Addictive Gameplay: What Casual Game Designers Can Learn from Slot Machine Research

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ABSTRACT

Slot machines are by far the most popular form of casino gambling today. Slot machine research, however, is a neglected area of exploration for video game designers and academics. This paper discusses structural characteristics that slot machine games and casual games have in common and then presents ideas that designers of casual games might learn from existing research into the design of contemporary digital slot machines. In particular, we introduce ideas about how casual games designers might capitalize on the properties of slot machines that encourage repeat play.

Categories and Subject Descriptors
K.8.0 [Computing Milieux]: Computing Milieux-Personal Computing-General-Games.

General Terms
Design, Human Factors

Keywords
Computer Games, Slot machines, Design, Addictive, Popularity, Principles

1. INTRODUCTION

Slot machine research is a neglected area of exploration for video game designers and academics. This paper asks what designers of casual games might learn from existing research into the design of contemporary digital slot machines (also known as video slots, video fruit machines, or electronic gambling machines) and its effect on players. We propose here that existing research into the design of slot machine games may provide casual game designers with insights into what makes a game popular and, in particular, how casual games designers might capitalize on the properties of slot machines that encourage repeat play. In particular we focus on the structural characteristics of games, by which we mean ‘those features inherent within the video game itself that may facilitate initiation, development and maintenance of video game playing over time’ [1]. Although all video games may share some of these design principles and can benefit from an understanding of these principles, our focus is on casual games, which are defined by the International Game Developers’ Association as ‘games that generally involve less complicated game controls and overall complexity in terms of gameplay or investment required to get through a game’ [2].

Throughout this paper, we have chosen to use the casual game Tetris for most of our examples, due to its enduring popularity. Originally developed in 1984 by Alexey Pajitnov, Tetris remains one of the most popular and highest grossing casual games of all time. Lifetime unit sales totals are estimated at over 100 million for just the mobile platform, and Tetris is currently available on over 800 different handset models [3]. The game frequently makes Top 10 Games of All Time lists [4]. The goal of Tetris is to place differently-shaped falling blocks together like a puzzle. When blocks in one row are all filled, the row is deleted from the puzzle. Points are scored by clearing rows as well as with each block placed. The game is over when the player has misplaced enough blocks that they fill up the space without having cleared the rows.

We begin with an overview of the similarities between slot machines and casual games, and then focus on research into slot machines and video games structural characteristics to outline some key design principles that can be adopted by designers of casual games.

2. EXISTING SIMILARITIES BETWEEN SLOT MACHINES AND CASUAL GAMES

Like casual games, slot machine games do not have complex gameplay and the player/gambler does not need to invest much time to understand the game controls. Figure 1 is a photo of a modern slot machine game. The game controls, seen at the bottom of Figure 1, are simple buttons for selecting the number of lines to be wagered upon and the credits wagered per line. Most wins must be three or more symbols starting from the left on a played line. The player simply presses ‘spin’ and the slot machine displays animated spinning reels for 5-6 seconds and then tallies...
the result. Even if the gambler were to misinterpret the outcome, it does not really matter, in that the slot machine always adds or subtracts credits appropriately. In Figure 1, the player has wagered 75 credits by wagering 5 credits on each of 15 lines. The player won 25 credits by having three clams on one of the 15 zigzag lines. One credit is a nickel, and thus the 75-credit wager is $3.75.

![Figure 1. Slot Machine screen showing play.](image)

The demographics of casual game and slot machine players are quite similar. According to various surveys, slots players are approximately 60% males and 40% females, with the average age being approximately 39-45 years old (see for example [5], a survey of over 3,000 individuals). The demographics of slot machine players are similar to the results reported by the 2007 Casual Game report, which showed that casual game players are fairly evenly split with 48.3% male and 51.7% female (although females account for 73% of paying casual gamers) and most casual game players (62%) are over 35 years old [6].

Casual games represent one of the fastest growing areas of video game sales. With distribution through Internet, mobile and smart phones, social networks such as Facebook, as well as downloads through consoles such as through Xbox LIVE Arcade, casual games now account for more than $3 billion in annual sales. To compare that figure, however, slot machines represent approximately $1 billion in sales each day in the United States alone (a figure that denotes profits by casinos, rather than take-home purchases) [7]. Over the past few decades, slot machines have become more popular and profitable for casinos than table games. Approximately 60% of slot machine revenue is derived from moderate and severe problem gamblers [5]. The enormous popularity of slot machines continues to grow as they are increasingly found outside of designated casinos in jurisdictions where they were previously restricted by government regulations.

