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Factors Correlated with Persistence in Online Texas Hold'em Poker Play

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Previous work in gambling has yielded important findings regarding persistence at and preference for a gaming device. The current study investigates and extends the significant finding in slot machine laboratory research that win frequency is the best predictor of persistence as applied to actual data from \$3/\$6 and \$0.01/\$0.02 online No-Limit Texas Hold'em poker. Specifically, player persistence at virtual gambling tables was investigated in association with the frequency of wins by the player, the total betting activity of all players at the table, and the player's summed financial outcome at the table. Results show that frequency of winning hands and total table betting activity were predictive of player persistence, and these relations were stronger for those who played tables sequentially rather than simultaneously. A player's cumulative financial outcome at a table was not related to persistence in play. Directions for future experimental work are explored.

Keywords: Poker, Internet gambling, Persistence, Win frequency

Previous laboratory research in gambling has yielded several hypothesized factors that relate to persistence or preference in gambling. For example, Dixon, MacLin, and Daugherty (2006) provided participants with a 5-minute training session on each of two monitors with a slot simulation that either produced a 10-credit win on an average of every 10 spins or a 50-credit win on an average of every 50 spins, counterbalanced for side and presentation order. Although the average win per spin was equivalent between the two groups, 15 of 18 subjects preferred slot machine simulations that produced wins more quickly, suggesting that player preference was biased toward frequency over magnitude. Haw (2008) conducted a similar study in which 70 undergraduate students played 40 trials on each of two identically-looking slot machine games played on a personal computer. After this training phase, participants played 120 trials on either machine and were free to switch machines at any point. Haw (2008) found that although frequency of wins and machine choice were not related, the payback rate was significantly predictive of machine choice in those players switching machines. While Dixon et al. (2006) and Haw (2008) did not specifically assess persistence, both studies supported the notion that players will select and play longer at slot machines whose reinforcement is frequent and variable, with no preference for magnitude.

These analogue studies provide important information about the factors influencing simulated gambling, but participants did not face the significant financial and social contingencies characteristic of actual gambling. For example, current research suggests that escape from aversive stimulation (e.g., debt, marital problems) may be a motivating factor in some human gambling behavior (particularly with problem gambling; see Weatherly, Montes, & Christopher, 2010). With respect to human analogue environments, other unique concerns must be taken into account. There are ethical considerations regarding the

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use of participant money in the gambling task at the laboratory (Lyons, 2006; Weatherly & Phelps, 2006). It is also the case that gambling outcomes may produce differential effects between real gaming environments and laboratory analogues. Specifically, the casino may have cash prizes in the hundreds of thousands of dollars, whereas the laboratory may have only comparatively minor sums of cash or research credit to offer. Further, it may be the case that research credits do not have the same influence over behavior as money (Weatherly & Phelps, 2006). To the extent that player persistence may be associated with the development of pathological or compulsive gambling, data about persistence gleaned from real-world gambling arrangements may improve the value of laboratory analogue data in informing treatment and prevention efforts.

It is in this light that the most prized datum of the gambling researcher is the one that is extracted from the gambling environment, especially if the gambler was unaware of the data collection taking place. Personal communications by the first author with casino pit bosses have yielded much resistance to collaborations for research or the exporting of casino-generated data. Few studies exist in the literature that use casino-based data, and likely for the reason just mentioned. There exists, however, one form of gaming in which individual data are collected and made readily available, for a price: internet poker.

Internet Poker and Data Collection

Internet poker is played exactly the same as non-virtual poker, except that additional environmental factors are missing. For example, moment-by-moment changes in facial expression or body posture from other players are absent. Internet poker exists in many varieties, including popular forms such as Limit Texas Hold'em, No-Limit Texas Hold'em, and Omaha. Games can be played in a sit-and-go fashion (i.e., enter and exit a game without penalty) or tournaments. Betting structures can range from free entries up to or exceeding initial betting requirements of $100 per hand. Of concern here is No-Limit Texas Hold'em (NLTH), the game selected for the current study.

NLTH is a poker variant in which two to ten players are dealt two hole cards (i.e., cards not seen by other players). Throughout the hand a series of up to five cards are placed face up on the table that serve as community cards, or cards everyone can incorporate into their two hole cards. After several rounds of betting, remaining players compete for making the best possible hand using only five cards (i.e., two hole cards plus five community cards). A rotating "dealer" button is passed around the table one player at a time after each hand is completed. The individual to the left of the dealer is required to place a bet known as a *small blind* prior to being dealt the two hole cards. The player to the small blind's left is required to place a bet termed the *big blind* (BB). In the case of $3/$6 NLTH, the small blind is $3 and the BB is $6. This, then, forces action at the table and encourages betting.

