

# EVIDENCE BRIEF

---

The effect and regulation of electronic gaming machine near misses and losses disguised as wins (LDWs) on the player

Date: April 29, 2016

Report prepared by:

Kevin Harrigan, PhD

Dan Brown, PhD

Jackie Stapleton

Kevin Barton, PhD

Amin Yazdani, PhD

Nadina Ayer, MA, PhD Candidate

Sarah Brown

Sai Kalvapalle, BA (Hons)

Gambling Research Lab

University of Waterloo

200 University Avenue West

Waterloo, Ontario, Canada

N2L 3G1

# About This Evidence Brief

---

This brief was created by researchers in the Gambling Research Lab at the University of Waterloo to serve as a basis for the discussion of current regulations surrounding the effects of near misses and losses disguised as wins (LDWs) on players. This brief includes a state-of-the-art understanding of this topic developed from a systematic review of research performed over the last quarter century, and includes:

- What is known about near misses
- What is known about LDWs
- Possible options to address the problem created by near misses and LDWs

As our intent is to inform policy makers based on current research evidence, we have listed suggested options but have avoided making specific recommendations on what the best course of action may be.

# Table of Contents

---

<b>Key Messages</b> .....	1
<b>The context: Regulations allow the presence of near misses and LDWs in Ontario</b> .....	1
What are near misses and are they legal in Ontario? .....	2
What are losses disguised as wins (LDWs)?.....	4
<b>The problem: Near misses and LDWs.....</b>	<b>7</b>
<b>appear to deceive players.....</b>	<b>7</b>
SUMMARY OF THE EVIDENCE ON THE EFFECTS OF NEAR MISSES .....	7
How do near misses affect the players? .....	7
Why do players react in this way to near misses? .....	8
Does the way an EGM presents wins and losses produce the near miss effect? NO.....	9
Do problem gamblers react differently to near misses? .....	9
SUMMARY OF THE EVIDENCE ON THE EFFECTS OF LDWS.....	10
How do LDWs affect the player? .....	10
Why are LDWs reacted to this way? .....	10
Do problem gamblers react to LDWs differently?.....	11
GENERAL CONCLUSIONS FROM THE SYSTEMATIC REVIEW OF RESEARCH.....	11
<b>Options: How Can We Address The Problem? .....</b>	<b>12</b>
Option 1 – Ban near misses and LDWs on EGMs.....	12
Option 2 – Study the efficacy of the ban on near misses and LDWs on EGMs in Queensland and Tasmania.....	12
Option 3 – Study the “best practices” in EGM regulations worldwide to document efforts to address near misses and LDWs on EGMs. ....	13
Option 4 – Conduct further Knowledge Translation and Exchange efforts related to near misses and LDWs on EGMs. ....	13
<b>References.....</b>	<b>14</b>

# Key Messages

## What is the problem?

A considerable body of research exists on the effects of certain Electronic Gaming Machine (EGM) features: near misses (the product of the use of weighted reels) and losses disguised as wins (LDWs). We present here the results of a **systematic review of the effect of near misses and LDWs on the player**, synthesizing the results of **51 peer reviewed scientific studies** (40: near misses; 10: LDWs; 1: both) on the effects of near misses and LDWs on the player. The key findings are:

Near Misses	LDWs
The <b>mere presence</b> of near misses is consistently shown to <b>motivate continued play, despite their status as a loss.</b>	The <b>mere presence of LDWs</b> causes players to <b>greatly overestimate the amount that they are winning</b> across a play session.
Near misses <b>arouse or excite the player</b> , driven by brain activity in regions related to <b>reward, despite their status as a loss.</b>	The feedback, particularly <b>the auditory feedback</b> provided by EGMs when winning, causes players to <b>view LDWs as an actual win</b> , despite actually losing money.
The <b>effect of near misses</b> is not the product of reinforcing sounds, animations, or images, but is instead <b>driven by their presence, alone.</b>	

In both cases, the consensus of decades of research is that both near misses and LDWs are **misunderstood by the regular, healthy, player, encouraging continued play by discouraging viewing a true loss as a loss.** At present, it is unclear if these mechanisms have a different effect on at-risk or problem gamblers.

## The context: Regulations allow the presence of near misses and LDWs in Ontario

Features like near misses (through such mechanisms as variation in symbol size, weighted reels, and asymmetric reels) and LDWs are potentially misleading or harmful to the player. However, to date, no large scale studies exist of their effect on the player.