Casual games represent perhaps the easiest entry to the games marketplace for designers, and due to their generally lower cost and shorter development cycles are the more common development choice for students and start-ups. These factors also make casual games useful teaching tools for educators. On the other hand, although slot machine games have simple gameplay, the gambling industry is highly regulated and thus entry to the market of slot machine games is very limited as the process of having a game approved is onerous. For that reason, the slot machine marketplace is dominated by only a few manufacturers, and each manufacturer creates both the game and the physical machines.

Slot machine game design today is becoming increasingly similar to that of video games. In part, this is due to the influence of game designers from the video game industry into slot machine companies. For instance, Joe Kaminkow once designed games for Data East Pinball as well as Sega, before going on to be Vice President for Game Design at International Game Technology (IGT), the leading slot manufacturer, bringing many ideas from the game industry with him. It is also common for video game sound designers and composers to work on contract for slot machine manufacturers.

Unlike the old mechanical reel slots, today’s slot machines incorporate high-resolution graphics, cinematic cut-scene sequences, high quality audio, and bonus levels. They are also increasing in complexity, although slot machines are attractive to players because, like casual games, they:

- require little or no training or previous experience;
- require little time commitment although players can continue to play for hours;
- are quick and easy to play – slots are considered a continuous form of gambling as you spin every 5-6 seconds;
- offer instant rewards for play in terms of feedback (whether financial, through points, or audio and video rewards).

In fact, Wood et al [8] argue that ‘The only major difference [between slots and video games] is that most video games do not offer the chance to win money by playing.’ Another major difference is that skill has little or no influence on the result of a slot machine spin whereas in casual games skill is important. Fisher and Griffiths [9] outline a series of characteristics that video games and slot machines share including:

- the provision of auditory and visual rewards for winning moves;
- incremental rewards that reinforce ‘correct’ behavior;
- scores;
- opportunities for peer approval;
- attention or recognition through competition.

As each industry advances, the importance of refining these characteristics has become more of a science than an art. Despite media attention, however, there has been very little academic research into video game addiction, with some researchers questioning the validity of the concept [10][11]. However, there is little doubt as to the addictive nature of slot machines, which has clear social and financial consequences, and as such, considerable research has been conducted into the addictive or popular properties of slot machines.

Below we present and discuss design principles from slot machine game design. For each of our principles, we outline existing slot machine research and compare the use of the design feature in slot machines with *Tetris*. By understanding the science behind these principles, we may begin to incorporate or enhance these areas in casual game design.
3. SLOT MACHINE DESIGN PRINCIPLES

3.1 Rewards

In slot machines, the most obvious form of reward is a financial pay-off. The player bets an amount of money, and the player wins back more than they bet. The actual payout from wins on slot machines and their relationship to rewards is far more complicated, however (see below). In addition to the financial rewards, however, are the other rewards that the player receives. Auditory and visual rewards are commonly heard and seen when a player wins. These include verbal reinforcement from virtual characters that may speak to the player [12], as well as ‘rolling sounds’ and various sound effects, as well as cut-scene animations and flashing lights.

The importance of sound effects in particular as reward is so apparent that slot machine manufacturers now use sampled sound effects of coins entering the hopper even when no coins are used on the machines. Describes Bill Hecht, an audio engineer for IGT, ‘We basically mixed several recordings of quarters falling on a metal tray and then fattened up the sound with the sound of falling dollars’ [7]. Moreover, these false coin sounds can portray wins much larger than the actual win. Research into sound’s effects on video games has found that sound can contribute significantly to stress and/or arousal during game play. One study even found that realistic sound was the most important feature of a video game [13]. But regular sounds can quickly fade into the background of a casino’s environmental noise. As such, randomized sound effects are now increasingly in use, in order to increase the perception that the sound is more real than it is in actuality, and to reduce the recognition that it is merely careful programming at play [14].

