# DRIVING ARTIFICIAL INTELLIGENCE USE IN RESPONSIBLE GAMBLING PRACTICES

by

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## Abstract

Gambling operators have incorporated specific responsible gambling (RG) measures as a unique approach to enhance their corporate social responsibility (CSR). However, staff accuracy in problem gambling identification, one important RG measure, remains low: venue staff can identify only 36% of patrons experiencing gambling problems. Artificial intelligence (AI)'s integration with responsible gambling (RG) practices has gained increasing attention in the gaming industry. The technological mechanisms set by AI can exploit the correlation and interaction between variables in a multivariate way, an utmost difficult task for humans, to identify risky patterns and determine which player attributes correlate with positive behavioral changes. The result helps to develop better RG strategies and safe play guidelines for players.

However, AI technologies encountered a low degree of acceptance and adoption in the industry because of technical, ethical, regulatory issues regarding AI applications for gambling and the way of data collection from gamblers. The extensive literature review on both AI and RG aims to recommend best practices for the use of AI in a way in which the gaming industry can comply with responsible gambling guidelines, while also ensuring they adhere to local law and best practice in data privacy. The recommendations cover four aspects of AI implementation: data privacy, security and governance; ethical consideration in deployment and design; data quality; and, transparency, interpretability, and accountability of AI systems. As there are almost no regulations designed for AI, this paper proposed the first set of solutions that can help gambling regulators, operators, and players better understand AI systems, thus using them more effectively and responsibly.



**Keywords:** artificial intelligence (AI), machine learning (ML), responsible gambling (RG), problem gambling, corporate social responsibility (CSR), data privacy.

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# PART ONE

## Introduction

The term artificial intelligence (AI), sometimes called machine intelligence, is often used to describe machines (or computers) that mimic cognitive functions that humans associate with the human mind, such as "learning" and "problem solving" (Russell, Stuart, & Norvig, 2016). AI systems are now being used for automated decision making in areas such as security, finance, autonomous vehicles, robotics, and healthcare (Socialnomics Trend, 2019). In some applications, AI is used to reduce fraud and crimes by recognizing and monitoring behavioral patterns of users for any abnormal changes or anomalies. When paired with facial recognition systems, it can be used for mass surveillance. AI systems also enable the coordination of sensors and effectors for threat or movement detection and identification.

The integration of these technologies has gained increasing popularity in the gaming industry. Macau casinos have been using the technology to categorize customers, establish gaming patterns, and "spot the biggest users" (Socialnomics Trend, 2019). According to Hong (2019), some of the world's biggest casino operators in Macau are starting to deploy hidden cameras, facial recognition technology, poker chips, and baccarat tables based on sensor technologies. The general set-up is this: gamblers' betting behavior is tracked through high-resolution cameras, and RFID-enabled poker chips and tables, with the intelligence, gleaned flowing back into a centralized database where a risk profile of the individual is then created (Hong, 2019). The data collected through these technologies could be used to detect collusion and track activities, and in the end, enhance casino operators' performance.

In addition to its benefits in supporting long-term revenue goals, AI tools can also play a critical role as a responsible gambling (RG) /corporate social responsibility (CSR) strategy to

improve player protection (Percy, Franca, Dragičević, & Garcez, 2016). Blaszczynski, Ladouceur, and Shaffer (2004) defined RG as a strategy aimed to prevent and reduce the potential risks from excessive gambling activities. RG programs closely resemble the ethical dimension of the CSR framework (Lee, Song, Lee, Lee, & Bernhard, 2013). Thus, RG should be implemented as a unique form of CSR to minimize negative impacts associated with problem gambling (Song, Lee, & Lee, 2012) and achieve the sustainable development of the casino industry. AI-led technologies have only recently been applied to the field of study of the gambling industry because of its potential to prevent problem gambling behaviors.

Casino firms are often associated with various social issues such as gambling addiction, family abuse, embezzlement, and other crimes (Song et al., 2012). Both governments and industry increased the interest on what would constitute a sustainable gambling approach to make gambling safer for consumers of gambling products (Bonello & Griffiths, 2017). Technology makes it easier for the gambling companies test measures that are aimed at minimizing excessive gambling (Bolat, Arden-Close, & Ali, 2019). For example. RG features can be embedded within gambling products (RGFs) (i.e. informed consent, time and best limits) (Ladouceur, Shaffer, Blaszczynski, & Shaffer, 2017). Machine learning (ML) algorithms are expected to transform raw gambling session data into meaningful, descriptive variables of behavior, called behavioral markers, and relate those descriptive variables to an individual who is potentially at risk (Percy et al., 2016). Thus, AI systems can be used to predict potentially harmful gambling based on patterns of gambling behavior (Percy et al., 2016; Philander, 2014). Such prediction can contribute to the development of safe play guidelines and better intervention messaging for player (Dragicevic, Garcez, Percy, & Sarkar, 2019). RG actions powered by technology and transparent use of customer data could potentially help the industry operators and

regulators engage in a set of science-based responsible gambling principles and, as a result, improve its negative image (Bolat et al., 2019), and provide a valuable consumer protection measure to their patrons.

