

## Built-in bad luck: Evidence of near-miss outcomes by design in scratch cards

Madison Stange,<sup>1</sup> Dan G. Brown,<sup>2</sup> Kevin Harrigan,<sup>3</sup> & Michael Dixon<sup>1</sup>

<sup>1</sup> Department of Psychology, University of Waterloo, Waterloo, ON, Canada

<sup>2</sup> David R. Cheriton School of Computer Science, University of Waterloo, Waterloo, ON, Canada

<sup>3</sup> Gambling Research Lab, University of Waterloo, Waterloo, ON, Canada

### Abstract

Scratch cards are a pervasive form of gambling in the Canadian marketplace. Despite their widespread appeal, we are only beginning to understand the influence of their structural characteristics on the player. The most widely studied of these characteristics is the near-miss, a game outcome in which the player gets two of the three needed symbols to win a jackpot prize. Although other authors have noted the existence of these outcomes in scratch cards, no systematic investigation has been undertaken to understand their occurrence in these games. We present the results of an analysis to determine the frequency of these outcomes using two samples (sample A,  $n = 41$ ; sample B,  $n = 61$ ) of a popular scratch card game available in Ontario, Canada. Our results suggest that certain scratch card games may be designed to include more pairs of jackpot symbols (i.e., more near-miss outcomes) than any other symbol pair. In the game that we analyzed, the top prize symbol occurred more often than any other symbol and appeared to be manipulated to appear in clusters of two, creating many near-miss outcomes to the jackpot prize. This work has strong implications for the study of gambling behaviour, responsible gambling strategies, as well as for the scientific investigation of scratch card games.

**Keywords:** scratch cards, near-misses, structural characteristics

### Résumé

Les cartes à gratter sont une forme très répandue de jeux sur le marché canadien. Malgré leur grand attrait, nous commençons à comprendre l'influence de leurs caractéristiques structurelles sur le joueur. La caractéristique la plus étudiée parmi elles est un résultat s'approchant du résultat gagnant; le joueur obtient deux des trois symboles nécessaires pour gagner un gros lot. Bien que d'autres auteurs aient noté l'existence de ce genre de résultats dans des cartes à gratter, aucune enquête

systematique n'a été entreprise pour comprendre leur occurrence dans ces jeux. Nous présentons les résultats d'une analyse pour déterminer la fréquence de ces résultats en utilisant deux échantillons (échantillon A,  $n = 41$ ; échantillon B,  $n = 61$ ) d'un jeu de cartes à gratter populaire, vendu en Ontario, au Canada. Selon nos résultats, certains jeux de cartes à gratter peuvent être conçus pour inclure plus de paires de symboles pour le gros lot (c'est-à-dire des résultats plus proches) que n'importe quelle autre paire de symboles. Dans le jeu que nous avons analysé, le symbole du prix le plus élevé était présent plus souvent que tout autre symbole et semblait être manipulé pour apparaître en grappes de deux, créant de nombreux résultats proches du résultat gagnant. Ce travail a de fortes répercussions pour l'étude du comportement du jeu, du jeu et des stratégies responsables, de même que pour l'étude scientifique des jeux de cartes à gratter.

---

## Introduction

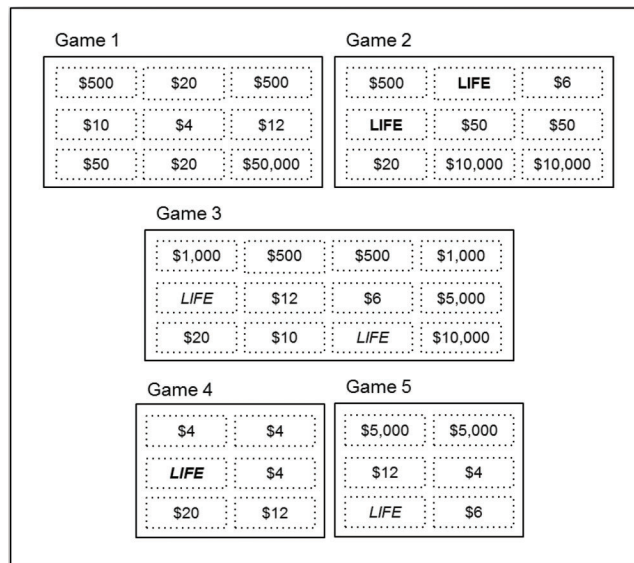
Scratch cards (also called “instant games” or “instant tickets”) are a popular, typically cheap, and seemingly innocuous form of gambling. In the 2014–2015 fiscal year, Ontarians alone spent over 1 billion dollars on these games (Ontario Lottery and Gaming Corporation [OLG], 2016, p. 19). Although technically falling under the umbrella of lottery products, scratch cards are quite structurally divergent from a traditional lottery draw in which a player buys a ticket and waits for a draw to determine the winner. Specifically, scratch cards allow for continual play, have a rapid event frequency, and contain near-miss outcomes: all characteristics of a “harder” and potentially more dangerous form of gambling (Griffiths, 2002). Indeed, some authors have cautioned against considering these games to be completely harmless, often likening them to paper versions of slot machines (Ariyabuddhiphongs, 2011; Griffiths, 1995, 1997).