On slot machines almost all auditory rewards are accompanied by a visual reward system—flashing lights, and/or some form of cut-scene animation, which typically take place after a large win. Similarly, in video games, cut-scenes are also commonly used in casual games as a reward when a player achieves a certain score or clears a particularly difficult level. An animation is played and the player gets a moment’s rest. On the original Game Boy version of Tetris (1987), for instance, after clearing level 9 on the high difficulty setting, a series of Russian dancers and performers play, followed by a space shuttle launching. In most other versions of Tetris, it is common to have Russian Cossack dancers in cut-scenes after achieving a certain level or score.

Auditory and visual rewards are common in casual games, although underused, and in the case of sound, often being given a back seat and small budget. We feel that sound in casual games is particularly overlooked, and could be one significant yet simple avenue for making games more attractive. To use Tetris as an example of this auditory rewards idea at work, pleasing sound effects are played upon clearing a row, as well as achieving certain scores. What a modern Tetris could benefit from is the idea of variable sound effects. For instance, the sound for clearing a row could vary based on the level, the colours of blocks in the row, or any other number of parameters. Similarly, one area that is lacking in casual game design is the use of replay sequences as cut-scenes. For instance, the game could track events that rewarded the player with a high amount of points, or a particularly difficult action sequence. These sequences could be played back in cut-scenes, in much the same way that replays are used in some sports games, such as NHL 2010 (EA Sports 2009). An announcer could even comment on the play, combining auditory and visual rewards.

In addition to these auditory and visual rewards, there are also rewards of a social nature. Casinos provide a unique form of positive reinforcement called ‘hand pays.’ Casinos have a cutoff amount for jackpot wins which must be paid to the gambler in cash by hand by a casino attendant. When a player wins the cutoff amount or more, the machine enters a ‘hold mode’ and the machine’s lights flash and sirens sound. At this time, players often receive peer praise from their fellow gamblers. After a minute or two, an attendant arrives and pays the gambler the winning amount in cash. The machine then returns to normal play.

While casual games typically may be played on one’s own, increasingly, winners are playing on portable handheld devices, and/or sharing games over the Internet, in a sense obtaining peer praise through competition or sharing. Moreover, the use of leader boards serves to reinforce behaviour through peer praise (see below). To use Tetris as an example again, in addition to auditory and visual rewards discussed, some rewards come in the form of points and leveling up. After a certain score or playing time is achieved, the player’s level is increased. The goal—the reward—is achieving a high level. This higher level, however, is accompanied by an increase in difficulty. The skill involved, therefore, in achieving a higher level, must also increase with that achievement. High scores may be shared with others through leader boards or verbally (‘I just got to level 22!’) for peer praise.

3.2 Reinforcement Schedules

Of course, the behaviours that are rewarded or punished in a game are only part of the equation: The timing of these events is of critical importance. Slot machines are designed to provide regular and frequent small wins. King, Delfabbro and Griffiths, drawing on the work of B.F Skinner, argue that in fact the reinforcement schedule is more important than the rewards themselves [1]. Slot machines incorporate a random ratio reinforcement schedule, which means that both the amount of the reward (i.e. the number of credits won) and the number of spins between rewards are varied [15]. A random ratio is well known to be a powerful reward schedule as it makes it difficult for individuals to cease a behavior.

The frequency of positive reinforcement (small wins) affects machine choice in slot machine play [16], with a preference for regular small wins, although the overall average percentage payback or return rate is also important [17]. With modern slot machine games, players often win ‘something’ on one-third of their spins, on average. This high frequency also helps to disguise loss [16]. Immediacy of some form of reward is also important: players play more games when rewarded immediately than with a delayed response [18]. It is the combination of a high frequency of rewards, the results of the bet, and the immediacy of the rewards that contribute to a game’s addictiveness, argues Griffiths [19].

