



Skill-Based Electronic Gaming Machines: a Review of Product Structures, Risks of Harm, and Policy Issues

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Abstract

Purpose of Review Skill-based gaming machines (SGMs) add interactive and/or skill features to electronic gaming machines (EGMs), often modelled on elements from arcade, video, online, or mobile games. Availability of SGMs is expanding in the USA and internationally, but evidence of the impacts of these machines is lacking. To provide direction to policymakers and the scientific community, this review critically evaluates the relevant literature and suggests future avenues for research and consumer protection measures.

Recent Findings Early data suggests that SGMs are most appealing to younger demographics and are likely to attract participation from regular gambling or gaming populations, potentially those with pre-existing problems. Studies of skill elements within other gambling activities indicate that players tend to overestimate their level of control in gambling situations that are determined by chance. Skill involved in SGMs could elicit illusions of control in players, which may contribute to the development of gambling problems.

Summary The impact of introducing SGMs is still relatively unknown. There is limited robust ecologically valid research on the use of these machines within gambling venues. It is possible that, like other new gambling activities, the introduction of SGMs may lead to harm. Vulnerable populations may include young adults, those with pre-existing problems, and those already involved in gambling and video/mobile gaming. Preliminary consumer protection strategies include player education techniques and account management tools, paired with an empirical evaluation framework. Future studies, including laboratory and field trials, are needed to examine if SGMs more strongly appeal to at-risk gamblers, to determine whether players recognise skill versus chance components, and understand the relationship between involvement, increased cognitive distortions, and problem gambling.

Keywords Skill-based gaming machines · Hybrid gaming machines · Illusions of control · Problem gambling · Consumer protection · Harm minimisation

Introduction

Electronic gaming machines (EGMs) that include a skill element, referred to herein as skill-based gaming

machines (SGMs), have emerged as a new category of gambling. These machines are reportedly designed by gaming machine manufacturers to attract younger and more diverse consumers [1•, 2]. Precipitating the development of SGMs are decreased participation rates in standard EGMs (e.g. ‘slots’, ‘pokies’, ‘VLTs’) and a growing preference for gambling activities emphasising skill and player-experience [3, 4]. Although several variants of SGMs exist, they may be simply described as a hybrid between arcade, video, online, or mobile games and EGMs. This category of machines reflects an integration of player skill, interaction, and impact into a primarily chance-determined game that must produce outcomes determined by some technical boundaries, such as minimum return to player percentage (RTP%) regulations.

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As of December 2019, SGMs are legally available in five US jurisdictions: New Jersey, Connecticut, Nevada, California, and Georgia [5–7]. In other US jurisdictions, including Virginia and Pennsylvania, there are cases where SGM manufacturers have claimed that these are games entirely of skill, rather than skill and chance, and therefore should not be classified as a gambling product [8]. Similar legal strategies were used in Ontario, Canada, but those arguments failed to withstand legal challenges [9, 10]. Gaming machine providers are seeking regulatory approval and expansion of SGMs into other regions, including Australia, the UK, Netherlands, and Macau [11]. Various factors complicate the licensing process, including the inadequacy of existing legislative codes and standards for the unique structural composition of SGMs.

Given the novelty of this new technology, there is a lack of empirical data to inform policymakers about impacts that may be associated with SGMs, including potential harms and the specifics of prevention and harm minimisation strategies required to counter impacts. Notably absent is study of the machines' potential to cause or exacerbate problem gambling, defined as spending excessive time and/or money gambling, which leads to serious harm affecting personal finances, relationships, and mental health [12]. To provide direction to policymakers and the scientific community, this review article provides a detailed description of the structural features and variations of SGMs, assesses current data on SGM player demographics, proposes potential paths for SGMs to cause harm to players based on theoretical and hypothesised mechanisms, and outlines consumer protection strategies that may be useful in preventing harms.

Structure and Variants of SGMs

Traditional EGMs incorporate multiple (often simulated) spinning reels that contain varied symbols that are consistent with the overall game theme. Players bet by selecting the number of lines and the size of the bet to place on individual reel spins and win credit if certain patterns of matching symbols are shown when the spinning stops. EGMs vary extensively by the theme of the game, size of minimum bet, outcome distribution, and additional features (e.g. free spins, the ability to bet on in-game random outcomes such as card flips) as well as local and linked jackpots. Outcomes are determined entirely by chance using a random number generator set to return approximately 90% of total wagers to players [13].