Arguably the most concerning feature of scratch card games is the presence of near-miss outcomes. A near-miss, as defined by Reid (1986), is an outcome that comes close to a win, but comes up short. A classic example of a near-miss can be found on a three-reel slot machine: spinning the reels results in two jackpot symbols on the payline, with the third just out of reach, either above or below the payline. The scratch card equivalent of this outcome type would consist of uncovering two out of the three required jackpot symbols to win said prize: the player comes close to the jackpot win, but falls short. Understandably, certain players misinterpret these outcomes as “coming close” to a jackpot win, inferring that they have narrowly missed their windfall prize because of bad luck. These near-miss outcomes are pure monetary losses and result in no financial gain to the player. Across a wide variety of individual game types, scratch cards appear to contain many such near-miss outcomes per card. In fact, our research group reported that in a small sample of cards obtained in Ontario, all cards contained at least one near-miss for the top prize,

with some cards containing more (Stange, Graydon, & Dixon, 2016). These outcomes are particularly striking in a game such as Cash for Life, a popular scratch card game in Ontario, one which costs \$4.00 to play and has a top prize of \$1,000 a week for life. The symbols representing the top prize are quite distinct from other symbols in the game matrix (the word LIFE vs. dollar amounts for other prizes), thus potentially increasing the visual salience of these prizes (see Figure 1). Given the seemingly frequent occurrence of these outcomes, researchers have started to identify what, if any, effects these games have on the people who play them. Since near-miss outcomes have been extensively researched in slot machine gambling, we briefly review these findings to inform the current investigation.

Research has overwhelmingly identified near-miss outcomes in slot machines as a problematic structural feature because of the negative effects that they have on the player. Specifically, slot machine near-misses have been found to increase physiological arousal (Clark, Crooks, Clarke, Aitken, & Dunn, 2012; Clark et al., 2013; Dixon et al., 2011; Dixon, MacLaren, Jarick, Fugelsang, & Harrigan, 2013) increase time spent gambling (Côté, Caron, Aubert, Desrochers, & Ladouceur, 2003; Kassinove, & Schare, 2001), and activate reward-related brain areas (Clark, Lawrence, Astley-Jones, & Gray, 2009), despite being monetary losses. Overall, these outcomes may be problematic for the gambler and may result in a physiologically arousing and frustrating experience, which could in turn encourage further play and increase expenditures (time and money) on this form of gambling.

Recently researchers have begun to study, both systematically and experimentally, scratch card near-miss outcomes in hopes of gaining a greater understanding of their



*Figure 1.* Schematic diagram of a Cash for Life card from sample A. Note the near-miss outcomes to the top prize of \$1,000 a week for life (denoted by the LIFE symbols) in games 2 and 3. Also note the three matching \$4.00 symbols in game 4, denoting a win of \$4.00.

effects on the player. Similarly to slot machine near-misses, scratch card near-misses have been shown to increase physiological arousal, as measured by skin conductance (Stange et al., 2016) and heart rate (Stange, Grau, Osazuwa, Graydon, & Dixon, 2017). Scratch card near-misses also increase subjective arousal, frustration, negative emotion, and disappointment (Stange et al., 2016, 2017). Critically, these outcomes also lead to higher ratings of urge to continue gambling (Stange et al., 2017; Stange, Graydon, & Dixon, in press), over and above that of regular losses. For example, Stange et al. (in press) gave participants the option to purchase additional scratch cards from the experimenter after the participants had experienced various outcomes during gameplay. In the key manipulation, one group was exposed to a regular loss just prior to deciding whether or not to purchase an additional card, while the other group was exposed to a near-miss just prior to making their decision. For those exposed to the near-miss, self-reports of urge to continue gambling at the time of purchase were positively correlated with their purchasing behaviour. By contrast, those exposed to the regular loss showed no relationship between urge to gamble and purchasing behaviour (Stange et al., in press). Therefore, it appears that scratch card near-misses are capable of promoting increases in the urge to gamble and encouraging further play. These findings are in line with results reported by Short, Penney, Mazmanian, & Jamieson (2015) which revealed that instant lottery play (e.g., scratch card play) was uniquely associated with problem gambling over time, but that traditional lottery play was not. These results are concerning given the availability of these games in the marketplace (there are approximately 9,700 retailers in Ontario alone [OLG, 2016]), their seemingly innocuous connotations (Short et al., 2015), the social acceptability of lottery play in general (Rogers, 1998), and the frequency with which near-misses seem to occur (Stange et al., 2016).