After the blinds are placed, a round of betting ensues where players may call, raise, or fold. In NLTH, a raise may consist of any amount from the minimum (i.e., one BB) to everything the player has available at the table. Once betting is completed, the first three community cards are placed on the table. This is known as the *flop*. A second round of betting ensues and the fourth community card, the *turn*, is made available to players. Betting continues and the fifth and final community card, the *river*, is placed on the table. After the river card, a final round of betting takes place and remaining players reveal their hole cards to determine the winner.

Computer-based casino-style games generate a wealth of information that is capable of being tracked. There are software programs available that allow individual players to track their play, and later analyze their decisions to serve as feedback. One such program is Hold'em Manager, a commercially available software package (Hold'em Manager, 2011). A feature of Hold'em Manager is the ability to import hands bought from data-mining sites, such as PokerTableRatings.com, which extracts data collected from popular online poker sites. These data, then, are available for purchase, and subsequently, can be analyzed via programs such as Hold'em Manager.

In light of the difficulties inherent in analogue work, and the issues accompanying data from casinos, the present study made use of existent software programs to analyze data collected from online poker players who were gambling with real money. Investigative variables were selected on the basis of Dixon et al. (2006) and Haw (2008), and we hypothesized that frequency of player wins, in addition to cumulative player earnings, would serve as predictors of persistence in online poker play.

METHOD

Participants

Participants consisted of 20 poker players who played NLTH online at $0.01/$0.02 or $3/$6 betting structures. Players were selected if they either a) played more than 500 hands and only played one table at a time (Sequential Condition), or b) played more than 500 hands and played multiple tables simultaneously (Simultaneous Condition). The first author generated the list of players by entering a player search function in Hold'em Manager and closing his eyes while hitting the keyboard with all 10 digits and selecting the first letter struck as a starting point. From there, the list was alphabetically checked for players with more than 500 hands. Players were added one per selection round (i.e., blindly selecting letters on the keyboard). While over 40,000 players were in the database, the study was limited to 20, evenly distributed across 4 conditions ($0.01/$0.02 and $3/$6 betting structures and simultaneous and sequential play), to reduce efforts of data extraction. No personal information was available on players. Thus, the only known information was player handle (altered for the purposes of the investigation) and the respective poker-based data.

Apparatus

A non-experimental correlational design was used with data that were purchased from PokerTableRatings.com. Data from the $0.01/$0.02 groups were collected by PokerTableRatings.com from PokerStars.net and the $3/$6 groups were from PartyPoker.com. Analyses were conducted using Hold'em Manager version 1.11.04 (Hold'em Manager, 2011). Individual player sessions, as defined by the time a player selected a poker table until play at that table was discontinued, were exported to a Microsoft Excel database for further analysis. This arrangement allowed for a sequential analysis of play across tables and sessions. Data from the $3/$6 analyses were purchased on September 9, 2010, and the data from the $0.01/$0.02 analyses on March 1, 2011. All data collected were from gaming sessions that took place no later than two weeks prior to the purchase date.

Procedure

Using sorting features available on Hold'em Manager V.1.11.04, participant data were arranged sequentially by the time a player selected a table. Each table's dataset was exported and entered into a Microsoft Excel spreadsheet and included information regarding hole cards (if available), time when the hand started, player action at the pre-flop, flop, turn, and river, amount won or lost by the player, the difference in expected value (a mathematical formula to calculate expected wins and losses over long periods of time given the same scenario), player position, who won the current hand and how much they won, and additional pre-flop descriptors (action of other players). Once individual data were summarized, correlation matrices for each player were calculated to reveal the strength and direction of associations between variables, and regression equations were calculated to determine the degree to which persistence at a table could be predicted by frequency of player wins, level of table activity, and total financial outcome (net won/lost) at the table.

RESULTS

Table 1 displays total hands played, number of tables played, total time combined for all tables, and earnings in terms of BBs for each player arranged by condition (i.e., sequential or simultaneous table play) and betting structure (i.e., \$0.01/\$0.02 and \$3/\$6). Total time for simultaneously played tables is aggregated. That is, 10 minutes of play across four tables played simultaneously would yield 40 minutes of aggregated play, though only 10 minutes was actually spent at the computer.