In contrast, SGMs offer players some degree of influence over gambling outcomes by introducing skill elements into games. This may vary from players being able to influence the size or multiplier of wins but not the number of wins, to skill influencing the outcomes for all aspects of game play. Other ways in which skill may be incorporated is through

segmented bonus game play, which may be triggered randomly in an otherwise traditional reel game. In most cases, the RTP% of SGMs is set below 100% to guarantee positive gross gaming revenue—even the most skilled player cannot expect to overcome the house edge and win money over the long-run in those games. Less common are SGMs that provide adequately skilled players with opportunities to achieve a positive long-run return [1••]. In these cases, industry revenue is earned from a larger proportion of less skillful players.

As a new product offering, SGMs are undergoing a period of rapid innovation and multiple configurations have emerged (see Table 1 below for actual product examples). Machine designs include various games themes (e.g. first-person shooter, sports games, solving puzzles, and traditional arcade games), unique hardware (e.g. touchscreens, joysticks, controllers), and player skill domains (e.g. literacy, pattern-recognition, hand-eye coordination, response speed, target accuracy).

There is an ongoing experimentation in SGM design elements. It is presently unclear whether this category will be attractive to consumers and what features they may prefer. Due to the dynamic nature of the industry and changes in regulatory approval processes, it is likely that industry practices will continue to evolve this machine class with new variants emerging over time. At this stage, casinos may be uncertain of how to market SGMs and where to position them on the gaming floor. In initial field tests in New Jersey, trialled SGMs were less popular than expected and casinos removed the machines as they failed to generate adequate returns [14].

Player Demographics and Risk Factors

SGMs are more likely to attract a younger adult demographic. Gamblit, an industry manufacturer, reports that a 10,000-person survey they conducted with SGM customers found those consumers had an average age of 36, compared with the average age of traditional EGM players of 58 [7]. Another SGM manufacturer, GameCo, reported that after 2.5 years of operation, their customers were, on average, 25 years younger than the standard EGM player [15]. One possible explanation is that younger adults prefer gambling games that are more interactive and incorporate components of skill [16]. Additionally, familiarity with the game titles and mechanics of the non-gambling version of games could play a role in attracting this demographic [1••]. The attraction of younger players is important from a risk perspective. Younger adults are more likely to develop gambling problems, in addition to other mental health and substance use disorders [17–19]. No academic studies have examined participation rates in SGMs using representative samples of gamblers or the general population.

Table 1 Skill-based gaming machine product examples

Product	Game description	Pay structure
Gamblit and PikPok's 'Into the Dead'	A first-person shooter where players run through a landscape of zombies. The goal is to dodge or kill zombies and move as far forward as possible before dying.	Higher bet increments give players access to more functional in-game features (e.g. gun ammo, guard dog) and a higher pay table. Players win money by completing up to three missions (e.g. kill 30 zombies).
Gamblit's 'Lucky Words'	Similar to a word search puzzle, the goal is to identify and trace (using a touch screen) as many words as possible on a 4 × 4 letter grid within a 30-s time limit.	Letters from correctly identified words go towards filling segments of five successively more difficult payout meters. Win amounts for each of the filled meters are randomly determined.
Gamblit's 'Pacman Battle Arena'	Up to four players compete against each other in an arcade game of Pacman Battle Royale. The aim is to be the last Pacman standing by eating or avoid being eaten by other players and game-controlled ghosts.	A spinning wheel randomly determines the cash prize amount at the beginning of the game. Bet size influences the potential payout amount. The last player alive wins the cash prize.
GameCo's 'Nothing but Net 2'	An arcade-style basketball shootout game. Players must use hand-eye coordination by pressing a button at the appropriate time. Players catch a simulated on-screen ball to make a bet, and then make a shot by stopping a line marker in a bar meter; they get 15 shots per game.	A potential cash or token amount is displayed onscreen immediately before each shot. Tokens can be used to access features that provide a player advantage. Players spin a progressive jackpot reel if they are able to make 10/15 shots.
Gotskill? Skill games	Games largely resemble normal EGMs with spinning reels and various themes (e.g. 'All American', 'Devil's Hot', 'Tropical Paradise'). The skill mode is activated when players earn a winning spin reel combination. In skill mode, the goal is to stop a fast-moving line marker in the centre point of a bar meter.	Payout amounts earned from spinning reels are based on a random multi-line pay table. Players have an opportunity to increase (or decrease) the win amount by up to 110% in the skill mode. If they can do this, players can theoretically achieve a positive RTP%.
Queen of Virginia Skill games	Game play starts with spinning reels revealing a 3 × 3 grid of themed symbols. Example game themes include 'Wild Beasts', 'Amigos Locos', and 'Pirates'. Like a game of tic-tac-toe, within a time limit, players search for two of the same symbols on a horizontal, vertical, or diagonal line, then touch the appropriate symbol to complete a full line of three.	Similar to an EGM, winning reel combinations are based on a random multi-line pay table. Each symbol is worth a different amount, including bonus and free game symbols. The manufacturing company claims that highly skilled individuals can win every time they play.
Scientific Game's 'Space Invaders'	Triggering the bonus feature on a standard Atari Space Invaders themed EGM allows players to choose between random free spins and playing the skilled arcade-style game.	If the skill bonus is selected, player performance during the game will determine what level of three progressive jackpots they can win.
Wymac Gaming Solution's 'Fortunes of the Brave'	After triggering the bonus feature in a reel-based EGM game, players use a console-like controller to battle waves of monsters in a third-person medieval fantasy arena. During normal reel play, a bonus currency is accrued that can be used to customise a player's avatar within the skill feature.	In the skill feature, points are earned by killing monsters that vary in strength and difficulty. Total score at the end of the timed game determines what level of four progressive jackpot amounts is won.