To address this issue, we systematically reviewed the research literature of how near misses and LDWs influence the player. We defined a comprehensive set of search terms (such as “near misses”, “near wins”, “close wins”, etc.) and used these search terms to identify all relevant research. We initially identified 802 potentially relevant research articles using these search terms and proceeded to examine the titles, abstracts, and eventually full text, to determine which of these articles presented experimental data on the effects of near misses and LDWs. We identified 51 articles (40: near misses; 10: LDWs; 1: both) investigating these phenomena, from 1990 to 2015, and emerging from a number of different countries (particularly Australia, Canada, the United Kingdom, and the United States of America). We sought to synthesize the relevant psychological, physiological, and behavioural effects on players, to provide a current and clear description of how the properties of near misses and LDWs delivered by EGMs may influence players.

## What are near misses and are they legal in Ontario?

A near miss is an outcome of an EGM that appears to be very close to that of a win, but fails to result in a win. A simple 3-reel near miss is presented in Figure 1.



**Figure 1.** An example of a 3-reel near miss on the third (right-most) reel, above the payline.

In Figure 1 the player does not win the jackpot with triple Blazing 7s because one of the Blazing 7s is above the payline. A similar type of near miss can occur in more modern EGMs as shown in Figure 2. In the game in Figure 2, three or more bells from the left results in the jackpot win. Reel three is starved of bells and thus the player sees three bells on the line but it is a non-winning spin – a near miss.



**Figure 2.** An example of a near miss on a modern multiline EGM. A near miss has occurred as 3 adjacent bell symbols from the left are required to win a jackpot, but the third (middle) reel on the top line is instead grapes, while the fourth reel is a bell, creating the impression of a near miss.

Ontario currently has several regulations in place designed to address the presence of near misses, in the *Electronic Gaming and Equipment Minimum Technical Standards* put forward by the Alcohol and Gaming Commission of Ontario. These standards include one regulation intended to educate the player about EGM outcomes (regulation 2.1.10):

“The following statement must be clearly visible to the player on each machine:  
The game display does not indicate how close you were to winning, and cannot necessarily be used to determine your chances of winning or losing if you continue to play”,

and one regulation preventing artificial injection of near misses through a secondary decision (regulation 14.3.1):

“After the selection of game outcome, the gaming equipment must not make a variable secondary decision which affects the result shown to the player. For instance, the random number generator (RNG) chooses an outcome that the game will lose. The game must not substitute a particular type of loss to show to the player.”<sup>1</sup>

Other EGM regulations limit the frequency at which near misses will be encountered during play (regulation 20.4.1 through 20.4.3):

“20.4.1: Games with reels must meet the following requirements for each of the game’s reels:

- a) For single-line games, jackpot symbols may not appear in their entirety more than 12 times, on average, adjacent to the payline, for every time they appear on the payline;

b) For multi-line games, jackpot symbols must not appear in their entirety more than 12 times, on average, not on any payline, for every time they appear on any payline; and

c) All symbols, including blanks, must each occupy a space with a minimum length of  $(L/N)*0.4$  and maximum length of  $(L/N)*1.6$ , where L is the length of the physical reel strip and N is the number of physical stops on the reel strip. Each symbol must not overlap the space of any other adjacent symbol, including blanks.

20.4.2: All blank and non-blank symbols must be centered in their respective space allocation.

20.4.3: If virtual reels that map to displayed reels are used, each of the reel stops of the virtual reel strip shall be mapped to a displayed symbol and shall have the same probability of occurring (e.g., if the virtual reel consists of N positions, the probability of occurrence of each position must be  $1/N$ ). There cannot be any displayed symbol with a virtual reel weight of zero; all displayed reel symbols must have a non-zero probability to occur.”

Although regulations 20.4.1a and 20.4.1b indicate that the number of near misses is limited to occur up to 12 times more often than they would by chance alone, this limitation effectively allows near misses to occur more often than by chance alone. Additionally, 20.4.1c allows jackpot symbols to be four times larger than blanks, and we see an example of this in Figure 1 where the jackpot “Blazing 7” symbols are much larger than the blanks. This increases the likelihood that at least part of a jackpot symbol will be visible above or below the payline within a reel, each time the EGM is played.

Regulations 20.4.1a, 20.4.1b, and 20.4.1c only apply to older-style single-line EGMs because in modern multiline slots there are no symbols above or below the payline – because players can wager on many lines and thus every symbol is on one or more paylines. In these modern games the layout of the symbols on the five reels can be designed so that one of the reels, usually the third reel, is “starved” of the jackpot symbol so that the player may see multiple jackpot symbols when the spin comes to a rest but the result of the play is a loss. An example of this is shown in Figure 2. Ontario has no regulations related to starved reels (which can also be referred to as asymmetric reels), thus allowing the manufacturers to create near misses using asymmetric reels.

