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The allure of multi-line games in modern slot machines

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ABSTRACT

Aims In multi-line slot machines, players can wager on more than one line per spin. We sought to show that players preferred multi-line over single-line games, and that certain game features could cause multi-line game play to feel more rewarding. **Measurement and Participants** Reward was measured using post-reinforcement pauses (PRPs) following each outcome (the time between outcome delivery and the next spin). Gamblers ($n = 102$) played 250 spins on a 20-line game and 250 spins on a one-line game (answering questions about game experiences following each session). Playing one-line, a small credit gain (e.g. 2 cents) was a net win. In the 20-line game it was a net loss of 18 credits but was still accompanied by 'winning' sights and sounds. **Results** Most players (94%) preferred the 20-line game. PRPs for small credit gains (net losses) in the 20-line game were equivalent, or larger than in the one-line game where such gains were wins. The largest increase in PRP size was between the 0 and 2 credit conditions for both games. Thus 20-line players reacted as though these net losses of 18 credits were rewarding. Players' estimates of the number of true wins were accurate in the one-line game, but they significantly over-estimated the number of true wins in the 20-line game ($P < 0.01$). Problem gamblers felt more skilful ($P < 0.01$) and were more absorbed ($P < 0.01$) by multi-line than single-line game play. **Conclusions** Multi-line games appear to be more appealing to gaming machine ('slots') players than single-line games. These games may be particularly absorbing for those with gambling problems.

Keywords Absorption, losses disguised as wins, post-reinforcement pauses, problem gambling, reinforcement, reward, slot machines.

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INTRODUCTION

Traditional slot machines have three reels and a single pay-line. Players make a wager, spin, and if three identical symbols fall on the pay-line the player wins. Here reinforcement is straightforward—a spin is 'reinforced' when the machine pays something. Slot machines reinforce players using a random ratio reinforcement schedule. Griffiths [1] noted that slots rewards (or non-rewards) are delivered continuously—players spin, and within seconds outcomes are delivered. Thus, large numbers of spins occur over short periods, with spins being reinforced intermittently in an unpredictable manner. The reinforcement rate is simply an average of the number of spins between reinforcements.

In modern multi-line video slots, players can wager on many lines each spin (e.g. players can bet 1 cent on each of 20 lines, for a total spin-wager of 20 cents). When players spin and lose their entire wager, the machine goes into a state of quiet. When players spin and win back more than their wager, the machine celebrates this win by animating the symbols and lines responsible for the win, and playing a 'winning' jingle. When players spin and win back less than their wager, despite losing money, the slot machine still celebrates these 'wins' with reinforcing sights and sounds. We refer to these latter outcomes as 'losses disguised as wins' (LDWs) [2].

Gamblers often miscategorize LDWs as wins [3]. Although slot machines contain counters that show spin wagers and credits gained, when asked to categorize LDWs as either wins or losses, the majority of novice players categorized these outcomes as wins. If players think LDWs are wins, this can severely distort reinforcement rates. If players treat LDWs as wins, they might prefer multi-line games over single-line games because they are exposed to more reinforcing stimuli. Livingstone *et al.* [4] interviewed gamblers who played multi-line slots. In these games players can choose to play on one line (no LDWs) or multiple lines (the more lines, the more LDWs). Gamblers preferred to play the maximum number of lines allowed.

Slot machines foster entrance into what Dow Schüll [5] calls 'the zone'. Some players enter a state where they become highly absorbed—losing track of time and all else around them [6–8]. Problem gamblers especially show a narrowing of attentional focus on game play [9,10]. Dissociation-like experiences appear to increase when players are allowed to choose the number of lines they wished to play [11], with the overwhelming majority of players opting for the maximum number of lines available [12]. Thus, multi-line games may lead to greater dissociation-like experiences than single-line games, especially for problem gamblers. Indeed, Dow Schüll has suggested that increasing the number of pay-lines may contribute to a 'smoother' game experience by reducing the length of losing streaks—chains of losses where no reinforcing stimuli are seen or heard [5].