It is plausible that individuals with existing high levels of gambling involvement and gambling problems will be among the first to participate in SGMs. Prior research shows that individuals with existing gambling problems engage in multiple gambling activities and gravitate to new gambling products [20–24]. Emerging gambling products and modes of access have demonstrated a higher uptake among people with existing gambling problems. These include Internet gambling [25], esports betting [21, 26], and daily fantasy sports [27]. A recent study by Gainsbury and colleagues [28••] found that in a crowdsourced sample of 232 Mechanical Turk participants, those with experience playing SGMs reported higher involvement in other gambling types and mobile games, and had more severe gambling problems (in addition to being younger and male). Research suggests that personality traits such as impulsivity and novelty seeking, in addition to the desire for

variety among highly involved gamblers, may explain why individuals with existing problems are attracted to new gambling variants [20]. In these cases, SGMs may not represent a causal factor in gambling problems, though they may exacerbate problems [29]. As new cohorts of gamblers engage with SGMs, it may be possible to delineate the role the games play in the development of gambling problems.

Findings from Gainsbury et al. [28••] suggest that SGMs could hold appeal to people who play mobile or video games. These populations are increasingly being exposed to gambling activities through the incorporation of gambling themes and mechanics within games [30], including social casino games use of gambling mechanics to earn in-game credits or currency, and 'loot boxes' (i.e. random in-game prize draws). A plausible hypothesis is that individuals could 'migrate' from these gaming activities to gambling due to the structural

similarities and shared commercial brands [31]. Studies have shown that adolescents and adults who play gambling-themed games, including social casino games and loot boxes, are more likely to engage in monetary gambling and experience gambling problems [31–34]. A similar effect might be expected with adolescents migrating from video or mobile games to playing SGMs when they reach legal gambling age.

Mechanisms for Potential Harm in SGMs

EGMs are associated with the most gambling-related harm compared with any other form of gambling. The Australian Productivity Commission [35] reported that approximately 80% of individuals who access gambling help services identified EGMs as the cause of most of their problems. Shared structural characteristics in EGMs and SGMs may contribute to the development and maintenance of gambling problems. EGM play is characterised by rapid and continuous betting [36]; outcomes are known almost immediately after the bet is placed (~3.5 s per spin; [37]), and the random intermittent nature and variable size of payout of EGMs means that players are unaware of the timing or amount of their next win [38]. Payout size and frequency in SGMs is mostly variable and play is continuous. The skill features allow players to offset some of the randomness in games and to decelerate or create a natural break from the rapidness of game trials, but the more complicated game structure of SGMs may lead to greater immersion. While study of links between game complexity and immersion is limited, multi-line slot machines have been found to be more immersive than simpler single-line games [39–41]. SGMs may be comparable in some ways to other forms of continuous skill-based gambling, such as blackjack, poker, or in-play sports betting, but also may lead to immersive states more similar to video games.