## Purpose

The purpose of this study is to recommend the criteria and processes for the use of AI tools in a casino's responsible gambling practices.

## Statement of Objective

This paper will explain the basics of the technology behind the AI systems used in casinos, identify the key considerations and challenges surrounding its application as an RG strategy aimed to prevent potential harm associated with problem gambling. The scope of the investigation covers technology, ethics, regulations, risk management, and management processes. Several high-level principles and recommendations follow based on literature review and research of best practices in terms of both technologies and applications.

## Justifications

Despite its rising popularity, AI has not gained wide application in venues (A. Feldman, personal communication, February 19, 2020). It starts to raise questions as to how this works and what the ramifications can be for things like patron privacy, anonymity, and data protection (Solis, 2020). There is an inevitable conflict between facial recognition technology and an expanding slate of data privacy and protection laws (Solis, 2020). An unintended outcome could be that patrons refuse to reveal their data and stop visiting the venues. It becomes pressing for casino venues to establish principles and processes for the responsible application of AI, aiming to detect risk and manage it, while also ensuring they adhere to local law and best practice in data privacy.

Also, diagnosing and ultimately steering problem gamblers to clinical help has long been a challenge for the industry (Solis, 2020). AI is recognized as a vehicle to find the most harmful behavior (Solis, 2020). But such implication has not been validated, and the accuracy of the AI program used to predict problem gambling behavior remains a question (Tottenham, 2019). According to a CDC report, an AI program can only predict with about 60% certainty who will become a problem gambler (Tottenham, 2019). One of the challenges comes from problem gambling (PG) identification, an important RG initiative (Delfabbro, Borgas, & King, 2012). The industry's uptake of such systems is primarily dependent upon the regulators' and gambling operators' ability to understand and effectively use them (Sarkar et al., 2016).

This professional paper aims to recommend solutions based on extant AI and RG research for stakeholders to follow when dealing with technology. The result of the investigation proposes some best practices that could guide the AI use in RG practices and help this technology get off the ground. This study also has academic implications. Currently, most of the discussion focuses on AI technology as a marketing tool, and relatively little research has explored AI's role in responsible gambling as a CSR strategy to promote casinos' image (A. Feldman, personal communication, February 19, 2020). The paper provides a different angle by integrating AI technology in casinos' responsible gambling practices.

## Constraints

While facial scanning artificial intelligence (AI) presents an opportunity worth more study, the field is still dominated by more questions than answers (A. Feldman, personal communication, February 19, 2020). Central to this discussion are diagnosis questions that serve as a precursor to AI use – are there patterns that the technology can use to detect problematic behavior, identify someone who may be in trouble, and/or prevent someone from reaching a

problematic state? Currently, there are almost no legal regulations for automated solutions like AI (Clarke, 2018; Lazcano, Avedillo, & Del Real, 2018; Socialnomics Trend, 2019), thus there are very few references that could guide current research. Also, CSR reports and the level of the use of AI vary in countries due to the differences in culture, business systems, and regulations. The researcher should consider all these factors when making a recommendation.

## PART TWO

### Introduction

Artificial intelligence (AI) has been adapted into every aspect of human life. When paired with other technologies such as facial recognition, sensor technology, and big data analytics, AI-led technologies have various applications in the setting of gambling, among which AI's integration with responsible gambling (RG) practices has gained increasing popularity. As the most powerful AI tool, machine learning (ML) algorithms could train a large amount of data collected from patrons to identify patterns of problem gambling behavior. The result can help casino operators stipulate intervention strategies to prevent potential gambling-related harms. AI applications for gambling and the way of data collection from gamblers have raised several questions: Is the use of AI in gambling ethical, legal, or socially acceptable? Which kinds of profiles fit into problematic gambling, and which attributes explain players who have such patterns? What are the best practices in terms of both technical and organizational considerations to implement such technological advances to enhance RG?

This professional paper aims to recommend best practices for the use of AI in a way in which the gaming industry can comply with responsible gambling guidelines. Through an extensive review of literature both in AI and RG, this section provides an overview of AI technology and its applications in both online and offline gambling, define problem and responsible gambling, and identify the key considerations and challenges surrounding the technology.