Players may choose multi-line play because they enjoy the reinforcing feedback concomitant with wins or LDWs. In terms of Pavlovian conditioning, regular wins are powerful stimuli that are experienced intermittently. The sights and sounds accompanying regular wins can become conditioned to trigger the hedonic experience of winning. When LDWs occur, the brief exposure to these conditioned stimuli may be sufficient for players to trigger reward-associated positive affect (despite losing money). Emotionally, the difference between LDWs and regular wins may become blurred, and the rewarding event frequency effectively becomes the rate of this conditioned reinforcement. As such, programming slots to feature large numbers of playable lines can lead to artificially high reinforcement rates that may add to the allure of multi-line play.

Conditioning aside, players may simply find multi-line games more exciting. On regular (complete) losses, the machine goes into a state of quiet. In single-line games, 84% of spins are losses. Only on 16% of spins do players experience the more exciting reinforcing feedback. Thus, single-line games constitute long chains of losing streaks with a few exciting outcomes. In multi-line games, the percentage of spins containing reinforcement (LDWs and wins) rises to 48%. Thus, players may simply find multi-line games more exciting.

Reinforcement is linked to reward. The hedonic enjoyment of reward can be measured using the delay between outcome delivery and the next spin—the so-called post-reinforcement pause (PRP). In one-line games, when players spin and lose, they initiate the next spin very quickly [13]. On wins, they pause before spinning again—the bigger the win, the longer the pause. In single-line games the biggest jump in PRP length occurs in the transition from losses to the smallest win [14].

Here we asked players to play two slots games: one line versus 20 lines. We used a realistic slots simulator to control the outcomes. When players wagered 1 credit on one line, a gain of 2 or more credits was a net win. In the multi-line game, players bet 1 credit on each of 20 lines (20 credits per spin). Here, any credit gain below 20 is a net loss. Thus, exactly the same outcome (e.g. 2 credits paid) was either a winning or a losing outcome depending on the game. We used PRPs to see if such wins and losses would be equally rewarding. After each game, we assessed players' game experiences using a questionnaire. We asked them to rate their excitement and arousal during each session. At the end of the experiment, we asked them which game they preferred and why. Finally, they were reminded that they played each game for 250 spins. For each game, they were asked to estimate the number of times they spun and won more than they wagered.

If players misconstrue LDWs as wins, they should show equivalent PRPs for small credit gains when they are wins (one-line game) and when they are LDWs (20-line game). If 20-line players treat 2-credit gains as the transition from losses to (rewarding) wins, then (like one-line players) they should show the largest jump in PRP size from full losses to 2-credit gains. Despite both games having the same number of actual wins, we predicted that most players would prefer the 20-line game, and find it more exciting. Based on previous dissociation research [5–10], we predicted that problem gamblers would find the 20-line games particularly absorbing. Finally, the LDWs in the 20-line game should cause players (regardless of gambling status) to over-estimate the number of times they won during multi-line play.

METHODS

Participants

Participants were recruited from an Ontario casino using a poster soliciting those who gambled once per month or more. Interested participants read an information synopsis then gave informed consent. Participants received a $25 Walmart gift card plus the remaining balance at the end of slots play. A total of 102 participants were recruited (65 females); mean age 61.27 years.

Apparatus

Slots simulator

A multi-line simulator patterned after a commercially available slot machine was used. The simulator contained