Do near-misses in gambling games occur more often than dictated by chance alone? This question has been extensively addressed with regards to slot machine games. Because of the symbol arrangement on slot machine reels, it is expected that a certain number of near-miss outcomes would occur by chance (e.g., two red 7s on the payline, with the third 7 above or below). Investigations into the structural design of slot machines have demonstrated that slot machine manufacturers have strategies to “engineer” near-misses and increase the frequency with which these outcomes occur. One such strategy is virtual reel mapping (Harrigan, 2007, 2009). In virtual reel mapping, the likelihood of the symbols used to create winning and losing reel combinations are not based on the potential stopping positions of the physical reels on the actual slot machine, but rather are determined by a virtual reel with many more stopping positions than the physical reel. These extra stopping positions can then be assigned in a “many-to-one” fashion to the stopping positions on the physical reel. The manufacturer simply assigns many more stopping positions to low-paying symbols or blank spaces between symbols than to high paying symbols. Since the random number generator randomly selects stopping positions on the virtual reel rather than on the physical reel, this many-to-one mapping ensures that the blanks and lower-paying symbols are “chosen” by the random number generator more often than the high paying symbols. The frequency of near-misses can then be elevated by assigning a disproportionate number of extra stopping places on the

virtual reel to the blank symbols that are adjacent to the jackpot symbols on the physical reel. This results in the blank symbol frequently occurring on the payline and the jackpot symbol being just above or just below the payline in an “engineered” near-miss. Not only does this technique make near-misses more frequent, but also the actual reel does not visually display these weighted, or unequally proportioned symbol ratios to the player (Turner & Horbay, 2004). Also, slot machine reels do not necessarily contain an equal number of jackpot symbols on each reel, creating a bias towards obtaining two of the three needed symbols to attain a jackpot (Turner & Horbay, 2004). Thus, it is clear that slot machine manufacturers design these games to include more near-misses than would be expected by chance alone through the use of subtle manipulations.

Given these apparently deliberate efforts of slot machine manufacturers to facilitate the occurrence of near-misses, and the numerous structural similarities between slot machines and scratch cards, we considered whether a similar process was at play with the design of scratch card games. Specifically, are scratch card games created in such a way to facilitate the occurrence of near-misses involving the jackpot symbols? To answer this question we collected scratch cards from a frequent scratch card player who purchased two instantiations of a popular scratch card game in Ontario called Cash for Life (sample A,  $n = 41$ , 5 games per card; sample B,  $n = 61$ , 5 games per card). We then analyzed the game symbols contained in our collection of purchased cards. If all symbols had an equal probability of being revealed then jackpot symbols would be uncovered during play with the same frequency as any other symbol. If card manufacturers were taking steps to ensure that near-misses occurred at elevated frequencies, however, jackpot symbols would appear in the game matrices more often than other symbols. More importantly pairs of jackpot symbols (creating a near-miss to the jackpot prize) would occur more often than any other pair of symbols within games.

## Method

### Materials

**Scratch Card Game Characteristics.** All scratch cards share some common game features. All game play information is printed directly on the cards themselves, and each game play area is covered with an opaque layer. The player then uncovers the opaque “scratch” layer to reveal different game outcomes. Typically these games involve matching symbols, letters, or numbers. However, each game type has distinct rules and instructions for play.

One common game type involves the player uncovering sets of symbols that correspond to various prize amounts, in hopes of finding three matching prize amounts within one game. Each game contains 6 to 12 symbols arranged in a grid-like matrix. All of the symbols are actual prizes that the player can win. Cash for Life is an example of a prize-amount-matching game (see Figure 1), with the top prize

being \$1,000 a week for life. To win this top prize, three LIFE symbols must be uncovered within a single game matrix. On the cards we analyzed (Game Nos. 1167 and 1171), each card contained five prize matching games and one extra image matching game (which is not analyzed here or described further because of its divergent properties). A near-miss in this type of scratch card game would consist of uncovering two of the three required symbols needed to attain the jackpot prize (e.g., two LIFE symbols) in one of the five game matrices.

As previously mentioned this top prize symbol is the only one represented by letters; all of the other symbols correspond to dollar amounts (i.e., \$4.00, \$1,000, etc.). One other curious perceptual feature of the symbol amounts in Cash for Life is the variability in font type and the presence or absence of italicization.

**Sample.** The scratch cards we analyzed were from two different “batches” of Cash for Life. In sample A (Game No. 1167 in Ontario) there were a total of 41 cards, and in sample B (Game No. 1171 in Ontario) there were 61 cards. Not surprisingly, neither sample contained a game containing the three LIFE symbols within a single game matrix (i.e., our samples contained no jackpot prize winners).