### An Overview of Artificial Intelligence

AI traditionally refers to an artificial creation of human-like intelligence that can learn, reason, plan, perceive, or process natural language ("Artificial Intelligence," 2020). Recent

literature (Kaplan & Haenlein, 2019) gave AI a more elaborate definition: a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks. Through flexible adaptation, applications of AI range from advanced robotics, autonomous vehicles, the specific regions of medical diagnostics, and intelligent computers (Schmidhuber, 2007; Xu, Xu, & Li, 2018).

Since 2000, and particularly after 2015, the rapid development of intelligent hardware (sensors and chips), the evolution of algorithms, and the support of big data have consistently driven the development of AI (Chen, 2019). The rationale is that AI relies on external information for analysis. Internet of Things (IoT) and other big data sources provide a substantial amount of data as an input for identifying underlying rules and patterns (Kaplan & Haenlein, 2019), variously within text, speech, and two-dimensional imagery, expert systems approach, and game-playing (Hyman & Ladanyi, 2019). Approaches from ML could train such data to help computers learn without being programmed.

AI covers a system's ability to perceive this data (e.g., natural language processing or voice/image recognition) or to control, move, and manipulate objects based on learned information, be it a robot or another connected device (Kaplan & Haenlein, 2019). ML, meanwhile, is an essential part of AI (Gustafson, 2019; Hyman & Ladanyi, 2019; Kaplan & Haenlein, 2019). It refers to designing, training, and deploying models to applications, processes, and other machines by providing algorithms, application programming interfaces (APIs), development and training toolkits, data, as well as computing power (Kasemsap, 2017). Instead of programming the computer every step of the way, ML makes use of learning algorithms that make inferences from data to learn new tasks (Hyman & Ladanyi, 2019; Kaplan & Haenlein, 2019). The main applications include improved marketing through customer segmentation, fraud

detection, credit risk management, algorithmic trading, regulatory compliance (Wall, 2018). ML is being used in banking to identify the customer, discover anti-money laundering, develop a stress testing model, and monitor behavior (Wall, 2018).

Deep learning is a subfield of ML, concerned with algorithms inspired by the structure and function of the brain called artificial neural networks (Wall, 2018). It enables computers to learn from experience and understand the world based on the hierarchy of concepts (Goodfellow, Bengio, Courville, & Bengio, 2016). Currently, deep learning is primarily used in pattern recognition and classification applications supported by large data sets (Kasemsap, 2017).

**How do Machines Learn**

A ML model may apply a mix of different techniques such as statistics, information theory, the theory of algorithms, mathematics, psychology, linguistics, philosophy, and many other fields ("Artificial Intelligence," 2020; Cerasa et al., 2018). Combining disciplines of different areas, the methods for learning can typically be categorized as three general types: supervised, unsupervised, and reinforcement learning (Gustafson, 2019; Hyman & Ladanyi, 2019; Kaplan & Haenlein, 2019). Supervised learning occurs when algorithms learn from interpreting labeled data and the desired output (Gustafson, 2019; Hyman & Ladanyi, 2019). An example is an image-processing algorithm to classify objects based on image recognition. This type of learning is considered supervised because humans ultimately retain control of what conclusions should be drawn from the algorithms (Gustafson, 2019). Under unsupervised learning, the inputs are labeled but not the outputs (Gustafson, 2019; Hyman & Ladanyi, 2019; Kaplan & Haenlein, 2019), and the algorithm is asked to identify patterns in the input data (Hyman & Ladanyi, 2019). Since the algorithm itself derives the output, it is not possible to assess the accuracy or correctness of the resulting output (Kaplan & Haenlein, 2019). One

example is the recommendation system of an e-commerce website where the learning algorithm discovers similar items often bought together (Hyman & Ladanyi, 2019). Reinforcement learning aims to interact with a dynamic environment that provides feedback in terms of rewards and punishments (Hyman & Ladanyi, 2019) to achieve automated equilibration within human-made systems (Clarke, 2018). Self-driving cars is one of examples.