### **What are losses disguised as wins (LDWs)?**

Losses disguised as a wins (LDWs) occur on the modern multiline EGMs. When playing a multiline EGM, the player selects a set of paylines that span the reels of the game in different ways. For each payline that the player bets on, the player is charged a certain amount of credits or money. Critically, selecting more than one payline increases the likelihood that at least one winning combination of symbols will be encountered, producing more wins during play. However, as is the case in Figure 3, by betting on more lines, the win is often of less value than the total player bet. In Figure 3 the player has wagered 75 credits and has “won” 30 credits, which is a net loss of 45 credits. Despite losing money, the machine celebrates the successful combination(s) of matching symbols in Figure 3 as a win, often with a litany of sound and animated feedback, creating an exciting win-like event, effectively creating a **loss disguised as win**.



**Figure 3.** A depiction of a loss disguised as win. In this game, the player is able to bet on more than one line at once. The player has selected 15 lines (not depicted in the figure), each costing 5 credits. After spinning, the reels have stopped, resulting in a win for 3 watermelon symbols and awarding 30 credits, highlighted in purple. Despite presenting the 30 credits as a win, the win is worth 45 credits less than the amount wagered, making this a *loss disguised as win*.

Presently, Ontario addresses how **betting** and **wins** are displayed to players, but not how losses are presented to a player. Regulation 14.1.8 states (emphasis added by authors of this report):

“The following information must be clearly displayed on the gaming equipment:

- a) Prior to committing a wager and at any time a game outcome is displayed during game play, each **individual bet option relevant to the game (e.g. line to be played, bet amount to be wagered, denomination being played)** so that the player is in no doubt as to which bet options are being played;
- b) **After the game is completed** and until the player interacts with the game (e.g., wager placed, wagering instrument accepted, game/denomination selected) or the game enters an attract mode, the **player options** selected (e.g., bet amount, lines played, denomination being played) and **the amount won** for each individual bet for the last complete game;
- c) Whenever the player redeems credits, the **number of credits paid** (until the player interacts with the game or the game enters an attract mode); and
- d) The winning combinations, (e.g., payline(s) on a video game this may be accomplished by drawing a line over the symbols on the payline(s) and/or the flashing of winning symbols and

line selection box. Where there are wins on multiple lines, **each winning payline may be indicated in turn**). If a progressive was awarded, it is sufficient to indicate the progressive was awarded and not display the value.”

No regulations exist **on how losses must be displayed** or presented to the player, allowing LDWs to be treated as a win state of the game.

# The problem: Near misses and LDWs appear to deceive players

## SUMMARY OF THE EVIDENCE ON THE EFFECTS OF NEAR MISSES

We summarized forty-one studies related to near misses in our systematic review.

How do near misses affect players?	
1. Are near misses perceived as losses?	<b>NO</b> , near misses are <b>viewed favourably</b> by players.
2. Are near misses frustrating to the player?	<b>NO</b> , players <b>reported feeling more motivated to continue playing</b> , despite their position as a loss.
3. Do near misses affect the player's emotions?	<b>YES</b> , Near misses are <b>less pleasant than losses</b> .
4. Do near misses change how the player will play during a session?	<b>YES</b> , Near misses <b>do not change betting behaviour</b> after each spin, but <b>do encourage longer play</b> on a game featuring near misses.
Why are near misses reacted to this way?	
	Near misses are physiologically <b>arousing – exciting or frustrating – events</b> .
	Near misses are treated by players' brains as <b>unexpected negative events</b> .
	Near misses recruit parts of the brain related to <b>reward, reinforcement and implicated in addiction</b> .
Is the way an EGM presents wins and losses what produces the effect of near misses?	
	<b>NO</b> , the effect of near misses is caused by the near misses <b>regardless of how they were produced</b> by the EGM.
Do problem gamblers react differently to near misses than regular players?	
	<b>Evidence is inconclusive.</b>

### How do near misses affect the players?

#### 1. Are near misses perceived as losses? **NO...**

Four studies explored whether near misses are falsely perceived as wins. Optimists were found to over-estimate the number of wins when near misses were present in an EGM game<sup>2</sup>, and players responded to<sup>3,4</sup> or rated near misses<sup>5</sup> similar to that of a true win while gambling.

## **2. Are near misses frustrating to the player? NO...**

The effect of near misses on the emotional experience of the player was investigated in 17 studies. The presence or number of near misses were found to be associated with persistence or desire to continue playing in seven studies<sup>6-12</sup>. Only one study found that wins, rather than near misses, were motivated to continued play<sup>13</sup>. Two studies that investigated the influence of perceived luckiness on gambling behaviour found that encountering a near miss increased the perception that the player was lucky<sup>14,15</sup> and was not found to relate to how much the player bet on playing the game.