**Sample Characteristics.** To ensure that our card samples were a close approximation to the population of cards as a whole, we computed the payback percentage and overall odds of winning any prize for both sets of cards. We then compared these values to the published information about the game that is provided by the OLG (2015a, 2015b). For sample A (Game No. 1167), the payback percentage of our sample was 40.24%. Although the published payback percentage for this game is 65.85%, this percentage is dramatically affected by the inclusion of the three top prizes of Cash for Life, which we calculated to equal an amount of \$800,000 (derived from the total number of prizes available, and the overall monetary value of all prizes combined). If one removes the top prizes of Cash for Life ( $\$800,000 \times 3$ ) the payback percentage of this game drops to 58.48%, a number still higher than, but more comparable to, our obtained sample.

The prize structure of sample B differed slightly from sample A. Most notably in sample B, there were 10 top prizes of Cash for Life, compared with only 3 in sample A (other subtle differences in prize structure existed between the two sets; see Table 1). Our sample of cards in set B (Game No. 1171) had a payback percentage of 50.41%, compared to a published payback percentage of 67.76%. When the 10 top “Cash for Life prizes” were removed from the overall payback percentage, this value dropped to 53.94%. In sum, although the payback percentages of our samples were lower than the published values for each game, these values were not that discrepant when this expected payback percentage was calculated after excluding the large and infrequently obtained top prizes (the odds of winning Cash for Life are 1 in 2,713,200 in Game No. 1167 [OLG, 2015a] and 1 in 1,537,480 in Game No. 1171 [OLG, 2015b]; see Table 1 for complete prize odds). We believe that these samples offer a close approximation to that of the overall game, and can therefore be used with confidence to examine the frequency of occurrence of jackpot symbols, and near-miss

Table 1  
*Prize structure comparison between sample A and sample B Cash for Life scratch cards*

Sample A(Game No. 1167)	Odds (1 in)	Sample B(Game No. 1171)	Odds (1 in)
\$800,000*	2,713,200.00	\$850,000*	1,537,480.00
\$50,000	8,139,600.00	\$100,000	7,687,400.00
\$10,000	8,139,600.00	\$10,000	3,074,960.00
\$5,000	8,139,600.00	\$1,000	1,537,480.00
\$1,000	8,139,600.00	\$500	1,537,480.00
\$500	1,627,920.00	\$50	7,001.28
\$50	3,499.40	\$20	35.00
\$20	22.73	\$12	30.34
\$12	756.75	\$7	20.09
\$10	756.75	\$4	9.22
\$6	27.67	-	-
\$4	8.96	-	-

Note. \* Cash for Life prize. Information adapted from OLG (2015a & 2015b).

Table 2  
*Payback percentage and odds comparison between all cards and sample cards*

Parameter	Sample A(Game No. 1167)	Sample B(Game No. 1171)
Published Payback %	65.85	67.76
Payback % minus Cash for Life	58.48	53.94
Sample Payback %	40.24	50.41
Published Overall Odds (1 in)	3.98	3.93
Sample Overall Odds (1 in)	5.86	2.73

outcomes involving these symbols. Table 2 summarizes the differences between the samples and overall published characteristics for each set of cards.

## Results

### Overrepresentation of the Jackpot Symbol

As previously described, prizes in these games are won when three identical symbols appear in the same game matrix of a card (see Figure 1); hence, a near-miss to the jackpot occurs when two of the LIFE symbols appear in the same matrix. The LIFE jackpot symbol has a frequency of 15% to 16% in our cards from both games, much more often than would be expected if jackpot symbols were chosen at the same frequency of any other game symbol. In sample A, which was based on an aggregate of 41 cards, there was a total number of 1,722 symbols (41 cards x 42 symbols per card). Given a uniform distribution, each symbol should occur approximately 143.5 times (1,722 total symbols / 12 possible game symbols). In contrast, the LIFE symbol

occurred a total of 257 times in this sample. A chi-square test of independence confirmed an overrepresentation of LIFE symbols,  $\chi^2(1) = 89.77, p < .001$ . The same overrepresentation was also found for sample B (61 cards, 42 symbols per card, 10 possible game symbols),  $\chi^2(1) = 86.42, p < .001$ . This overrepresentation is clearly exemplified in Figures 2 and 3, which shows the number of occurrences of each symbol type within the card samples; overwhelmingly, the LIFE symbol is the most common symbol in both card samples. We statistically verified this overrepresentation by comparing the number of observed LIFE symbols to the next most common occurring symbol. The two most common symbols in sample A were the LIFE symbol (which occurred 257 times) and the \$6.00 symbol (which occurred 152 times). A chi-square test of independence confirmed that the LIFE symbol occurred significantly more often than the next most common symbol (the \$6.00 symbol),  $\chi^2(1) = 72.53, p < .001$ . Again, this overrepresentation was confirmed in sample B, in which the second most common symbol was the \$4.00 symbol (occurring 256 times),  $\chi^2(1) = 86.72, p < .001$ .

