond the scope of this study. However, considering how skewed the distributions of poker variables are, the construction of appropriate statistical tests might be interesting both as a matter within the study of gambling and more broadly as a theoretical question in statistics.

Conclusion

Our study set out to replicate and expand upon the findings of LaPlante et al. (2009). We investigated real online poker behavior in the form of electronic betting records among a cohort of 2489 new subscribers to a major gambling operator's platform over a two-year period. By examining their poker and financial activity, we drew comparisons to the previously observed behavior from the previous era of online poker a decade earlier (i.e., LaPlante et al., 2009). Although the online poker landscape might have changed over the years, our results indicate that many facts about the online poker landscape from ten years ago still hold true today. Our analyses provided two predominant profiles of online poker gambling behavior. To borrow Juran's (1954) terminology in his work on the Pareto principle, they are the "trivial many" (e.g., 99% of online poker players) and the "vital few" (e.g., the most involved, top 1% of online poker players). The trivial many do not spend or lose too much, seemingly satisfied with games with lower stakes. However, the vital few differed drastically in their gambling behavior and are probably gambling in games at much higher stakes. Based on previous studies (e.g., Deng et al., 2021; Tom et al., 2014), we suspect that problem gambling behaviors are more pervasive among the most involved poker players than among the remaining majority, highlighting the importance of responsible gambling tools and player safety initiatives for this most involved player subgroup.

Data availability The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Declarations

Conflict of interest All interests have been disclosed above in the Funding section.

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