## **3. Do near misses affect the player emotionally? YES...**

As far as the effect of near misses on the experience of negative thoughts, two studies found that near misses before<sup>7</sup> or after<sup>16</sup> the payline were experienced as aversive or unpleasant. Either form of near miss (above or below the payline) were found to be rated as not as rewarding in one study<sup>17</sup>. Four studies found that near misses were experienced as less pleasant than full, unambiguous losses<sup>18-21</sup>. Near misses were also shown to be associated with a higher rating of impulsiveness and willingness to engage in risky behaviour<sup>22</sup>.

## **4. Do near misses change how a person will gamble during a session? YES...**

The presence of near misses was not found to influence the reels selected by players to lock or hold in place in one study<sup>10</sup> and participants were not found to be able to differentiate between EGM games offering more frequent or less frequent near misses in two studies<sup>23,24</sup>. The effect on the amount bet on the next immediate game was inconsistent across several studies, with two studies showing no effect on betting behaviour<sup>6,14</sup>, one study showing a tendency to bet less on the next game<sup>25</sup>, and one study showing the tendency to increase the amount bet<sup>26</sup>. Players encountering near misses were also found to play 33% more games than those playing on an EGM with no near misses in one study<sup>27</sup>. A small number of near misses – 30% – were associated with the highest persistence in gambling in one study<sup>28</sup>.

## **Why do players react in this way to near misses?**

One way to understand how near misses cause players to play EGMs longer is to investigate their physiological reaction to near miss events. We can examine how arousing or exciting a near miss is through recording of skin conductance level (SCL), examine the type of brain activity in real-time during a near miss to characterize how they are perceived (through a technique called electroencephalography, EEG), and by investigate how the brain treats near misses (by imaging changes in blood flow in the brain using functional Magnetic Resonance Imaging, fMRI). Each approach provides us with information on the mechanisms driving player's reactions when playing EGMs, often in ways that are too subtle for players to consciously report.

## **Do near misses physiologically arouse or excite a player? YES...**

Eleven studies were found to investigate the effect of how arousing a near miss event is through skin conductance level. In general, near misses were associated with an elevated skin conductance level in ten studies<sup>9-11,16,18,21,29-32</sup>; one study disagreed and suggested this was only true for wins<sup>33</sup>. Two of those studies found that a higher skin conductance was found for near misses occurring after the payline than those occurring prior to the payline<sup>10,16</sup>. Taken as a

whole, near misses appear to increase the level of arousal or excitement felt by the player immediately following one.

### **How does the brain treat near misses?**

EEG reveals that associated near misses with brain activity related to the processing of an unexpected event – termed feedback related negativity (FRN). Higher FRN was found in loss and near miss cases<sup>13,17,34</sup>. Increased activity related to decision making and choice (signals known as P300 and P3b) was found following near misses in two studies<sup>17,26</sup>. Both these type of brain signals have been shown to relate to how the brain treats certain activities or interactions as reinforcing or punishing<sup>35</sup>.

Finally, encountering a near miss during play was found to relate to areas important in reward processing and the development of chronic addictions through fMRI<sup>5,20,36</sup>, and increased activity was observed in brain areas with pathological gambling in one study<sup>37</sup>. One study also revealed that when patients who had damage to one specific brain area known to be important in rewarding behaviour (and revealed by the aforementioned studies; termed the insula or insular cortex) showed no response or change in behaviour related to near miss events<sup>8</sup>.

### **Does the way an EGM presents wins and losses produce the near miss effect? NO...**

Having established that near misses increase motivation to play and experienced levels of arousal and reward processing, we investigated whether a specific type of feedback was necessary to elicit this effect. Of the 41 published studies, 13 provided feedback by displaying "You win!" or "You lose!" on the screen, 6 displayed a visual change or animation on the screen, 3 provided a physical payout to the participant on wins, and 18 did not indicate the method of feedback clearly. We see no systematic connection between the way in which the game presented wins and losses to players and the effects on behaviour, emotions, arousal, or brain activity discussed previously. This suggests that the effect of near misses is one that is specific to encountering a near miss or near win, not how the machine functions.

### **Do problem gamblers react differently to near misses?**

Of the studies investigating near misses, only seven assessed the role of problem gambling in the observance of the phenomenon, in all cases assessed through the use of the Problem Gambling Severity Index (PGSI). Problem gamblers reported higher levels of feelings of control following near misses<sup>5</sup> and showed higher levels of arousal in response to a near miss event<sup>38</sup>. Activity in the brain was not found to differ between problem gamblers and non-problem gamblers in response to near misses<sup>34</sup> but increased use of brain areas implicated in pathological gambling was observed in one study<sup>37</sup> and did not differ in another study<sup>39</sup>. Two studies assessed problem gambling but did not appear to investigate differences<sup>21,29</sup>. Consequently, little conclusive evidence appears to exist at this time to show a differential effect of near misses on pathological gamblers.