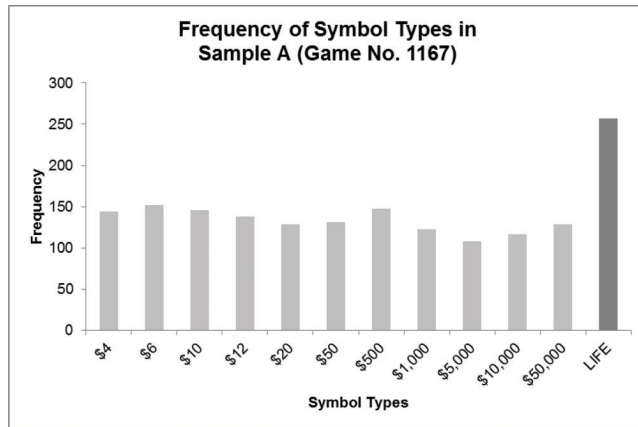


Figure 2. The number of symbol occurrences for each symbol type in sample A (Game No. 1167).

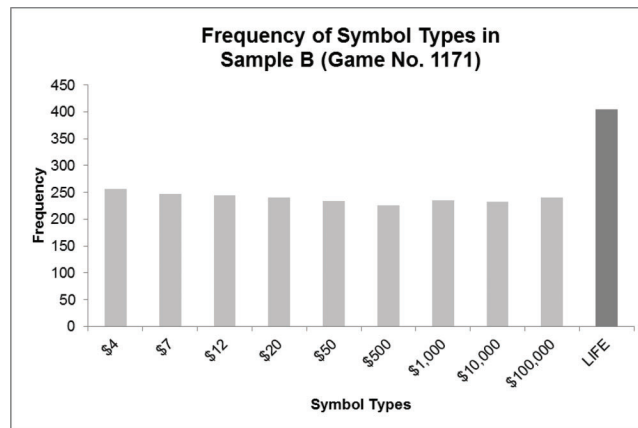


Figure 3. The number of symbol occurrences for each symbol type in sample B (Game No. 1171).



### Clustering Symbols to Create Near-Misses

In addition to verifying that the jackpot symbol appears more often than any other symbol, we also assessed whether it also appears disproportionately often in pairs (i.e., in a near-miss configuration). We calculated how often we would expect to see a near-miss to the jackpot (i.e., two LIFE symbols within a game) on Cash for Life cards. This calculation assumed that the frequency of the LIFE symbol was 15% (taken from our previous analysis), and that the occurrence of each game symbol was independent of the occurrence of every other symbol. In Games 1 and 2, with 9 symbols, we would expect to see near-misses 26% of the time (this is calculated as  $\binom{9}{2} \times .15^2 \times .85^7$ ). In Game 3, with 12 symbols, we would expect to see near-misses 29% of the time. In Games 4 and 5, with 6 symbols, we would expect a near-miss 18% of the time. The expected number of jackpot near-misses per card, thus, would be 1.16 (or  $.26 \times 2 + .29 + .18 \times 2$ ; the slight difference is because of rounding) if the symbols were chosen just with an overall frequency of 15% for the jackpot symbol. In fact, we see more than twice this many near-misses (2.44 per card on Game No. 1167, and 2.63 on Game No. 1171). For Game 1 and 2, the density of near-misses is strongly significant,  $p < .01$ , using the Chernoff bound (Dubhashi & Panconesi, 2009); for Game 3, the frequency of near-misses has a  $p$  value of less than  $10^{\Delta-6}$ , and for Games 4 and 5, the  $p$  value is less than  $10^{\Delta-14}$ . As such, we can confidently assert that these games are designed to have a disproportionately large number of near-misses to the jackpot.

A similar analysis that makes clear this clustering of top prize symbols is a comparison between the number of LIFE symbol pairs and the next most frequently occurring pair of symbols across each set of cards. For sample A, the next most common symbol pair was \$6.00, with 38 total pairs in the sample. LIFE pairs, which occurred 100 times in this sample of cards, occurred significantly more frequently than \$6.00 pairs,  $\chi^2(1) = 101.16$ ,  $p < .001$ . This was also true for the sample B cards, in which the next most common symbol pair was \$50.00 with 61 occurrences overall. This is in comparison to 162 LIFE symbol pairs within this card sample. LIFE pairs occurred significantly more often than \$50.00 pairs,  $\chi^2(1) = 167.23$ ,  $p < .001$ . The inflation of LIFE symbol pairs compared to the other symbol type pairs in both samples of cards are shown in Figures 4 (sample A cards) and 5 (sample B cards).