In video games, experience points, level-ups, and item rewards are all part of the reinforcement schedule. However, as some researchers have found, ‘some elements of failure and punishment in video games are perhaps essential in order to establish the contextual worth of in-game rewards (i.e., that rewards can prevent the player from losing) and show the player that making progress is not simply inevitable but skill-based.’ [1] Moreover, a
game must provide enough frustration as to be interesting. If the
game is too easy, the player will lose interest. According to
Csikszentmihalyi’s concept of flow, games must become
progressively more difficult in order to maintain our interest. [20]

3.3 Non-Rewards: Near Misses

The algorithm the slot machine game designers use is simple yet
eloquent. The reels on the slot machine are weighted so that the
blank symbols that are adjacent to jackpot symbols each occur on
the payline six times more often than the jackpots symbols appear
on the payline. The third reel in Figure 2 is an example. The blank
below the ‘Blazing 7’ appears on the payline six times out of
every 256 spins, on average. The ‘Blazing 7’ that is shown just
above the payline appears on the payline once, on average, in
every 256 spins. The blank above the ‘Blazing 7’ on the third reel
(not shown) appears on the payline six times out of 256 spins, on
average. Thus, on average, in every 256 spins the jackpot symbol
appears above and below the payline 12 times more often than it
appears on the payline.

Figure 2. A ‘near miss’ of 7s failing to line up

The casino industry uses near misses to increase the entertainment
value of the games, and regulators allow the intentional
programming of near misses by the manufacturers. The fact that
near misses increase the entertainment value of the games has
been proven by problem gambling researchers who have shown
that near misses increase the number of games played [21]. If you
walk around a casino floor you will see that players rarely react to
the frequently occurring small wins but they often be seen
reacting to near misses with comments such as ‘aw shucks’
coupled with physical reactions such as snapping their fingers.

The ratio of 12:1 of near misses being designed into the games
versus near misses that happening by chance alone has been
arrived at by slot machine game designers over many years and
this can be used as a guideline for casual game designers – if there
were too many near misses then players would grow accustomed
to the near misses and thus the near misses would not increase the
entertainment value of the game. The 12:1 ratio seems to be the
’sweet spot’ regarding how many near misses will make the game
most entertaining.

With near misses, argues King et al [1], the players are not
constantly losing, but constantly ‘nearly winning’. Near misses
have not, to our knowledge, been intentionally included in any
casual game design, although there it may be argued that the
nature of video games encourages the feeling of ‘almost
happening’. In Tetris, for example, players may accidentally place
a block in the wrong spot (a fairly common occurrence depending
on the controls involved and the experience of the player). As the
speed of the blocks increases, errors are made not in the intended
placement of the block, but in the actual placement. In this sense,
the player believes that it was an error of physical dexterity that
can be fixed and that trying again will solve the problem.

3.4 Non-Rewards: Losses Disguised as Wins

A slot machine loss disguised as a win (LDW) is a play in which
the player ‘wins’ but receives a payout amount of money less than
that of the amount wagered, hence actually losing on the wager
[22]. So for example, a gambler might wager $2 on a play and win
back 50 cents. The gambler is actually losing $1.50, but is given
the reinforcement cues (the auditory and visual rewards) of a win.
Physiologically, gamblers respond as if they are winning when
they are, in actuality, not winning at all [22].

These losses disguised as wins are the consequence of allowing
players to wager on multiple lines on one spin. For example, a
player may wager 25 cents on each of 15 lines for a total wager of
$3.75. That player may win $1 on one line and 75 cents on
another line for a total ‘win’ of $1.75. The player will experience
the winning graphics and winning sounds although they have just
lost $2.00 in a six-second spin. On modern slot machines, the
number of LDWs is often more than the number of regular wins.
Ontario’s casinos have a wide mixture of slot machines including
older style one-line slot machines that have no LDWs and modern
50-line games with a LDW on every fifth spin or so. We visit one
casino frequently and the multi-line games are much busier than
the single line games. In fact, in many jurisdictions the modern
multi-line games have completely replaced the older-style single
line games. On hundreds of casino visits we observed the playing
habits of gamblers playing multi-line games, and the overwhelming
majority are playing a small amount, such as five
cents on 15 or more lines per spin (i.e. a $0.75 wager) and are
experiencing LDWs on approximately 20% of their spins.

The research is clear that players physiologically experience
LDWs and regular wins identically [22]. Thus, even while taking
money from the gambler, the slot machine game designers have
figured out how to reward the player. This technique may be
particularly appropriate for casual games. Casual gamers are not
as ‘hard core’ as other gamers and may be looking for a game that
provides rewards without too much time and effort on their part.
Finding a place in the causal game to reinforce the gambler with
‘wins’ (through rewards of a score, auditory nature, etc.) that are
not really wins may provide just the arousal needed to increase the
time on that game by the casual gamer.

