Comments and Suggestions

Regarding

$120 Hourly Losses

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A Key Point on page XIV of the Australian Productivity Commissions draft Gambling report dated October 2009 states:

> "Most recreational gamblers play at low intensity, but the machines allow losses of up to $1,200 per hour.
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> - The bet limit should be lowered to one dollar per button push (equating to losses of around $120 per hour), with much lower limits on how much cash can be fed into machines at any one time. Recreational players would be minimally affected."

The $120 hourly loss is calculated based on a game with a payback percentage of 90% and the player making 1,200 wagers of one dollar each in an hour. The player loses ten cents, on average, per spin and thus with 1,200 wagers in an hour the player would lose, on average, $120 per hour.

I have been asked by Paul Bendat to (a) comment on how many players would have losses much larger than $120 in one hour, (b) to make suggestions on how the hourly losses can be held closer to $120 for most or all players while (c) retaining the entertainment value of the games for recreational players. I will address these issues by discussing Volatility and Speed of Play.

Note that the actual number of spins per hour also has to take into consideration events such as bonus rounds which will slow down play (this was noted in the Productivity Commission's report). For this report I will be using 1,200 spins per hour as that is what is used in the calculation of the average hourly loss of $120.

My Background

My Research

I am a Research Associate Professor at the University of Waterloo in Ontario, Canada. I am a computer programmer and have studied and taught computer programming for many years. My current teaching is related to the design of computer games. My research is on the design of slot machine games and the potential effect the design may have regarding problem gambling. More specifically, my expertise relates to the underlying math, statistics, and computer algorithms that are used in the design of slot machine games. Through requests via Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) I have obtained the design documents, called PAR Sheets, for various slot machine games that have been approved for use in Ontario. I have published five peer reviewed journal articles related to the design of slot machine games (Harrigan, 2007, 2008, 2009; Harrigan & Dixon, 2009a, b). In 2001, I was the producer of a software program called the Safe@Play Slot Machine Tutorial which teaches people about how slot machines work. The tutorial is used by gambling addictions counselors with selected clients.

I am the lead researcher on the University of Waterloo's problem gambling research team. Our team has two labs which we use for conducting research experiments. The first is called the "slots lab" and contains five slot machines and equipment for taking various physiological measurements including heart rate and galvanic skin response (GSR). The second is the "slot machine simulation lab" and contains a slot machine simulator on a PC as well as equipment for measuring heart rate, GSR, and pupil dilation.

I have read the Australian Productivity Commissions draft Gambling report dated October 2009 and the Australian/New Zealand Gaming Machine National Standard revision 8.0 dated December 1, 2004. I do not have access to the PAR Sheets for slot machine games in Australia and thus throughout this report I will refer to PAR Sheets for games in Ontario. I would expect that the slot machine games in Ontario and Australia have similar designs but I do not know that.

My Home Jurisdiction

My home jurisdiction of Ontario, where I conduct most of my research, has 23,000 slot machines which are all in casinos and racetracks. Half of the machines are the older-style traditional slot machines with actual reels that spin. The other half are the newer-style touch screen games. These latter machines are similar to pokies in Australia.

Annual slot machine revenue in Ontario is approximately $3 billion and this annual revenue is higher than the revenue for all other forms of gambling combined. Sixty percent of slot machine revenue is from moderate and severe problem gamblers (Williams and Woods, 2004).

I have good working relationships with both our Ontario Lottery and Gaming Corp. and our regulator the Alcohol and Gaming Commission of Ontario. With their full cooperation, my colleague Dr. Mike Dixon and I are currently conducting three studies where we (1) have removed banking machines from the casino floor, (2) surveyed 800 OLG employees regarding their gambling habits, and (3) developed animations to explain near misses, randomness, stop buttons, and virtual reels to players.