### Discussion

The results of our analysis indicate that the symbol arrangements on Cash for Life cards are likely manipulated to include more near-miss outcomes than would be expected by chance alone. Specifically, the jackpot symbol (LIFE) occurred more often than any other symbol in the game (15% of all symbols). Additionally, near-misses are facilitated by the clustering of LIFE symbols in pairs, with more LIFE pairs occurring in each sample of cards compared to any other symbol type, and more than would be expected given position-independent symbol arrangements.

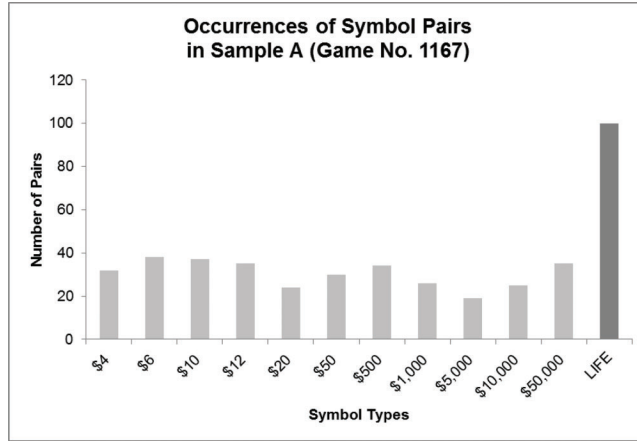


Figure 4. The number of occurrences of symbol pairs for each symbol type in sample A (Game No. 1167).

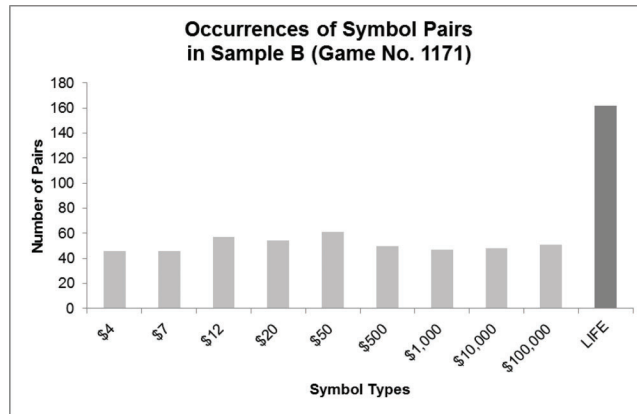


Figure 5. The number of occurrences of symbol pairs for each symbol type in sample B (Game No. 1171).

Crucially however, this overrepresentation does not extend to triplets (which would lead to the jackpot prize). Indeed, the extreme rarity of the top prize when juxtaposed with the extremely high frequency of the individual life symbols strongly suggests that the symbol arrangements are manipulated by design. Specifically the arrangements appear to be manipulated to increase the number of near-misses that a player experiences in the Cash for Life game series.

Why would scratch card games be manipulated to include more of these outcomes? Studies examining the player experiences of near-miss outcomes, as previously discussed, may help to elucidate an answer. These types of outcomes exert strong effects on a player’s physiological arousal (Stange et al., 2016, 2017). When players experience a near-miss, the autonomic nervous system is activated such that a cascade of physiological changes occur: skin conductance increases, heart rate rises, and the player becomes aroused. Gambling researchers have long considered this

physiological arousal, common to virtually all forms of gambling, to be the primary reinforcer of gambling behaviour (Brown, 1986): the feeling that encourages the gambler to keep gambling. Following a winning outcome, this excitement is inevitable, and indeed, scratch card players react to wins with increased physiological arousal—but what about increased arousal for losing outcomes? Near-misses, although they are monetary losses, are capable of creating this type of arousal, thus potentially reinforcing the player for losing and encouraging further play through monetary loss. In addition to this increase in arousal, near-miss outcomes also fuel player frustration from having just narrowly missed a large prize. Although resulting in the same net loss, near-misses are consistently rated as a more frustrating outcome type when compared to regular losses that do not involve a near-miss (Stange et al., 2016, 2017). This frustration and increase in physiological arousal may then influence a player’s desire to continue gambling and his or her subsequent gambling behaviour. In a study examining player purchasing behaviour, it was found that players who experienced a near-miss not only experienced a greater urge to continue gambling than those who experienced a regular loss, but also produced a strong positive correlation between this urge and later purchasing of additional scratch cards. The same relationship was not found with players who experienced regular losses (Stange et al., in press).