## SUMMARY OF THE EVIDENCE ON THE EFFECTS OF LDWS

---

We summarized eleven studies related to LDWs in our systematic review.

How do LDWs affect players?	
1. Are LDWs viewed as losses?	<b>NO</b> , LDWs cause players to consistently <b>overestimate of how much a player is winning</b> .
2. Are LDWs frustrating or negative to the player?	<b>NO</b> , <b>not on their own</b> .
3. Do LDWs change how the player will play during a session?	<b>YES</b> , players will preferentially play on EGMs offering LDWs.
Why are LDWs reacted to this way?	
	<b>LDWs are arousing, exciting events.</b>
Do problem gamblers react to LDWs differently?	
	<b>Problem gamblers prefer EGMs offering multiline play.</b>

### How do LDWs affect the player?

#### 1. Are LDWs viewed as losses? **NO...**

Six studies found that the mere presence of LDWs caused players to overestimate the number of wins that they had experienced across the entire play session<sup>40-45</sup>. Of these studies, two investigated the role of game sounds on the overestimation of wins, finding that the presence of the real EGM sounds during an LDW experience is what increased the overestimation of wins<sup>41,44</sup>.

#### 2. Are LDWs frustrating or negative to the player? **NO...**

The effect of LDWs on the emotional experience of the player was assessed in only one study<sup>7</sup>, finding that in the presence of both near misses and LDWs, the negative emotional response to near misses was amplified.

#### 3. Do LDWs change how the player will play during a session? **YES...**

Two studies explored whether players preferred to play on EGMs offering LDWs<sup>40,43</sup>. Both studies showed a preference to play on multiline EGMs offering LDWs, with one study indicating that 94% of players preferred these machines<sup>43</sup>.

### Why are LDWs reacted to this way?

The physiological basis driving the emotional response and behaviour to LDWs was assessed in 5 of the 10 studies identified by our review.

Skin conductance, an indicator of arousal or excitement, was found to be similar between a win and a loss disguised as win in one study<sup>41</sup>. The magnitude of the win or loss disguised as win was found to be associated with the size of skin conductance response in three studies<sup>44,46,47</sup>. Two studies explored the role in game sounds in changing the size of skin conductance response and found that the presence of realistic celebratory game sounds was associated with a larger, more aroused response<sup>44,47</sup>.

### **Do problem gamblers react to LDWs differently?**

Only two studies were found to explore the role of problem gambling in the perception and response to LDWs. Of these studies, high risk gamblers were found to prefer play on multiline machines offering the potential for LDWs<sup>43</sup>. Problem gamblers were also shown to respond less, physiologically, to LDWs than non-problem gamblers<sup>48</sup>.

## **GENERAL CONCLUSIONS FROM THE SYSTEMATIC REVIEW OF RESEARCH**

---

There is consensus in the scientific work on both near misses and LDWs that players experience them as reinforcing or rewarding events during gaming sessions. Both near misses and LDWs encourage play by turning a loss during a gambling session into a more exciting type of event – a close call or a 'small win', respectively. The result of each mechanism is a fundamental desire to continue playing, despite incurring ongoing loss.

While the effect of near misses appears more subtle than LDWs, the result of their presence appears the same: turning a loss into an exciting or reinforcing event, instead of a punishing one. But in addition to this, near misses also increase the willingness to engage in risky behaviour, and are systematically related to systems in the brain that are known to either contribute to or eventually cause addiction and persistence of behaviour. All of this was found to be the product of the presence of nearly winning unto itself, and not any specific celebratory or feedback mechanism endemic to EGMs. Clearly, near misses are a mechanism that can effectively and without necessarily the player being aware of it, cause the player to take less notice of their losses during gaming sessions.

Similarly, LDWs appear more strongly related to how the game delivers feedback to the player: the sounds and sights that look like what happens in a win encourage ongoing play. LDWs also distract players from the true outcomes of spins during a gambling session.

# Options: How Can We Address The Problem?

Earlier in this document (pages 2 to 5), we outlined present regulations in Ontario and the ways in which near misses and LDWs are produced within current regulatory statutes. Given the extensive research on how near misses and LDWs are misleading and potentially harmful to players, we now consider how Ontario regulators could address this problem. Rather than put forward recommendations ourselves, we will suggestion options that could be adopted. Note that more than one option could be adopted at the same time.

## **Option 1 – Ban near misses and LDWs on EGMs.**

Ontario could explicitly ban near misses and LDWs in EGMs. Under this sort of approach, any intentionally deceptive gaming mechanism would be forbidden within EGMs.