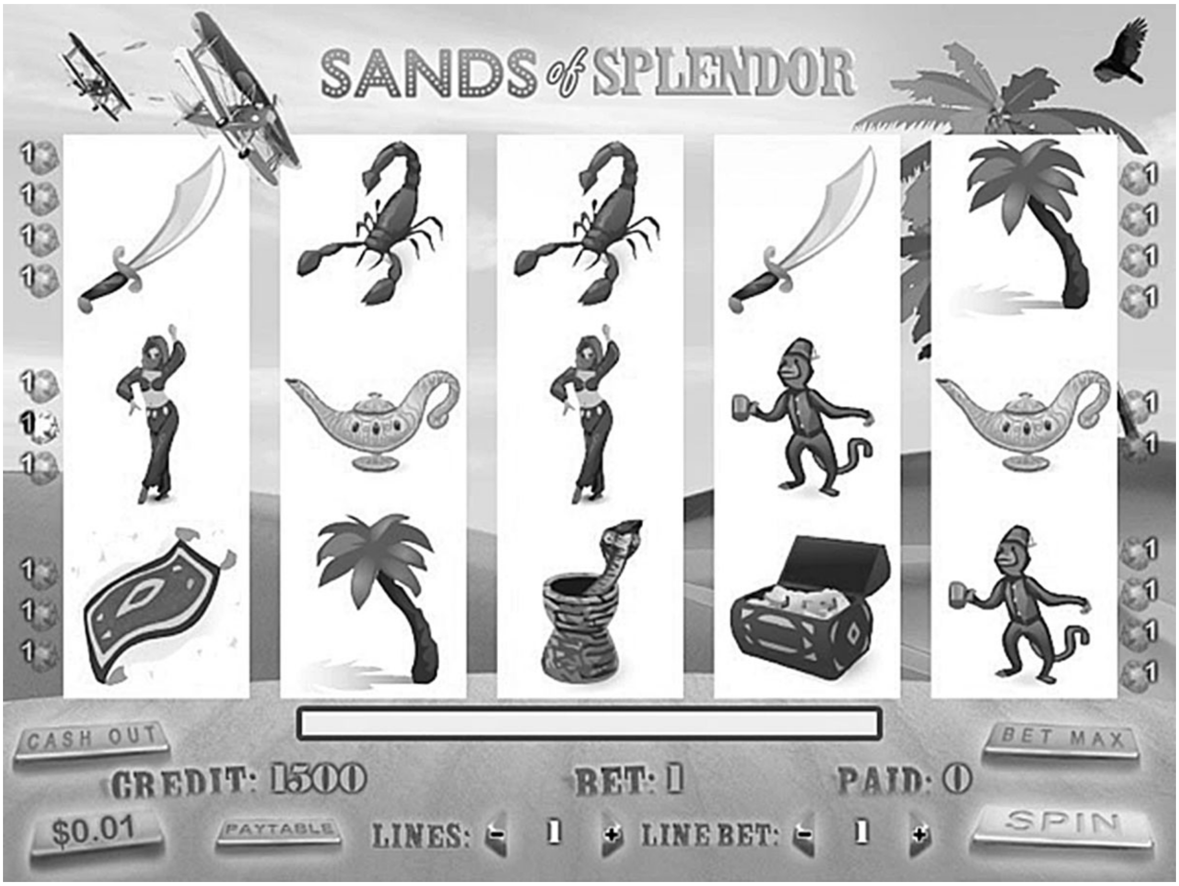

Figure 1 Screenshot (grey scale of original colours) of the multi-line simulator patterned after a commercially available slot machine used in the current study

counters showing: the number of lines played, amount bet per line, total bet per spin and a credits 'paid' counter (see Fig. 1). For regular losses, the 'paid' counter immediately showed 0; for LDWs and wins, this counter sequentially flashed rising digits culminating in the amount of credits 'won'. The symbols responsible for the credit gain animated, and the line containing these symbols was highlighted. Credit gains were accompanied by winning songs that ranged from 1.5 to 5 seconds (the more credits gained the longer the song). Players could initiate a new spin during the celebratory feedback of the current outcome.

The simulator sent event markers to an ADinstruments Powerlab at outcome delivery and spin initiation allowing PRPs to be recorded. Skin conductance was recorded but not analysed.

Gambling questionnaires

The Canadian Problem Gambling Index (CPGI) [15] was used to assess demographic information. The modified cut-offs of the Problem Gambling Severity Index (PGSI) were used to stratify gamblers [16]. Those scoring 0 were considered non-problem gamblers (NPGs); 1–4 'low-risk' gamblers, and 5–27 'high-risk/problem' gamblers.

The streamlined, 14-item in-game version of the Game Experience Questionnaire (GEQ) [17] assessed seven components of game play. There were two questions each for: immersion, positive affect, negative affect, tension, flow, challenge and competence. Each item was followed by response options of: 'not at all', 'slightly', 'moderately', 'fairly' and 'extremely'. These categorical responses were converted to a 0–4 scale, with component scores comprising the average of that component's two questions. The immersion component relates to the 'story' of the game, and was not analysed.

Arousal and pleasantness questions

Players answered the following: (i) 'I found this playing session arousing/exciting'; and (ii) 'I found this playing session pleasant', using the GEQ response options noted above.

Game preference questions and win estimates

After playing both sessions, players were given a forced-choice question concerning whether they preferred playing the one-line or 20-line game, and asked for each session to estimate the number of spins, out of 250, that they won more than they wagered.