## Problem and Responsible Gambling

### Definition of Problem Gambling

The National Council on Problem Gambling (NCPG) defines problem gambling (PG) as a gambling behavior that causes disruptions in any major area of life: psychological, physical, social or vocational. PG is an urge to gamble continuously despite harmful negative consequences or a desire to stop (Delfabbro, 2013). Often described using a variety of terms, including, 'compulsive gambling,' 'disordered gambling' or 'excessive gambling,' PG is an overarching term most commonly used to describe a syndrome of gambling-related behaviors that often leads to significant harm to individuals, to others close to the gambler and the community (Neal, Delfabbro, & O'Neil, 2005). The most recent edition of American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (APA, 2013) defines PG as a behavioral disorder based on nine criteria; the number of criteria met helps clinicians assess the severity of the disorder. The symptoms include increasing preoccupation with gambling, a need to bet more money more frequently, restlessness or irritability when attempting to stop, "chasing" losses, and loss of control manifested by continuation of the gambling behavior in spite of mounting, serious, negative consequences (APA, 2013). The presence of four to five symptoms in 12 months is often associated with a mild gambling problem, while six to seven symptoms represent a moderate problem, with a severe gambling

problem comprising of eight to nine symptoms (APA, 2013). “Gambling disorder” or “pathological gambling” are terms often used by clinicians or in clinical settings, while PG usually refers to both, and as a general colloquial term for public discussion. The DSM-5 reclassified pathological gambling as addictive disorders rather than impulse control disorders (APA, 2013). Such classification is due to the symptomatology of the disorder resembling an addiction not dissimilar to that of substance-abuse (Christensen, Jackson, Dowling, Volberg, & Thomas, 2015). Those who are pathological share certain individual traits (e.g., genetic markers) that differentiate them from others without the disorder (Delfabbro, 2013).

According to the NCPG, approximately 85 percent of U.S. adults have gambled at least once in their lives, 60 percent in the past year; 15 percent of Americans gamble at least once per week; gambling addiction affects more than three percent of population of all ages, men more often than women: adults (1%) are estimated to meet criteria for severe gambling problems in a given year; another 4-6 million (2-3%) would be considered to have mild or moderate gambling problems; youth risk is developing a gambling problem at a rate of about two to three times that of adults, and approximately 6 percent of college students in America have a gambling problem. In extreme cases, PG can result in financial ruin, legal problems, loss of career and family, or even suicide.

**Regulatory and Industry Interest in RG**

Player protection has been in the center of gambling regulation, and various initiatives have been set in place by gambling companies to ensure responsible gambling and harm minimization that might be derived from PG (Bonello & Griffiths, 2017). The gambling industry first designed voluntary codes and policies, such as mission statements, principles, and guidelines that gambling operators should follow, partly in response to government and

community pressures (Blaszczynski et al., 2011). The government imposed legislation or directives to supplement these voluntary codes, which later constituted an industry-based strategy called responsible gambling (RG) programs (Blaszczynski et al., 2011). RG incorporates concepts of "consumer protection," "harm minimization," and "harm reduction" (Blaszczynski et al., 2011). It aims to help protect players from the potential harms (e.g., financial, familial, professional) that excessive gambling may cause while simultaneously providing benefits to the local community (Blaszczynski et al., 2004). In other words, RG refers to a duty of care including consumer education, playing within limits, information to allow informed choice that includes resources for help, information about games and information to combat misconceptions, and gambling fallacies (Blaszczynski et al., 2011). In this regard, gambling operators and regulators have begun to apply AI technologies as an effort to understand aspects of harmful gambling behavior and implement RG strategies.

## Applications of AI-led Technologies in Gambling

AI-led technologies have various applications in the gambling business, such as facial recognition, enhanced player tracking systems, payment systems, and the forecast of win chance of every player, every bet, and every moment (Feldman, 2020). Many of these applications fall into the customer service realm, allowing a casino operator to automatically recognize their patrons and adjust service in real-time (Solis, 2020). For example, some casino operators in Macau are starting to deploy hidden cameras, facial recognition technology, and digitally-enabled poker chips and baccarat tables to track the activities of their patrons (Hong, 2019). Such implementation can help casino operators potentially cut down on fraud, enforce self-banned or casino-banned players, and increase the potential to snag new players in existing customer

loyalty programs (Solis, 2020). And eventually, it will help to achieve efficiency, accuracy, and integrity in casino venues (Feldman, 2020).

AI is also a marketing tool to bring revenue. To better appeal to customers, AI-based technologies can be used to optimize game design, create marketing campaigns to a target group, customize the user interface, and optimize revenue streams from slots or casino games (Tottenham, 2019). Gambling, whether online or land-based, produces vast amounts of data, both about player behavior and game performance (Tottenham, 2019). A decision tree, a data mining algorithm, could build a predictive model based on such data to predict online player churn behavior to retain customers (Santos, 2017). Also, AI may be of great help for analyzing the habits and wishes of the audience and predict what games will be of the highest interest (HEFFX Australia, 2020). Thus, AI is ideal for developing winning game-playing strategies, especially games, where skill is a factor in determining the outcome (Tottenham, 2019). Simulation-based AI has been highly integrated with electronic gambling machines (EGMs), which represent a large part of the gambling industry (Santos, 2017), to engage with players so that they will stay around and keep playing.