Two jurisdictions have regulation to ban near misses and LDWs. Queensland in Australia has moved away from a prescriptive/detail-oriented approach to EGM regulation to one that is more principles-based, primarily around harm minimization. In particular, regulation 3.3 of the Australian and New Zealand Gaming Machine National Standards has been interpreted in a manner that has caused Queensland to ban near misses and LDWs:

3.3 "[Games must] Not be misleading, illusory or deceptive – such as a near miss design" <sup>49</sup>.

Additionally, games are regulated to:

"Provide sufficient information to facilitate informed choice"

The Australian state of Tasmania stipulates that LDWs will have their auditory feedback scrutinized and congratulatory messages must be removed prior to receiving approval using the following regulation:

"If the net win of a play is less than the total credit bet any audible affirmation associated with the win will be subject to close regulatory scrutiny, and any display of “congratulatory” messages is prohibited."<sup>50</sup>

## **Option 2 – Study the efficacy of the ban on near misses and LDWs on EGMs in Queensland and Tasmania.**

To our knowledge, there have been no research studies on the efficacy of the ban of near misses and LDWs in Queensland and Tasmania. Ontario could conduct a research study to determine the efficacy of these bans and use the results to inform policy/regulatory decisions regarding near misses and LDWs in Ontario.

### **Option 3 – Study the “best practices” in EGM regulations worldwide to document efforts to address near misses and LDWs on EGMs.**

In this current study we did review regulations in various jurisdictions worldwide including Ontario, Australia and New Zealand, New Jersey, Macau, and Singapore. However, we feel a more systematic and thorough review of regulations worldwide is warranted.

In this current study we did determine the following.

The form of regulation used in Queensland and New Zealand has also been adopted in Macau, one of the world's foremost centres of casino games and EGMs, within the EGM Technical Standards for Macau, enacted July 2014:

"The display of the result of a game outcome must not be misleading or deceptive to the player (e.g. must not improperly indicate a near-miss)"<sup>51</sup>

The New Jersey Division of Gaming Enforcement specifically reduce near miss frequency in Chapter 69E of the Gaming Enforcement Regulations:

“Slot machines shall comply with Division rules for random number generators (RNGs) and shall not permit a symbol above or below the top jackpot symbol to be mapped more than six times more frequently than any other symbol on a reel strip.”<sup>52</sup>

Singapore has adopted a more detailed approach in their Technical Standards for EGMs:

“The use of a [random number generator] shall result in a selection of game symbols or game outcomes that are proven, via the application of recognized statistical tests, to be: a. Statistically independent; b. Uniformly distributed over their range; and c. Unpredictable.”<sup>53</sup>

### **Option 4 – Conduct further Knowledge Translation and Exchange efforts related to near misses and LDWs on EGMs.**

This current study was a Knowledge Translation and Exchange effort in which we systematically reviewed the literature on near misses and LDWs. It has provided a solid evidence-base to inform decision makers in Ontario. There are other Knowledge Translation and Exchange techniques that could be implemented as a follow-up to this current study. For example, a Citizens' Forum could be conducted to gather opinions from the community, and this current document could be used as base material for the Citizens' Forum.