Design

Participants played 250 spins, wagering 1 credit per line on each of 20 lines for a total spin wager of 20 credits. They then played 250 spins, wagering 1 credit on one line (session order was counterbalanced across participants). Table 1 (top panel) shows the number of spins yielding specific outcomes in the one-line game. Most of the credit gains for the one-line session were of 2 credits only, with a few spins leading to larger wins.

The bottom panel of Table 1 shows that, for the 20-line game, only gains above 20 were actually wins (values shown in bold type). Gains between 2 and 20 credits were LDWs. In the 20-line game, players wagered 5000 total credits. The simulator paid back 4625 credits for a payback percentage of 92.5%. In the one-line game players wagered 250 credits, and won back 230 credits for a payback percentage of 92%. These payback percentages are comparable to commercially available slots. Despite having the same payback percentage as the one-line game, players experience more ‘big wins’ in the 20-line game (compare the single win of 50 credits in the one-line game to the 27 wins above 50 credits in the 20-line game).

Overall, players lost 375 credits in the 20-line game and 20 credits in the one-line game. ‘Losing streaks’ (chains of full losses) were longer in the one-line game (average = 4.5, maximum = 10) than in the multi-line game (average = 1.4, maximum = 3).

Procedure

Players completed the CPGI and PGSI. Players were shown that 1500 credits had been loaded into the machine (equal to $15.00) and shown the pay table (the various symbols’ worth in winning alignments). After completing the one-line game (or 20-line, depending on counterbalancing), players completed the GEQ, arousal and pleasantness questions, and returned to the simulator to play the 20-line game. They then completed the GEQ, arousal and pleasantness questions pertaining to this game. Players were asked which game they preferred and then estimated the number of wins they experienced in each game. Lastly, players were given their $25 gift card and the $11.05 remaining in the slot machine.

RESULTS

For four participants, gambling status could not be assessed because of missing data on the PGSI. Table 2 shows the breakdown of NPGs, low-risk and high-risk/problem gamblers who played the one-line game first versus the 20-line game first, as well as their demographic information. For all analyses, alpha was 0.01, Greenhouse–Geisser Sphericity corrections were applied when necessary, and the power of detecting significant effects was 0.75 or above.

Post-reinforcement pauses

Outcomes were separated into the four bins shown in the upper panel of Fig. 2. For each player a mean PRP was calculated for each bin. Prior to averaging, one PRP over 24 seconds was removed. The other PRPs underwent the outlier trimming procedure of Van Selst & Jolicoeur recommended for data sets with different numbers of observations per cell [18]. Zero and 2-credit gains were of key importance. They were frequent in both games, and represented the transition between losses and wins in the one-line game (but not in the 20-line game). Gains between 10 and 19 and between 20 and 29 represented

Table 1 Number of spins resulting in different sizes of credit gains in the one- and 20-line games.

One-line game

	Losses	*Wins*						
Credits gained	*0*	*2*	*5*	*10*	*15*	*20*	*25*	*50*
Spins	205	**35**	**2**	**4**	**1**	**1**	**1**	**1**

20-line game

	Losses	*Losses disguised as wins*					*Wins*				
Credits gained	*0*	*2*	*4–7*	*8–10*	*12–15*	*16–19*	*21–29*	*30–49*	*50–99*	*100–199*	*200–260*
Spins	130	11	14	14	21	15	**9**	**9**	**11**	**11**	**5**

Table 2 Demographic and gambling status information of participants in the two counterbalanced orders.

Condition	*No. of participants*	*Gender*	*Mean age*	*Gambling status*		
				NPG	*Low*	*High*
One line first	51	33 female	60.80	15	22	14
20 lines first	51	32 female	61.72	15	24	8
Modal frequency of slots play				5	4	6[a]
Modal frequency of lottery play				1	1	6[a]
Modal frequency of scratch card play				3[a]	0	0

NPG = non-problem gamblers; low = low-risk gamblers; high = high-risk/problem gamblers. There were missing Problem Gambling Severity Index (PGSI) scores for four participants (all in the 20-line condition). Gambling frequency is scored on the following scale: 0 = never; 1 = between one and five times/year; 2 = between six and 11 times/year; 3 = about once/month; 4 = two to three times/month; 5 = about once/week; 6 = two to six times/week; 7 = daily. [a]In cases where there were multiple modal values, the table reports the highest.