R^2 values (indicating the proportion of variability in persistence explained by the predictor variables) for three regression analyses based on identified areas of investigation are presented in Figures 1, 2, and 3. Figure 1 shows the relation between number of hands won by the individual player and persistence at the table. R^2 values ranged from 0.73 to 0.97 for 19 of the 20 players, with an additional R^2 value of 0.39 for an additional player (overall M = 0.82, SD = 0.13; top 19 players' M = 0.84, SD = 0.08). Figure 2 displays the relation between total table activity and player persistence at the table. R^2 values ranged from 0.63 to 0.95 (M = 0.80, SD = 0.10). Finally, Figure 3 is shows the relation

		Player	*Hands*	*Tables*	*Total Time*	*Earnings*
\$0.01/\$0.02	Sequential	A1	1178	33	1025	-224
		A2	1493	38	1360	-186.5
		A3	1799	56	1923	-179.5
		A4	1378	27	1349	-73.5
		A5	1157	26	1166	283.5
	Simultaneous	B1	2623	34	2384	88
		B2	1164	26	1117	351.5
		B3	1153	12	1050	146
		B4	1860	55	1801	-223
		B5	1348	33	1262	162
\$3/\$6	Sequential	C1	906	23	847	-10.07
		C2	755	9	867	-40.76
		C3	637	13	602	61.82
		C4	886	10	846	65.52
		C5	716	35	709	-143.61
	Simultaneous	D1	1309	18	1603	254.75
		D2	1848	21	2003	220.23
		D3	4191	57	5474	-658.3
		D4	1391	39	1316	825.06
		D5	2249	23	2508	-414.86

Table 1. Total hands, tables, time in minutes, and earning in BBs for each player by condition and blind structure.

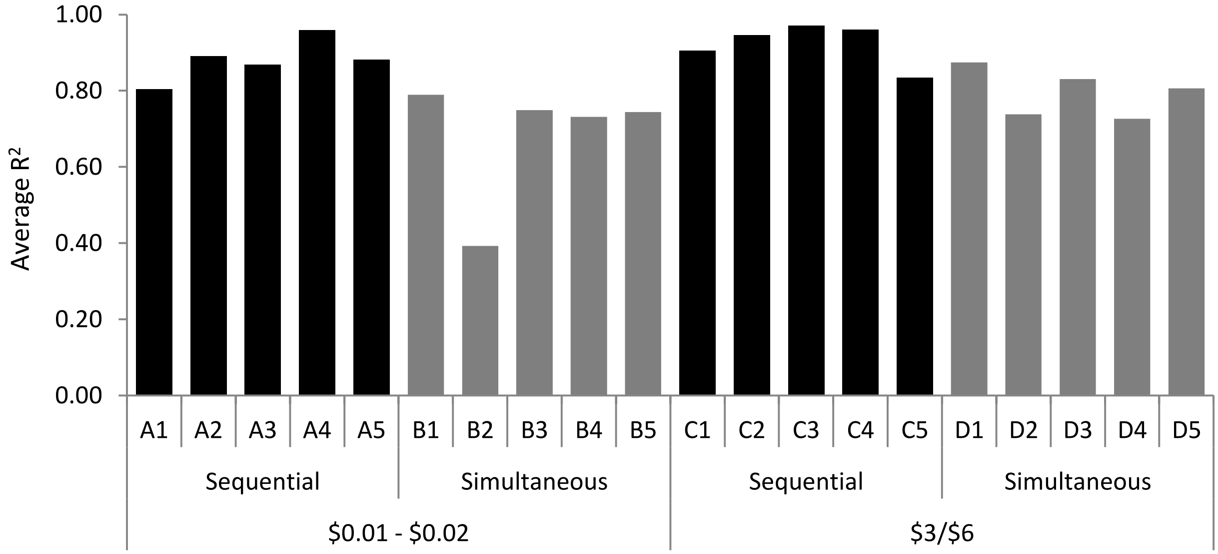

Figure 1. R^2 values reported for persistence at the table by number of hands won by each player.

ship between player persistence and total player winnings at the table, with R^2 values from <0.01 to 0.58 (M = 0.10, SD = 0.15).

A one-way Analysis of Variance of R^2 values revealed significant effects for number of winning hands, F (1, 18) = 13.20, p = .002, η^2 =.423, and for total table activity, F (1, 18) = 7.14, p = .016, η^2=.284. Subsequent group comparisons indicated these variables predicted table persistence more strongly for sequential players than for simultaneous players (t (18) = 3.63, p <.001 for number of winning hands, t(18) = 2.67, p < .01 for total table activity). Cumulative player financial outcome was not a significant predictor of table persistence, F (1, 18) = 1.398, p = .252, η^2=.072. Group comparisons revealed no significant differences between players of $0.01/$0.02 games and players of $3/$6 games in the R^2 values associated with these variables.