Volatility

Modern slot machine games have many possible outcomes and large prizes. For example, on the two modern touch screen games for which I have the PAR Sheets the number of possible outcomes is 16,777,216 for one game and 256,440,000 for the other and the jackpot amount for both is 50,000 credits. Playing these games, a player making 1,200 wagers may experience many losses, or many medium sized wins, or a large win and thus the outcome is very unpredictable. This is called the "volatility" of the game.

Using the PAR Sheets of a game, volatility can be calculated and tables can be produced to show the number of players who would be expected to have a payback percentage within a certain range after a given number of plays. The "volatility index" is a number which indicates how

much the actual payback percentage will vary from the stated payback percentage of the game. For example, in a game with a payback percentage of 90%, the volatility index is used to calculate how many players will be expected to get a payback percentage of 20%, 50%, 70%, 90%, or 110%, etc. over a certain number of plays. It is calculated using the standard deviation of the prize amounts from the theoretical stated payback percentage of the game. In general, games with larger jackpots have higher standard deviations and thus have a high volatility index. Typical volatility indexes in the PAR Sheets that I have seen vary from a low of 14 to a high of 22.

Table 1 below is from an actual PAR Sheet for a three reel slots game called Phantom of the Opera. It shows that with 1,000 plays on this 90.002% payback percentage game we can be confident that 90% of the players would have a payback percentage between 42.73% and 137.27% and thus the outcome in the short-term (i.e. 1,000 spins) varies significantly. Table 1 also shows that in the long-term (i.e. over millions of spins) the payback percentage is close to the stated 90.002% payback percentage of the game. For example, after one million plays we are 90% confident that the payback percentage will be between 88.51% and 91.50%.

Importantly, this is a 90% confidence interval. This means that with 1,000 spins on Phantom of the Opera, 5% of the players would have a payback percentage less than 42.73% (and 5% of the players would have a payback percentage above 137.27%).

Table 1. Phantom of the Opera

90% Confidence Values

Volatility Index = 14.949

Payback Percentage 90.002%

Source: PAR Sheet

	Lower	Upper
Plays	Percentage	Percentage
1,000	42.73%	137.27%
10,000	75.05%	104.95%
100,000	85.27%	94.73%
1,000,000	88.51%	91.50%
10,000,000	89.53%	90.47%
100,000,000	89.85%	90.15%

I have obtained the PAR Sheets for the game Lucky Larry's Lobstermania and I used these to create the confidence intervals in Table 2 below. Lobstermania is a multi-line game on which the player can wager on up to 15 lines. The calculations in Table 2 assume the player is wagering on one line only. Lobstermania has a higher volatility index than the Phantom of the

Opera and thus after 1,000 plays the range of payback percentages (22.72% to 162.30%) is much wider than the range for 1,000 plays on Phantom of the Opera (42.73% - 137.27%).

A player making 1,200 one dollar wagers in an hour on Lobstermania has a confidence interval range of 28.80% to 156.22%. A player who experiences a payback percentage of 28.80% would lose $854 in one hour of play (1200 * (1-.2880) equals $854). Because this is a 90% confidence interval, this means five percent of the players would lose more than $854. These players are experiencing losses over seven times the average hourly loss of $120 (854 / 120 equals 7.11).

Table 2. Lucky Larry's Lobstermania

90% Confidence Values

Volatility Index = 22.070

Payback Percentage 92.510%

Source: My calculations

	Lower	Upper
Plays	Percentage	Percentage
600	2.41%	182.61%
1,000	22.72%	162.30%
1,200	28.80%	156.22%
10,000	70.44%	114.58%
100,000	85.53%	99.49%
1,000,000	90.30%	94.72%
10,000,000	91.81%	93.21%
100,000,000	92.29%	92.73%

Recommendation

In the PAR Sheets I have studied the volatility index is in the range of 14-22. If Australia would like to keep the average hourly loss to $120 or less then I recommend that only games with a low volatility index be used. The volatility can be reduced by decreasing the amount of the larger/jackpot prizes and keeping the game with the same payback percentage by adding many more smaller and medium sized prizes. Australia has many pokies, there may already be some games in use in Australia that have low volatility.