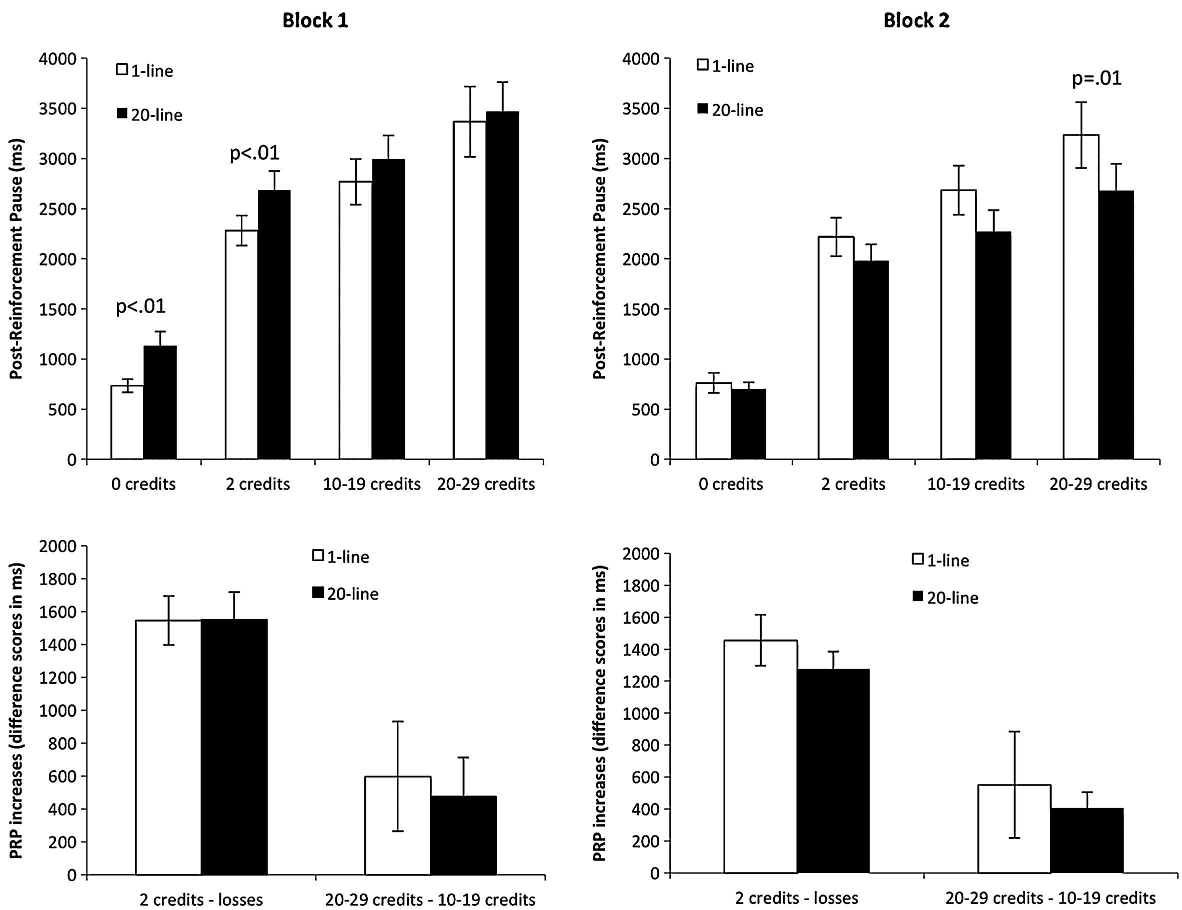

Figure 2 Mean post-reinforcement pauses as a function of bin for block 1 (upper left panel) and block 2 (upper right panel). The bottom panels shows the post-reinforcement pause (PRP) increases from the 0-credit to 2-credit conditions (the transition from losses to wins in the one-line game), and the PRP increases from the 10–19 to 20–29 credit conditions (the transition from losses to wins in the 20-line game)

the transition between losses and wins in the 20-line game (all these outcomes were wins in the one-line game).