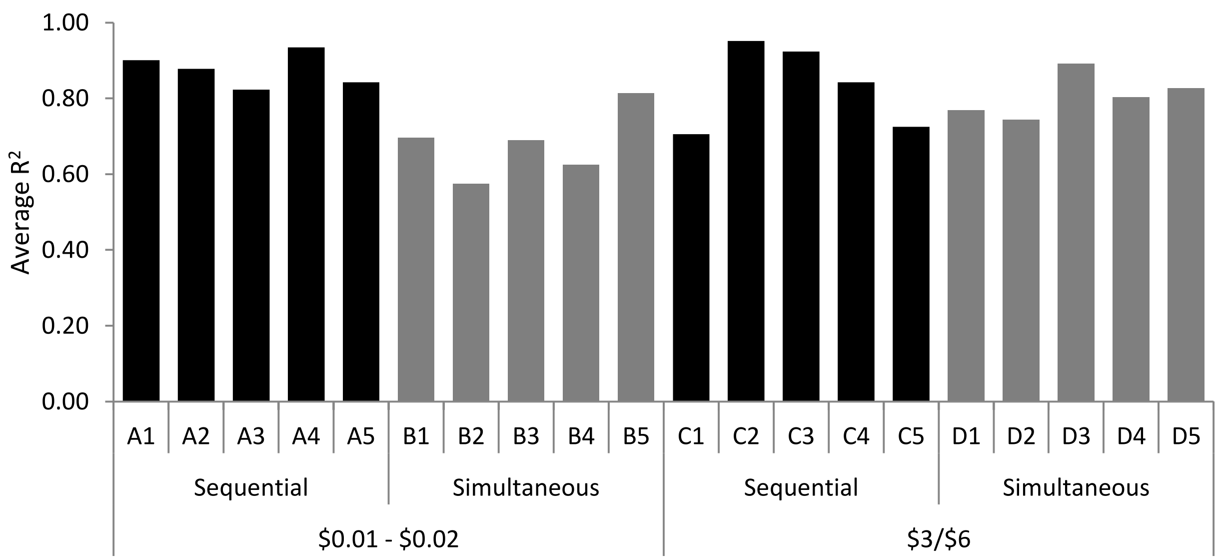

Figure 2. R^2 values reported for persistence at the table by total table activity.

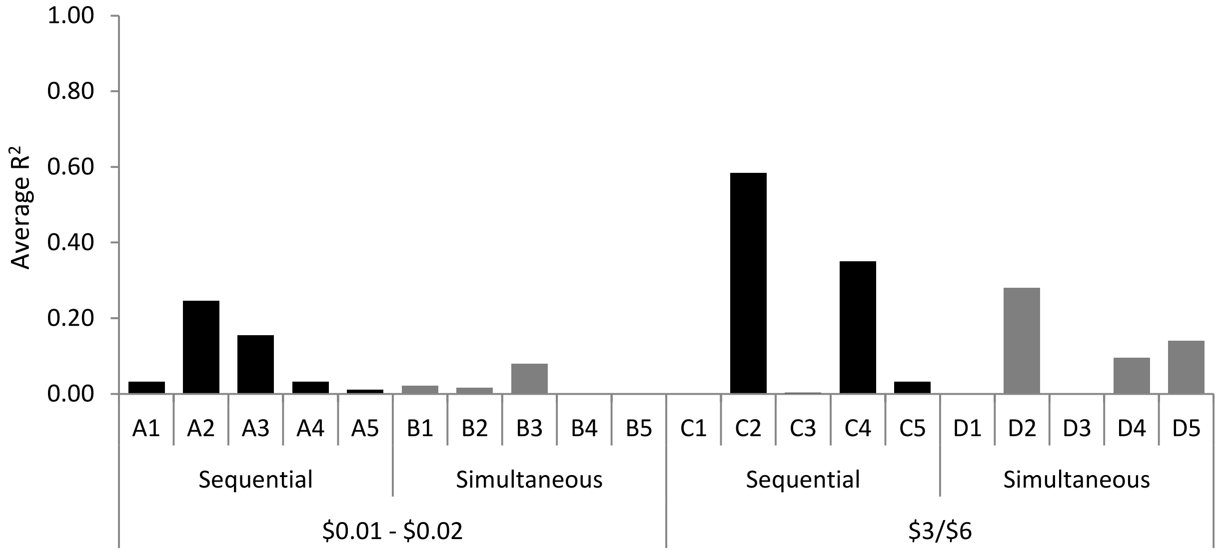

Figure 3. R^2 values reported for persistence at the table by total winnings in BBs for each player.