This loss disguised as a win phenomenon is not found in Tetris,
although it is certainly found in other games to a limited and
unscientific extent. The original Prince of Persia platform game
(1989 Brøderbund) for instance would often make the player work
hard to get to a potion. It was only when the potion was drunk that
the player would discover that it was a bad potion that subtracted
from their health score. Had the player been given the auditory
rewards of a win in this case (a good potion sound), it may have
been enough to trick the player into psychologically believing it
was a positive event, even though their life score was being
reduced. There is no research, however, into this phenomenon in
video games, although gambling research suggests this may help to increase player excitement.

### 3.5 Illusion of Control/ Skill

There is strong evidence that gamblers who are given an illusion of control in a gambling game will value their chances higher than those who feel they have no control. This is true even when the gambler understands that the outcome of the game is completely random. Langer [23] conducted a series of classic experiments in which people bought tickets for an office raffle. Half of the people chose their ticket number and half were just given a numbered ticket. Later, Langer asked each person if she could buy back the raffle ticket (she had made up a story as to why she wanted to buy the ticket back). People who were able to choose their tickets valued their tickets as being worth significantly more than did those who did not get to choose their tickets, although both groups clearly understood that the outcome of the raffle was random. Thus, providing the player with choice even in an event that is understood to be random has a powerful effect on the player.

Slot machines provide an illusion of control by allowing the player to use a stop button. Slot machines work by generating tens of thousands of random numbers per second, even when the game is not being played. When the gambler presses ‘spin’ or pulls the handle, the random numbers available at that instant are used to determine the outcome instantly. However, the player has to wait 5-6 seconds for the reels to stop spinning before he/she knows the outcome. The games will often provide the player with a stop button that stops the reels in two seconds or so. Gamblers can often be seen hovering over the stop button and pressing it at a particular instant as if they somehow are influencing the outcome. Of course, pressing the stop button simply allows them to see the result of the spin faster.

The use of a stopping device increases the perception that the stopping is not random, but rather that there is some form of skill involved: By having that control, there is an increased probability of success, thus making the game more attractive to the player [24]. Nevertheless, these are illusive devices that fail to have an actual outcome on the game. King et al describe that it is also necessary, however, to have some degree of chance involved. Events that cannot be controlled by the player increase the replayability and enjoyment of the game [1].

In *Tetris*, for instance, while the player must have the skill to place the blocks in a way such as to eliminate rows, the choice of where to place the blocks is open to the player. The skill is in the selection of the placement of the blocks. The randomness occurs in the actual block given to the player at each regular interval. A player may hope for a particular block in order to clear a line, but may be given a block that does not fit and causes a problem. Thus, there is a degree of both randomness and skill involved in the success of the player.

The lesson for the designers of casual games is that players may enjoy an illusion of control that does not affect how the game works but does potentially have a positive effect on the experience of the player.

### 3.6 Bonus Rounds

Several authors have noted that the illusion of control or skill is interrelated with the degree of personal participation (involvement) in a machine [12, 24]. Nudge, holds, and other buttons have increasingly found their way into slot machines, along with bonus rounds that also give the illusion of skill. For instance, a bonus round in *Lucky Larry’s Lobstermania* asks players to select from one of a series of buoys floating in a lake. Although the outcome is random, the use of choice (and therefore the illusion of skill in selecting the correct buoy) is one example of this use of illusion of control.

All modern slot machines have some type of bonus round. It is entered randomly. When in bonus round the player always wins something: It is always a positive experience. When in bonus mode, the game may be free spins with added prizes or it may be a completely different game altogether. Players consistently rate the excitement of bonus modes as one of the most compelling reasons why they choose one game over another [25].

On a larger scale, bonus rounds are often used in video games to reward players for longer times spent with a game. The idea is that when the player has mastered the technical skills required to play the game, there are still rewards for continued play [26]. The skill in this case is the ability to discover these hidden levels or sections of a game.

In casual games, bonus modes could come up randomly or in a more predictable manner. For example, in between levels a bonus round could occur. Instead of a cut-scene where the player is a passive viewer, the cut-scene could contain three separate paths. The player is given the choice of path A, B, or C. Depending on the player’s response the player may gain few or many points. It is still just a cut-scene but the player is experiencing an illusion of control and is being rewarded with points.