Additionally, a behavioural study examining the effect of “nearly winning” (i.e., obtaining a near-miss) on consumer behaviour reported that participants who came close to winning on a symbol matching task walked faster towards an unrelated reward, compared to those who did not come close (Wadhwa & Kim, 2015). Taken together with findings from the slot machine literature that suggest that near-miss outcomes encourage further gambling behaviour (Kassinove & Schare, 2001; Côté et al., 2003), we find the overrepresentation of LIFE symbols to create near-misses in scratch cards particularly worrisome. Specifically, these results highlight the potential for near-miss outcomes in scratch cards to affect player behaviour, resulting in more time and money being spent on these games. While this may be of benefit to the operator who profits from sales, the player is surely the one being shortchanged.

### **Limitations**

Limitations of the current design include the smallness of the sample from which we had to draw. Considering the fact that scratch cards are printed in batches of millions of cards, using a larger sample would allow us to be more confident in our analyses and results.

### **Conclusion**

In conclusion, the results of our investigation suggest that the similarities between slots and scratch cards do not stop at the mere occurrence of near-miss outcomes; rather, it appears that scratch card games are also manipulated to facilitate the occurrence of near-miss outcomes. However, the exact strategy and motive for accomplishing such a goal remains unknown.

## References

- Ariyabuddhiphongs, V. (2011). Lottery gambling: A review. *Journal of Gambling Studies*, 27, 15–33. doi:10.1007/s10899-010-9194-0
- Brown, R. I. F. (1986). Arousal and sensation-seeking components in the general explanation of gambling and gambling addictions. *International Journal of the Addictions*, 21(9–10), 1001–1016. doi:10.3109/10826088609077251
- Clark, L., Crooks, B., Clarke, R., Aitken, M. R., & Dunn, B. D. (2012). Physiological responses to near-miss outcomes and personal control during simulated gambling. *Journal of Gambling Studies*, 28, 123–137. doi:10.1007/s10899-011-9247-z
- Clark, L., Lawrence, A. J., Astley-Jones, F., & Gray, N. (2009). Gambling near-misses enhance motivation to gamble and recruit win-related brain circuitry. *Neuron*, 61, 481–490. doi:10.1016/j.neuron.2008.12.031. Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2658737>
- Clark, L., Liu, R., McKavanagh, R., Garrett, A., Dunn, B. D., & Aitken, M. R. (2013). Learning and affect following near-miss outcomes in simulated gambling. *Journal of Behavioral Decision Making*, 26, 442–450. doi:10.1023/A:1026384011003
- Côté, D., Caron, A., Aubert, J., Desrochers, V., & Ladouceur, R. (2003). Near wins prolong gambling on a video lottery terminal. *Journal of Gambling Studies*, 19, 433–438.
- Dixon, M. J., Harrigan, K. A., Jarick, M., MacLaren, V., Fugelsang, J. A., & Sheepy, E. (2011). Psychophysiological arousal signatures of near-misses in slot machine play. *International Gambling Studies*, 11, 393–407. doi:10.1080/14459795.2011.603134. Retrieved from: [https://uwaterloo.ca/reasoning-decision-making-lab/sites/ca.reasoning-decision-making-lab/files/uploads/files/DixHarJarFugShe\\_2011.pdf](https://uwaterloo.ca/reasoning-decision-making-lab/sites/ca.reasoning-decision-making-lab/files/uploads/files/DixHarJarFugShe_2011.pdf)
- Dixon, M. J., MacLaren, V., Jarick, M., Fugelsang, J. A., & Harrigan, K. A. (2013). The frustrating effects of just missing the jackpot: Slot machine near-misses trigger large skin conductance responses, but no post-reinforcement pauses. *Journal of Gambling Studies*, 29, 661–674. doi:10.1007/s10899-012-9333-x
- Dubhashi, D. P., & Panconesi, A. (2009). *Concentration of measure for the analysis of randomized algorithms*. New York, NY: Cambridge University Press.
- Griffiths, M. (1995). *Adolescent gambling*. London, UK: Routledge.
- Griffiths, M. (1997). The national lottery and scratchcards: A psychological perspective. *Psychologist Bulletin of the British Psychological Society*, 10, 23–26.