DISCUSSION

This study is the first attempt in the behavior-analytic literature to describe online NLTH poker data as it occurs in non-contrived gaming situations (i.e., laboratory studies). While the opportunities for analysis within these data are great, we limited the investigations to parallel one significant finding in the slot machine literature, with the additional extension of these findings to include total table activity as well as cumulative player wins. In this study, online NLTH players persisted at a table longer if player wins occurred frequently, and table activity was high (more BBs passing between players), regardless of whether the player cumulatively earned or lost money at the table. In other words, the more molecular variable of winning frequency trumped the more molar variable of total winnings in describing players who persist at particular tables. The results from this study for frequency of wins for the individual player is in line with results from Dixon, MacLin, and Daugherty (2006; cf. Haw, 2008). However, the additional finding that overall table activity predicted player persistence was not anticipated.

An interpretation of persistence being related to table activity may be that it is the opportunity to win big that keeps a player, and not necessarily winning big. Said differently, a skilled poker player may opt for the best possible environment in which to gamble. In this case, an ideal environment sees the player winning frequently with the opportunity to take large wins from the other players (i.e., table activity). Further, this scenario may be enhanced when the player's attention is not divided amongst several tables, which may then help to explain why winning frequency and size were more influential for simultaneous rather than sequential table players. These are, of course, empirical questions to be answered.

One limitation of this study is that we did not have control over the variables studied. As such, it may be the case that the frequency of wins for the player and table activity are merely autocorrelated. That is, the longer one persists, the greater the frequency of player wins and table activity. However, this may not comprise the full account of the relationship between these variables. Specifically, a player may persist longer at a table where wins average, for example, 20 BBs, as opposed to a table where wins average 2

BBs. The same player may also shy away from tables where wins average in the hundreds of BBs. The correlations may prove to be equivalent, though the specific data involved may be of varying magnitudes. Regardless, these findings provide the opportunity for further empirical investigations.

There are other factors which make this area of research difficult. In particular, NLTH is a game of skill rather than a game of chance. As such, the generation of rules, such as which cards to play in which position while factoring number of players, may have an impact on outcome, unlike in games of chance where rules hold no ability to alter player outcomes. This is because rules in games of skill, such as NLTH, are based on mathematical probability which, in the long run, do influence financial outcomes. A review of leading poker tutorial books lends much credibility to this assertion (e.g., Sklansky, 2004). There exist in casinos games that are on a continuum from pure chance, to mostly, and arguably to some, purely skill. Games such as traditional slot machines[1] and baccarat are based on pure chance. That is, there is nothing a player can do to alter the outcome of the gaming event, and each player has the same odds as any other player. There are those games that offer some potential mix of skill and chance, such as with video poker (for video poker strategy, see Jensen, 2010) or blackjack (e.g., Vancura & Fuchs, 2001). In these games, strategy, properly used, can actually create an advantage over the house. In other words, playing these games can result in a profitable outcome for the player. Finally, there are those games argued to be comprised mostly or completely of skill-based elements. Of note are many of the poker varieties. As a game of skill, the player with a finely-tuned poker repertoire can act in such a manner as to maximize wins and minimize losses. Often this requires an incorporation of basic strategy, mathematical calculations, and knowledge of individual player history (e.g., Sklansky, 2004).

As an example of additional challenges faced in investigating a game of skill, consider the results of Chóliz (2010). In that study, Chóliz investigated the effect of immediacy of reward on persistence in slot machines. Findings from ten individuals diagnosed as pathological gamblers showed that players persisted longer in games with smaller delays to reinforcement (i.e., 2 seconds) than in games with longer delays (i.e., 10 seconds). Immediacy, then, seems to be an important factor, at least with respect to slot machine play. However, rapidity of responding in a game of skill may be a sign of expertise, either through quick decision-making or through playing multiple tables simultaneously in online poker play, and thus speed may or may not be a factor in preference or persistence. Of course, rapidity may relate to different levels of expertise depending upon bet limits. For example, rapidity of play in a $25/$50 table may be a sign of expertise, while the same rapidity may not reflect expertise in a $0.01/$0.02 table where novices may just be playing quickly as there is very little at stake. How immediacy or rapidity factors into NLTH, across various skill levels, would prove to be an interesting study.

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