### 3.7 Competition

Competitiveness is an important component of all games. This involves competing against the machine, competing against oneself, as well as competing against others. In slot machines, one is always competing against the machine: attempting to beat the odds. However, one is also in a sense in competition with others on the casino floor. The perception that a big win on a machine will somehow mean lower immediate future payouts is a popular one. Gamblers will stick with one machine that has not paid out recently in the hopes that the payout is coming. Moreover, the attention paid to big winners on the casino floor is also in a sense a form of competition.

Competing with the machine or against oneself of course involves the illusions of control and skill discussed above. Competing against others, however, has always been a particularly important part of video games. Vorderer et al argue that competition is the key determinant of a game’s enjoyment [27]. They argue that the outcome of competition is to increase the player’s self-esteem and mood. Features such as high score tables (leader boards) are critical to repeat plays, as players attempt to not only beat their own score, but the highest score amongst their peers. Casinos and lottery winners must allow their photos to be taken and displayed inside the casino. The entrances to casinos all have such photos with large cheques being handed to the winners, a concept which is very similar to leader boards.

King and Delfabbro refer to this concept as ‘meta-game rewards’ that allow players to assess their overall mastery of a game by comparing their results to others [28]. Long-term or larger goals are set by leader boards in order to increase playing time.
In traditional games of Tetris, players can gauge their success by the leader boards in the game—typically only competing against themselves or the small group of people who may have played on that particular machine. Now that the games are networked, the leader boards are more competitive and the issue of social competition has become more important to casual games. Facebook games, for instance, commonly post level up or score information to all of one’s friends, encouraging entry and longevity of play through competition.

4. CONCLUSIONS

This paper has outlined some of the key components that increase playing time and player enjoyment on slot machines, and drawn on Tetris to illustrate the practical implementation of these ideas in casual video games. We summarize our main findings here:

- Rewards are intrinsic to video games, and as shown they can take the form of points, auditory or visual rewards, and help to increase the self-esteem of the player.
- Non-rewards or punishments provide enough of a frustrating value to make the game interesting for longer periods of time.
- Rewards are tied to reinforcement schedules in which players are kept interested through regular payouts of reward. The timing and frequency of these rewards has been the subject of decades of research, and while most games rely intuitively on these schedules, more scientific approaches could be taken to ensure playability.
- Illusory rewards are also important to keep player interest while maintaining a degree of difficulty. Losses disguised as wins at an approximate 20% ratio of overall play-time are one example of these illusory rewards in slot machines.
- Near-misses at a 12:1 ratio encourage longer play times by raising excitement levels.
- Skill and competition also play very important roles in video games. Whether this is an actual skill or the illusion of skill, the player’s perception of control is critical to the game.
- A degree of randomness or loss of control is also important. The importance of this ratio of the chance to skilled element remains unexplored and could be a valuable area of future inquiry.
- As player skill increases, competition is important to maintain motivation. Whether this is competition with the game, or competition with other players, competition keeps players interested in the game for longer periods of time. The concept of ever-increasing difficulty and level of competition is the key to Csikszentmihalyi’s concept of flow, or immersion, popularly applied to video games.

We have shown that there is considerable research into gambling and slot machines in particular that can be incorporated into video game research. While video games have become incorporated into gambling and psychology research (notably the work of King, Delfabbro, Griffiths, and Wood), the inverse is not true. Video game researchers—even those purporting to seek out the properties that make video games ‘fun’ or ‘playable’ or more ‘immersive’ or ‘engaging’ (e.g. [29] [30])—have largely ignored this important body of research and its empirical scientific work.

As discussed, some of the practice of game design is shared between industries, and video game designers are sometimes aware of the ongoing research in gambling. Denis Dyack, president of Silicon Knights, for instance, stated in a private discussion with two of the authors in 2008 that the idea of reinforcement schedules was used in the Xbox 360 game Too Human (2008). Researchers into video game design, therefore, should be aware of this body of work on gambling and its impact on game design.

By summarizing the key ideas, we have begun to introduce this body of work to researchers. Moreover, these ideas form design principles that can be incorporated into casual games, as well as into the classroom environment when teaching game design.

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