## References

- [1] Alcohol and Gaming Commission of Ontario (2014). *Electronic gaming equipment minimum technical standards, March 2014*.
- [2] Gibson, B., & Sanbonmatsu, D. M. (2004). Optimism, Pessimism, and Gambling: The Downside of Optimism. *Personality and Social Psychology Bulletin*, 30(2), 149-160.
- [3] Dixon, M. R., & Schreiber, J. E. (2004). Near-miss effects on response latencies and win estimations of slot machine players. *Psychological Record*, 54(3), 335-348.
- [4] Dixon, M. R., Nastally, B. L., Jackson, J. E., & Habib, R. (2009). Altering the near-miss effect in slot machine gamblers. *Journal of applied behavior analysis*, 42(4), 913-918.
- [5] Dymond, S., Lawrence, N. S., Dunkley, B. T., Yuen, K. S. L., Hinton, E. C., Dixon, M. R., . . . Singh, K. D. (2014). Almost winning: Induced MEG theta power in insula and orbitofrontal cortex increases during gambling near-misses and is associated with BOLD signal and gambling severity. *NeuroImage*, 91, 210-219.
- [6] Devos, G., Clark, L., Maurage, P., Kazimierzczuk, M., & Billieux, J. (2015). Reduced inhibitory control predicts persistence in laboratory slot machine gambling. *15(3)*, 408-421.
- [7] Sharman, S., Aitken, M. R. F., & Clark, L. (2015). Dual effects of 'losses disguised as wins' and near-misses in a slot machine game. *15(2)*, 212-223.
- [8] Clark, L., Studer, B., Bruss, J., Tranel, D., & Bechara, A. (2014). Damage to insula abolishes cognitive distortions during simulated gambling. *Proceedings of the National Academy of Sciences of the United States of America*, 111(16), 6098-6103.
- [9] Clark, L., Liu, R., McKavanagh, R., Garrett, A., Dunn, B. D., & Aitken, M. R. F. (2013). Learning and Affect Following Near-Miss Outcomes in Simulated Gambling. *Journal of Behavioral Decision Making*, 26(5), 442-450.
- [10] McKavanagh, R., Garrett, A., Dunn, B. D., Aitken, M. R. F., Clark, L., & Liu, R. (2013). Learning and affect following near-miss outcomes in simulated gambling. *Journal of Behavioral Decision Making*, 26(5), 442-450.
- [11] Porchet, R. I., Boekhoudt, L., Studer, B., Gandamaneni, P. K., Rani, N., Binnamangala, S., . . . Clark, L. (2013). Opioidergic and dopaminergic manipulation of gambling tendencies: A preliminary study in male recreational gamblers. *Frontiers in Behavioral Neuroscience(OCT)*.
- [12] Billieux, J., Van der Linden, M., Khazaal, Y., Zullino, D., & Clark, L. (2012). Trait gambling cognitions predict near-miss experiences and persistence in laboratory slot machine gambling. *British Journal of Psychology*, 103(3), 412-427.
- [13] Ulrich, N., & Hewig, J. (2014). A miss is as good as a mile? Processing of near and full outcomes in a gambling paradigm. *Psychophysiology*, 51(9), 819-823.
- [14] Wu, Y., van Dijk, E., & Clark, L. (2015). Near-wins and near-losses in gambling: A behavioral and facial EMG study. *Psychophysiology*, 52(3), 359-366.
- [15] Wohl, M. J. A., & Enzle, M. E. (2003). The effects of near wins and near losses on self-perceived personal luck and subsequent gambling behavior. *Journal of experimental social psychology*, 39(2), 184-191.
- [16] Sharman, S., & Clark, L. (2015). Mixed Emotions to Near-Miss Outcomes: A Psychophysiological Study with Facial Electromyography. *Journal of gambling studies / co-sponsored by the National Council on Problem Gambling and Institute for the Study of Gambling and Commercial Gaming*.
- [17] Lole, L., Gonsalvez, C. J., Barry, R. J., & De Blasio, F. M. (2013). Can event-related potentials serve as neural markers for wins, losses, and near-wins in a gambling task? A principal components analysis. *International Journal of Psychophysiology*, 89(3), 390-398.

- [18] Clark, L., Crooks, B., Clarke, R., Aitken, M. R. F., & Dunn, B. D. (2012). Physiological Responses to Near-Miss Outcomes and Personal Control During Simulated Gambling. *Journal of Gambling Studies*, 28(1), 123-137.
- [19] Qi, S., Ding, C., Song, Y., & Yang, D. (2011). Neural correlates of near-misses effect in gambling. *Neuroscience letters*, 493(3), 80-85.
- [20] 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(3), 481-490.
- [21] Griffiths, M. (1991). Psychobiology of the near-miss in fruit machine gambling. *The Journal of psychology*, 125(3), 347-357.
- [22] Luo, Q., Wang, Y., & Qu, C. (2011). The near-miss effect in slot-machine gambling: Modulation of feedback-related negativity by subjective value. *Neuroreport*, 22(18), 989-993.
- [23] Kurucz, G., & Körmendi, A. (2012). Can We Perceive Near Miss? An Empirical Study. *Journal of Gambling Studies*, 28(1), 105-111.
- [24] Maclin, O. H., Dixon, M. R., Daugherty, D., & Small, S. L. (2007). Using a computer simulation of three slot machines to investigate a gambler's preference among varying densities of near-miss alternatives. *Behavior Research Methods*, 39(2), 237-241.
- [25] Sundali, J. A., Safford, A. H., & Croson, R. (2012). The impact of near-miss events on betting behavior: An examination of casino rapid roulette play. *Judgment and Decision Making*, 7(6), 768-778.
- [26] Alicart, H., Cucurell, D., Mas-herrero, E., & Marco-pallarés, J. (2015). Human oscillatory activity in near-miss events. *Social Cognitive and Affective Neuroscience*, 10(10), 1405-1412.
- [27] 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(4), 433-438.
- [28] 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(2), 155-158.
- [29] 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(4), 661-674.
- [30] Lole, L., Gonsalvez, C. J., Blaszczyński, A., & Clarke, A. R. (2012). Electrodermal activity reliably captures physiological differences between wins and losses during gambling on electronic machines. *Psychophysiology*, 49(2), 154-163.
- [31] 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(3), 393-407.
- [32] Griffiths, M. D. (1990). The cognitive psychology of gambling. *Journal of Gambling Studies*, 6(1), 31-42.
- [33] Wilkes, B. L., Gonsalvez, C. J., & Blaszczyński, A. (2010). Capturing SCL and HR changes to win and loss events during gambling on electronic machines. *International Journal of Psychophysiology*, 78(3), 265-272.
- [34] Lole, L., Gonsalvez, C. J., & Barry, R. J. (2015). Reward and punishment hyposensitivity in problem gamblers: A study of event-related potentials using a principal components analysis. *Clinical Neurophysiology*, 126(7), 1295-1309.
- [35] Holroyd, C. B. C., M. G. H. (2002). The neural basis of human error processing: Reinforcement learning, dopamine, and error-related negativity. *Psychological Review*, 109, 679-709.