A potential concern about games with skill components is that players may overestimate the role of skill, eliciting competitiveness and leading to attempts to chase losses and ‘beat’ the games [42•]. SGMs appear most likely to reinforce these cognitive distortions through impacts related to illusions of control, which refers to players’ misplaced beliefs in their control over events that are determined by chance [43]. It is one of several erroneous gambling-related beliefs characterised by a failure to understand how gambling activities have negative long-run expected values [44•, 45]. Several experimental studies have demonstrated that people behave as though chance outcomes are determined by skill when some element of competition, familiarity, or choice is introduced into games. For example, the act of rolling dice or choosing lottery ticket numbers, as opposed to someone else doing

so, has been shown to increase peoples’ confidence in achieving a winning outcome [43, 46, 47]. Personal biases play a key role in this phenomenon as gamblers tend to attribute their wins to personal skill, whereas losses are rationalised as the result of some external uncontrollable event [48]. Stronger illusions of control have been found in problem gamblers compared with healthy controls which suggests they may be etiologically linked to problem gambling [49]. The important role of cognitive distortions in the development and maintenance of problem gambling is emphasised in key conceptual models of gambling addiction [50–52] and in the treatment of gambling disorders [53].

SGM products introduce an explicit skill component into the game structure of traditional EGMs, which may further reinforce illusions of control in players. Lending support to this proposition, Gainsbury et al. [28••] found that SGM players reported higher levels of erroneous gambling cognitions (including illusions of control) compared with non-SGM players. Those individuals were also less knowledgeable about the respective roles of skill and chance in SGMs and EGMs, even though self-belief in their level of knowledge was higher.

Player skill typically has a sufficiently small impact that even highly skilled players will lose over the long run. Confounding the issue are less typical SGM variants where a very small proportion of highly skilled players could theoretically win consistently (e.g. Gotskill? Skill games and Queen of Virginia skill games [see Table 1]). The variation within the SGM category may increase player misunderstanding of the relative roles of skill vs. chance and the extent to which it is possible to turn a profit if they possess relevant knowledge or skills.

It is conceivable that individuals involved in video or mobile gaming will inaccurately attribute a high role of skill to SGMs. The use of familiar game titles, console game-style controllers, and an equivalent level of graphics may have a compounding effect on this illusion of control. While practice and persistence enhance gaming skill and expected outcomes, skill has a smaller role in determining SGM outcomes than typical video games, and on-going play can be costly. In an experimental study involving a gambling task with video-game-like features, King et al. [54•] found that participants who regularly played video games and gambled exhibited greater illusions of control compared with participants that only did one or the other activity. In an Australian survey, social casino game players who gambled as a result of these games were significantly more likely to report that they played the games and gambled to improve their gambling skills [31]. These findings suggest that individuals who game and gamble may be vulnerable to erroneous beliefs that gaming experience will help them to win on SGMs.

Potential Protective Features of SGMs

Certain features of SGMs may protect players from gambling-related harms, especially when compared directly with traditional EGMs. Skill game elements can slow down the speed of the game and betting by extending individual bets across approximately 30 to 60 s of play. This creates a longer duration between outcomes of game trials. Individuals may also receive a break-in-play when multiplayer variants require players to wait for others to join the game. Breaks in play theoretically provide an opportunity for gamblers to make an informed choice to continue to gamble, and there is some evidence that these may reduce continuous gambling [55]. In contrast, the capacity to play rapidly on EGMs is associated with a higher frequency of wagers over prolonged periods and difficulty stopping, particularly among problem gamblers [37]. Therefore, the naturally occurring breaks in SGMs and fewer betting options may reduce excessive gambling within a single session and the negative impact of high financial expenditure.

SGMs are expected to promote social interaction, especially in multiplayer machines and via spectator-like behaviour from other casino patrons. This may serve as a protective factor because problematic gambling has been associated with gambling alone and in secret [56, 57], and social bonding is a protective factor for problem gambling [58].