- Retrieved from: [http://www.academia.edu/429695/Griffiths\\_M.D.\\_1997\\_.The\\_National\\_Lottery\\_and\\_scratchcards\\_A\\_psychological\\_perspective.The\\_Psychologist\\_Bulletin\\_of\\_the\\_British\\_Psychological\\_Society\\_10\\_23-26](http://www.academia.edu/429695/Griffiths_M.D._1997_.The_National_Lottery_and_scratchcards_A_psychological_perspective.The_Psychologist_Bulletin_of_the_British_Psychological_Society_10_23-26)
- Griffiths, M. (2002). Are lottery scratch cards a “hard” form of gambling? *Journal of Gambling Issues*, 7. doi:10.4309/jgi.2002.7.8. Retrieved from: <http://jgi.camh.net/doi/abs/10.4309/jgi.2002.7.8>
- Harrigan, K. A. (2007). Slot machine structural characteristics: Distorted player views of payback percentages. *Journal of Gambling Issues*, 20, 215–234. doi: 10.4309/jgi.2007.20.7. Retrieved from: <http://jgi.camh.net/doi/pdf/10.4309/jgi.2007.20.7>
- Harrigan, K. A. (2009). Slot machines: Pursuing responsible gaming practices for virtual reels and near misses. *International Journal of Mental Health and Addiction*, 7, 68–83. doi:10.1007/s11469-007-9139-8. Retrieved from: <http://stoppredatorygambling.org/wp-content/uploads/2012/12/Slot-Machines-Pursuing-Responsible-Gaming-Practices-for-Virtual-Reels-and-Near-Misses.pdf>
- Kassinove, J. I., & Schare, M. L. (2001). Effects of the “near miss” and the “big win” on persistence at slot machine gambling. *Psychology of Addictive Behaviors*, 15, 155. doi:10.1037//0893-164X.15.2.155
- Ontario Lottery and Gaming Corporation (2015a). *Player's guide fact sheet, Cash For Life, INSTANT Lottery Game No. 1167*. Retrieved from: <https://www.olg-wp.ca/instantgames/wp-content/uploads/sites/23/2015/12/CASH-FOR-LIFE-Game-No.-1167.pdf>
- Ontario Lottery and Gaming Corporation (2015b). *Player's Guide Fact Sheet, Cash For Life, INSTANT Lottery Game No. 1171*. Retrieved from: <https://www.olg-wp.ca/instantgames/wp-content/uploads/sites/23/2015/12/CASH-FOR-LIFE-Game-No.-1171.pdf>
- Ontario Lottery and Gaming Corporation (2016). *2014–15 Annual report*. Sault Ste. Marie, ON: OLG. Retrieved from: [http://www.olg.ca/assets/documents/annual\\_report/annual\\_report\\_14-15.pdf](http://www.olg.ca/assets/documents/annual_report/annual_report_14-15.pdf)
- Reid, R. L. (1986). The psychology of the near miss. *Journal of Gambling Behavior*, 2, 32–39. Retrieved from: [https://www.stat.berkeley.edu/~aldous/157/Papers/near\\_miss.pdf](https://www.stat.berkeley.edu/~aldous/157/Papers/near_miss.pdf)
- Rogers, P. (1998). The cognitive psychology of lottery gambling: A theoretical review. *Journal of Gambling Studies*, 14, 111–134. doi:10.1023/A:1023042708217
- Short, M. M., Penney, A. M., Mazmanian, D., & Jamieson, J. (2015). Lottery ticket and instant win ticket gambling: Exploring the distinctions. *Journal of Gambling Issues*, 30, 6–21. doi:10.4309/jgi.2015.30.4

Stange, M., Grau, M., Osazuwa, S., Graydon, C., & Dixon, M. J. (2017). Reinforcing small wins and frustrating near-misses: Further investigation into scratch card gambling. *Journal of Gambling Studies*, *33*, 47–63. doi:10.1007/s10899-016-9611-0

Stange, M., Graydon, C., & Dixon, M. J. (2016). “I was that close”: Investigating gamblers’ reactions to losses, wins, and near-misses on scratch cards. *Journal of Gambling Studies*, *32*, 187–203. doi:10.1007/s10899-015-9538-x

Stange, M., Graydon, C., & Dixon, M. J. (in press). Increased urge to gamble following near-miss outcomes may drive purchasing behaviour in scratch card gambling. *Journal of Gambling Studies*. doi:10.1007/s10899-016-9662-2

Turner, N., & Horbay, R. (2004). How do slot machines and other electronic gambling machines really work? *Journal of Gambling Issues*, *11*. Retrieved from: <http://jgi.camh.net/doi/full/10.4309/jgi.2004.11.21>

Wadhwa, M., & Kim, J. C. (2015). Can a near win kindle motivation? The impact of nearly winning on motivation for unrelated rewards. *Psychological Science*, *26*, 701–708. doi:10.1177/0956797614568681

\*\*\*\*\*

Submitted August 5, 2016; accepted February 5, 2017. This article was peer reviewed. All URLs were available at the time of submission.

Madison Stange, BA (Hons.), Department of Psychology, University of Waterloo, 200 University Avenue West, Waterloo ON, Canada. Email: [mstange@uwaterloo.ca](mailto:mstange@uwaterloo.ca).

Competing interests: None declared.

Ethics approval: Not required.

Acknowledgements and Funding: We would like to thank Paula Parejo, Sai Kalvapalle, and Arielle Levy for their assistance with data collection and entry.