A regulation or standard could state the maximum volatility. It could be a specific number such as 10. Or it could state that that for 1,200 plays the 90% confidence interval must be within a certain range such as plus/minus 10% or 20%. For example, the regulation or standard could state that on a 90% payback percentage game the 90% confidence interval must be between

80%-100% payback percentage (which would be plus/minus 10%) or 70%-110% payback percentage (which would be plus/minus 20%).

Table 3 shows what would happen to the confidence intervals if the Lobstermania game was redesigned so that the volatility index was cut in half (from 22.070 to 11.035). The range of payback percentages after 1,200 spins is 60.65% to 124.36%, which is a much smaller range than the range in the actual game, which is 28.80% to 156.22% as shown in Table 2.

Table 3: Lucky Larry's Lobstermania with the volatility index cut in half.

90% Confidence Values

Volatility Index = 11.035

Payback Percentage 92.510%

Source: My calculations

Plays	Lower Percentage	Upper Percentage
600	47.46%	137.56%
1,000	57.61%	127.41%
1,200	60.65%	124.36%
10,000	81.47%	103.54%
100,000	89.02%	96.00%
1,000,000	91.41%	93.61%
10,000,000	92.16%	92.86%
100,000,000	92.40%	92.62%

Speed of Play

Average hourly losses can be decreased by decreasing the speed of play. Even a modest decrease in speed has a significant effect on average hourly losses. For example, going from three seconds per spin to four seconds per spin decreases the average hourly loss by 25% (from $120 to $90). Table 4 shows some examples. My examples in Table 4 are similar to Table 11.2 in the Productivity Commission's report.

Table 4. Speed of play.		
Seconds	Spins	Average
Per Spin	Per	Loss
	Hour	Per Hour
3	1200	120
4	900	90
5	720	72
6	600	60
Assuming a 90% payback.		

Page 11.8 of the Productivity Commission's report states that slowing down the machines will not help much and it will adversely affect recreational gamblers. But even slowing down by one second per spin has a significant effect on average losses so I would highly recommend setting the machines at 4, or 5, or 6 seconds per spin. Machines in Ontario are typically set at 5-6 seconds per spin.

In both Table 2 and Table 3 I included a row for 600 plays which equates to one hour of play with a spin every six seconds. With less plays, the volatility index will be

higher. For example, Table 2 shows that for the 92.5% Lobstermania game that for 600 plays we are 90% confident that the player will experience a payback percentage between 2.41% and 182.61%. A payback of 2.41% on 600 plays of one dollar each is a loss of $585 (600*(1-.0241)) equals $585.

Table 3 is similar to Table 2 but has the volatility index for Lobstermania cut in half. The row for 600 spins shows that the range of payback percentages for 90% of the players will be 47.46% to 137.56%. Making these reductions in volatility index and speed of play does not guarantee that all players lose $120 or less in an hour but it is a dramatic improvement over the range of 28.80% to 156.22% payback percentage for 1,200 plays in the current game as shown in Table 2.

Summary

My suggestions to keep the player's hourly loss close to $120 or less are:

- Limit the maximum wager to one dollar as suggested in the Productivity Commission's draft report
- Limit the volatility of the game (perhaps a limit of 10)
- Slow the games to 5 or 6 seconds per spin

As noted, I have not seen any PAR Sheets for pokie games that are used in Australia. If I was given access to those PAR Sheets I could analyze them and offer suggestions for limiting the volatility and perhaps offer other suggestions for keeping the hourly loss to $120 or less for most players.

As computer programmer, my opinion is that implementing these changes would not involve a complete reprogramming of the games. As a computer game designer, my opinion is that implementing these changes would not take away the entertainment value of the games for recreational players.

I am available should the Commission wish to contact me for any reason.

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