Compared with repetitious and non-cognitively demanding EGM reel spins, SGMs likely involve greater cognitive engagement given higher levels of game interaction. Players may therefore be less likely to ‘zone out’ and lose track of the time and money they spend [59]. However, greater absorption in SGMs related to achievement-driven motivation may still result in spending more time and money than intended. Experimental evidence has shown links between intense immersion (i.e. ‘zoning in’) during EGM play and risk of problem gambling [60, 61].

Strategies for Consumer Protection

Informed decision-making is believed to be an important feature of responsible gambling by individuals [62, 63]. Health promotion campaigns aimed at the general public may wish to focus on the intrinsic value of SGMs as an entertainment product to be enjoyed in moderation, emphasising the social aspects of play. It appears reasonable that SGM marketing communications should emphasise that they are a gambling product not a video game, cannot be mastered or beaten, and should not be perceived as a way to make money.

To minimise the risk of existing players developing problems, it may be important to provide clear information on how each machine operates in terms of RTP% and the role of skill. This needs to be done in a manner that is easy to understand by

players, potentially involving a graphical display [64]. Built-in game tutorials can explain the important elements of the machine, without the need to place a wager. Due to the varying elements in game design, player education may need to be game-specific, targeting illusions of control with the intention to prevent persistent play and excessive spending. On-device messaging may therefore be an important intervention. In EGMs, dynamic pop-up messages have been shown to reduce irrational beliefs about gambling [65] and are most effective when placed in centre-screen during play [66]. Computer animations and graphs can facilitate communication of complex abstract ideas in a general entertainment setting [67].

Product variation within the category of SGMs, including differing degrees of skill involved, presents a challenge for educating players using consistent messages. For example, a message that “all players will lose in the long run” may be true for traditional EGMs but does not hold for all SGMs. Credibility of an educational campaign may be reduced if players become aware of misleading message content; therefore, messages should be matched appropriately to individual games or game types. During gameplay, it may be important for individual SGMs to clearly signpost when outcomes are influenced by skill and when chance dominates. Finally, as players are likely to conflate SGMs with EGMs, educational strategies should extend to both activities, with the aim to clearly distinguish the features of one from the other.

Clinically, one aspect of cognitive behavioral therapy (CBT)—the recommended treatment approach for gambling problems [68]—is to replace erroneous gambling cognitions with more accurate beliefs. Many CBT programs are geared towards purely chance-based EGM gambling; therefore, cognitive restructuring techniques may need to be adapted for treatment of problems with SGMs [53]. As stated in Chrétien et al. [53], ‘the thoughts of gamblers that participate in gambling activities that involve some skills would forcibly be different from the thoughts of gamblers that choose games of pure chance’ (p. 109). Clinicians may therefore need to be upskilled so that they are knowledgeable about the structural characteristics of SGMs, the specific types of cognitive distortions they elicit, and how to effectively address these differences.

Conclusions and Future Directions

The availability of SGMs is growing rapidly. These machines are expanding into multiple US jurisdictions and several other countries are considering regulatory approval. While the long-run take-up and engagement with SGMs is unclear, the limited empirical evidence suggests that they appeal more strongly with the intended younger adult demographic that may already be involved in non-gambling video gaming. This increases risk to consumers as the target market for SGMs is

known to be more susceptible to gambling problems compared with older demographics [17–19].

Lack of knowledge about impacts of SGMs on problem gambling prevents the development of an informed regulatory framework to license EGMs that contain elements of skill. It is plausible that SGM players may be at greater risk of developing illusions of control than traditional EGM players, due to the injection of some skill into an otherwise chance-based game structure. Player education techniques targeting cognitive distortions, accompanied by account management tools that include limit-setting options, may be a positive initial strategy for consumer protection.

To support evidence-based regulatory decisions, it is essential that studies are conducted based on samples of SGM players in order to understand their unique personal characteristics, attitudes, and motivations. We suggest several key research priorities for future studies: (1) characteristics of individuals attracted to these games and their unique risk profiles; (2) players' understanding of skill versus chance features of SGMs; (3) effects of play on increasing cognitive distortions; (4) effect of SGMs on gambling including persistence within a gambling session, chasing losses, initiating new gambling sessions, dissociation/immersion, and impact on use of other gambling products; and (5) the effectiveness of consumer protection measures in preventing or reducing gambling harm. Beyond these priorities, there remains substantial opportunity to study SGMs, including exploration of the diverse structural characteristics in the games and examining etiological links of SGMs to other forms of gaming and gambling.

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