- [36] Shao, R., Read, J., Behrens, T. E., & Rogers, R. D. (2013). Shifts in reinforcement signalling while playing slot-machines as a function of prior experience and impulsivity. *Translational psychiatry*, 3.
- [37] Habib, R., & Dixon, M. R. (2010). Neurobehavioral evidence for the "near-miss" effect in pathological gamblers. *Journal of the experimental analysis of behavior*, 93(3), 313-328.
- [38] Harrigan, K., Dixon, M., MacLaren, V., Collins, K., & Fugelsang, J. (2011). The maximum rewards at the minimum price: Reinforcement rates and payback percentages in multi-line slot machines. *Journal of Gambling Issues*, 26, 11-29.
- [39] Chase, H. W., & Clark, L. (2010). Gambling severity predicts midbrain response to near-miss outcomes. *Journal of Neuroscience*, 30(18), 6180-6187.
- [40] Templeton, J. A., Dixon, M. J., Harrigan, K. A., & Fugelsang, J. A. (2015). Upping the reinforcement rate by playing the maximum lines in multi-line slot machine play. *Journal of Gambling Studies*, 31(3), 949-964.
- [41] Dixon, M. J., Collins, K., Harrigan, K. A., Graydon, C., & Fugelsang, J. A. (2015). Using sound to unmask losses disguised as wins in multiline slot machines. *Journal of Gambling Studies*, 31(1), 183-196.
- [42] Dixon, M. J., Harrigan, K. A., Santesso, D. L., Graydon, C., Fugelsang, J. A., & Collins, K. (2014). "The impact of sound in modern multiline video slot machine play": Erratum. *Journal of Gambling Studies*, 30(4), 931.
- [43] Dixon, M. J., Graydon, C., Harrigan, K. A., Wojtowicz, L., Siu, V., & Fugelsang, J. A. (2014). The allure of multi-line games in modern slot machines. *Addiction*, 109(11), 1920-1928.
- [44] Dixon, M. J., Harrigan, K. A., Santesso, D. L., Graydon, C., Fugelsang, J. A., & Collins, K. (2013). The Impact of Sound in Modern Multiline Video Slot Machine Play. *Journal of Gambling Studies*, 1-17.
- [45] Jensen, C., Dixon, M. J., Harrigan, K. A., Sheepy, E., Fugelsang, J. A., & Jarick, M. (2013). Misinterpreting 'winning' in multiline slot machine games. *International Gambling Studies*, 13(1), 112-126.
- [46] Harrigan, K. A., Sandhu, R., Collins, K., Fugelsang, J. A., & Dixon, M. J. (2010). Losses disguised as wins in modern multi-line video slot machines. *Addiction*, 105(10), 1819-1824.
- [47] Dixon, M. J., Harrigan, K. A., Sandhu, R., Collins, K., & Fugelsang, J. A. (2010). Losses disguised as wins in modern multi-line video slot machines. *Addiction*, 105(10), 1819-1824.
- [48] Lole, L., Gonsalvez, C. J., Barry, R. J., & Blaszczynski, A. (2014). Problem gamblers are hyposensitive to wins: An analysis of skin conductance responses during actual gambling on electronic gaming machines. *Psychophysiology*, 51(6), 556-564.
- [49] Queensland Government: Australian/New Zealand Gaming Machine National Standard 2015 § 3.3 (2015).
- [50] State Revenue Office: Australian and New Zealand Gaming Machine National Standard – Tasmanian Appendix Version 10.06 § T3.16 (2014).
- [51] Directorate of Inspection and Games Coordination: EGM Technical Standards Version 1.1, July 2014 § 4.13.2 (2014).
- [52] New Jersey Division of Gaming Enforcement: Chapter 69E: Gaming Equipment § 13:69E-1.28A(k) (2015).
- [53] Casino Regulatory Authority: Technical Standards For Electronic Gaming Machines (Singapore), Version 1.5 § 3.4.3 (2014).