One participant quit prior to completing experimentation, and five were eliminated due to technical errors. For the remaining 96 participants, preliminary analyses indicated that gambling status was unrelated to PRPs, but game order significantly influenced PRPs. The PRPs of those playing the one-line game in block 1 were therefore contrasted with those playing the 20-line game in block 1. For block 1, an outcome (0 credits, 2 credits,

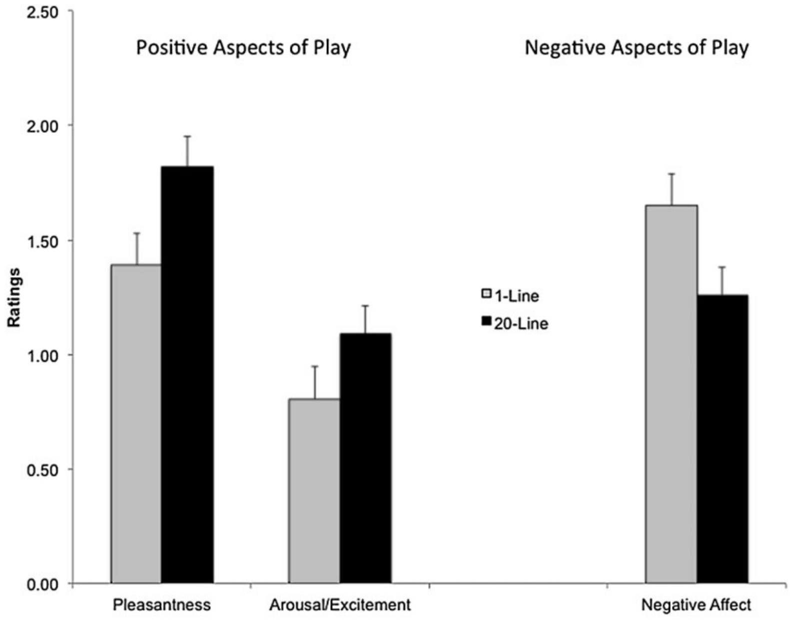

Figure 3 Pleasantness, arousal/excitement and negative affect ratings as a function of game (one-line versus 20-line)

10–19 credits, 20–29 credits gained) × game (one-line, 20-line) analysis of variance (ANOVA) revealed only a main effect of outcome, $F_{(3,282)} = 562.21$, $P < 0.001$. All outcomes were significantly different (all *P*-values < 0.001). Those playing the one-line game in block 2 were contrasted with those playing the 20-line game in block 2. For block 2 an outcome × game ANOVA revealed a main effect of outcome, $F_{(3,282)} = 483.93$, $P < 0.001$ (all outcomes were significantly different—all *P*-values < 0.001). There was also an outcome × game interaction, $F_{(3,282)} = 6.08$, $P < 0.01$. Because of their theoretical importance, *post-hoc* contrasts compared one-line PRPs to 20-line PRPs for each outcome bin (losses, 2 credits, 10–19 credits and 20–29 credits). The upper left panel of Fig. 2 show significantly longer PRPs for the 20-line game than the one-line game in block 1 for both losses ($P < 0.001$) and credit gains of 2 ($P < 0.002$). In block 2 (upper right panel), wins of 20–29 triggered higher PRPs in the one-line game compared to comparable wins in the 20-line game $t(94) = 2.56$, $P = 0.01$. No other between-game contrasts were significant.

The bottom panel of Fig. 2 shows the large PRP increases from the 0-credit to 2-credit conditions (the transition from losses to wins in the one-line game), and the PRP increases from the 10–19- to 20–29-credit conditions (the transition from losses to wins in the 20-line game). These data were analysed using transition point (0–2 credits, 10–19 to 20–29 credits) × game ANOVAs for each block separately. For both blocks the greatest increase in PRP length was between 0 and 2 credits, leading to a main effect of transition point in block 1, $F_{(1,94)} = 320.70$, $P < 0.001$ and block 2, $F_{(1,94)} = 292.65$, $P < 0.001$. There were no significant effects of game in either block, nor any transition point × game interactions.

Subjective responses following one-line and 20-line game play

Ninety-eight participants completed the GEQ for each game. Each GEQ component and the arousal and pleasantness questions were analysed using a game (one-line, 20-line) × gambling status (NPG, low-risk, high-risk/problem) ANOVA. For brevity, only significant effects involving the game variable or its interaction with gambling status are reported. For GEQ components with non-significant gambling status × game interactions, the data were re-analysed to include participants for whom gambling status could not be determined. Figure 3 shows that compared to the one-line game, the 20-line game triggered lower negative affect, $F_{(1,97)} = 10.98$, $P < 0.002$, higher pleasantness ratings, $F_{(1,97)} = 11.48$, $P < 0.002$ and higher arousal/excitement ratings, $F_{(1,97)} = 7.06$, $P < 0.01$.

Flow ratings revealed a main effect of game, $F_{(1,91)} = 10.24$, $P < 0.003$, and a game × gambling status interaction, $F_{(2,91)} = 6.51$, $P < 0.003$. Figure 4 (left panel), shows a significant effect of game for the high-risk gamblers, $F_{(1,20)} = 12.78$, $P < 0.003$, but not for the low-risk or NPGs.

Competency revealed similar effects; namely, a main effect of game, $F_{(1,91)} = 10.21$, $P < 0.003$, and a game × gambling status interaction, $F_{(2,91)} = 5.14$, $P < 0.009$. Figure 4 (right side) shows a significant effect of game for the high-risk gamblers, $F_{(1,20)} = 10.44$, $P < 0.005$, but not for the low-risk or NPGs.

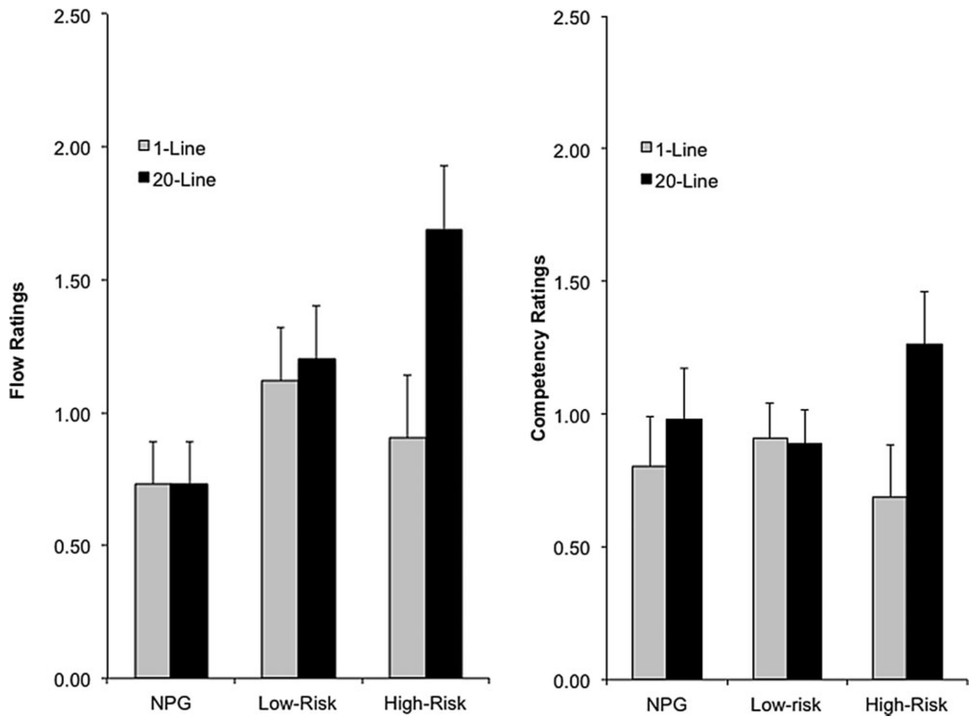

Figure 4 Flow ratings and competency ratings as a function of problem gambling status. NPG = non-problem gamblers

Game preference and win estimates

Ninety-five participants answered the preference question, and 97 gave win estimates for each game. Ninety-four per cent (89 of 95) of players preferred the multi-line game, $\chi^2_{(n=95)} = 72.5$, $P < 0.001$. The average win estimate for the one-line game (46.75) closely approximated the actual number of wins (45) experienced, $t_{(96)} = 0.37$, not significant. The average win estimate for the 20-line game (60.48) was significantly higher than 45, $t_{(96)} = 2.59$, $P = 0.01$. A game (one-line, 20-line) × gambling status (NPG, low-risk, high-risk/problem) ANOVA revealed only a main effect of game, $F_{(1,90)} = 6.55$, $P = 0.01$, but no main effect of gambling status or game × gambling status interaction (both F-values < 1.0).

DISCUSSION

The data provide strong evidence for the allure of multi-line games. Although players lost more money in the multi-line game, they still overwhelmingly preferred it to the single-line game.

The finding that high-risk gamblers gave higher endorsements to the flow questions: 'I felt completely absorbed' and 'I forgot everything around me' replicates other research on dissociative-like experiences among problem gamblers [5–10]. Importantly, for high-risk/problem gamblers, multi-line games preferentially triggered these dissociative-like experiences. In single-line games, wins may stand in stark contrast to the long chains of losses. In multi-line games losing streaks are reduced, and players experience reinforcing stimuli on about half the spins (48% in our simulation). This reinforcement schedule may 'smooth' the game experience for problem gamblers [5] and foster dissociation.

The competence dimension of the GEQ was based on how 'successful' and 'skilful' players felt. Because players actually lost less on the one-line game, and had no influence over the outcomes of either game, they should have given either equivalent ratings, or higher ratings of competence for the one-line game. Instead, players gave higher endorsements to competency questions following the 20-line game. Crucially, this tendency to (mis)attribute skill and success to their play in the 20-line session was more pronounced in high-risk/problem gamblers.

In our 20-line game, LDWs outnumbered wins by a substantial margin (75 LDWs versus 45 wins). Players' win estimates suggest that gamblers miscategorized at least some LDWs as actual wins. In the one-line game, where no LDWs exist, players' win estimates were essentially accurate (within 2). In the 20-line game, players significantly over-estimated the number of wins (by approximately 15). This LDW-triggered, win over-estimation effect replicates prior research with novice gamblers [3] but uses a large sample of experienced gamblers. It clearly shows that in games with no LDWs (single-line games) players are capable of accurately remembering wins. In games with many LDWs (20-line games) players, regardless of problem gambling status, tend to over-estimate how often they won. Our contention is that for these gamblers some LDWs were either miscategorized or misremembered as wins. Our PRP analysis supports this interpretation by showing that players found 2-credit gains that were LDWs (losses of 18 credits in the 20-line game) as rewarding as 2-credit gains that were wins in the one-line game. Despite being losses in one game and wins in the other, the PRPs for small credit gains (from 2 to 19 credits) were either identical in each game or longer for the 20-line game. Furthermore, as shown in Fig. 3, the largest increases in PRPs were between the full losses and the 2-credit gains regardless of game. In the 20-line game the monetary difference between these conditions is a loss of 20 credits and a loss of 18 credits, respectively—yet the substantial jump in PRPs between these outcomes is the same size as the jump in PRPs for those playing the one-line game. Players in both games appear to be treating 2-credit gains as wins. In sum, PRPs suggest that LDWs are reinforcing outcomes even though they lead to monetary loss.

Typically, wins are considered reinforcement in slot machine play, and the reinforcement rate is the average number of spins between wins. If players miscategorize LDWs as winning outcomes due to their reinforcing sights and sounds, this would dramatically increase the perceived rate of reinforcement. In the one-line game, reinforcement occurred on average once every 5.6 spins. In the 20-line game, if players psychologically treated LDWs as wins, then reinforcement would occur approximately every 2.08 spins.

Limitations

In attempting to account for the allure of multi-line games, we focused on LDWs (i.e. the experiment was designed to show equivalent PRPs for 2-credit gains that were either wins or losses). In so doing, important features other than LDWs necessarily differed between games: players wagered more, and the number of relatively large wins was greater in the 20-line game. Such factors could markedly influence game experiences [19]. It is possible, for example, that bigger wins could have contributed to arousal and pleasantness ratings and even game preferences. Also, the average age of players recruited at the casino was more than 60 years. Further research should be conducted to ensure that these results generalize to a younger cohort of gamblers.

In summary, players overwhelmingly preferred multi-line games to single-line games. They found multi-line games more arousing, pleasant and less associated with negative affect. They also felt that they won more often playing multi-line games. Crucially, those with a high risk for gambling problems felt more skilful, and became more absorbed during multi-line play—findings that could have implications for the time they will spend on these machines and the amount that they will ultimately lose.

Declaration of interests

None.

Acknowledgements

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