Consumer protection is also something that concerns gambling operators in a commercial manner to protect the company's brand and reduce potential harm to customers (Carran, 2013). Gambling operators have increasingly assumed a duty of care for their patrons (Wohl, Sztainert, & Young, 2013). Various apps and projects are beginning to use AI-led technologies to make gambling safer and better regulated (Socialnomics Trend, 2019). In addition to land-based venues' efforts of combining AI with other technologies for mass surveillance to identify and track problem gambling behaviors, online gambling operators come up with their strategies for best responsible gambling practices. Because of the way that online companies can collect data

on their clientele via behavioral tracking, internet gambling may, in turn, offers possibilities for utilizing RG tools. Examples include temporary self-exclusion, personalized behavioral feedback, limit setting tools, pop-up reminders, etc. Such tasks might be difficult in a land-based setting unless player cards are used to track the totality of a gambler's behavior (Wood, Shorter & Griffiths, 2014).

## A Machine Learning Perspective on Responsible Gambling

Currently, there are no simple ways to identify and prevent vulnerable groups from gambling (Lazcano et al., 2018). PG identification and intervention by venue staff are two important ways of implementing RG strategies (Quilty, Robinson, & Blaszczynski, 2015; Tomei & Zumwald, 2017). One challenge comes from venue staffs' reluctance to intervene due to the lack of the ability to identify problem gambling behaviors (Quilty et al., 2015; Tomei & Zumwald, 2017). The only study to date, which has examined staff accuracy in PG identification, found that venue staff is able to identify only 36% of patrons experiencing problems with gambling (Riley et al., 2018).

As a result, AI's application to predict potentially harmful gambling based on patterns of gambling behavior has gained the attention from gambling operators in recent years (Gustafson, 2019) and is becoming a new field of study (Cerasa et al., 2018; Percy et al., 2016; Sarkar et al., 2016). AI systems are expected to be an effective tool that helps operators keep in compliance with responsible gambling principles (Santo, 2017) as they set forth the technological mechanisms that can automatically control and ensure the appropriate use of both gaming and gambling activities (Lazcano et al., 2018). The rationale behind this is that these new technologies go a step further in tracking and rating every customer, building up a treasure trove of data (Hong, 2020) that could be used for analysis via ML approaches. ML can exploit the

complex correlation and interaction between variables in a multivariate way that highlights differences that might otherwise remain undetected (Huys, Maia, & Frank, 2016). Once trends in addictive behaviors are identified, AI can be used to restrict those at risk of developing a gambling problem from betting.

One example is behavioral feedback systems, which enable an optimistic approach of RG, as they achieve the targeted goal of helping the players sensibly limit the amount of time and money spent gambling (Santos, 2017). Simulation-based AI analyzes the behavioral change in a vast array of online gamblers that receive personalized feedback after they have signed up to a voluntary service (e.g., "mentor", a software, or any other responsible gaming feature) at an online gaming website (Santos, 2017). Players who receive tailored feedback about their online gambling behavior are more likely to change their gambling behavior, which is measured by the amount of time and money spent, compared to those who do not receive tailored feedback (Auer, & Griffiths, 2014; Auer, Litler, & Griffiths, 2015).

In terms of what algorithms to apply, supervised machine learning has become increasingly relevant recently as a method to help gambling operators better protect players from harm (Hassanniakalager & Newall, 2019; Percy et al., 2016). Supervised machine learning models have been evaluated in various studies (Percy et al., 2016; Philander, 2014; Schellinck & Schrans, 2011) in the context of predicting which gamblers could be at risk of problem gambling. Philander (2014) examined nine supervised learning methods to determine which data mining methods are most effective at identifying disordered internet sports gamblers. The supervised learning methods include logistic regression and other regularized general linear models (GLM), neural networks, support vector machines (SVM), and random forests, with results ranging from 62% to 67% (Philander, 2014). A more recent study by Percy et al. (2016)

demonstrates accuracy performance on test data-sets in the 72–87% range, pointing towards a set of additional gambling behavior variables that are worth assessing further to improve the accuracy of prediction. Random forests are recognized the highest performing technique in all the studies reviewed (Dragicevic et al., in press; Gustafson, 2019; Percy et al., 2016; Philander, 2014; Sarkar et al., 2016).

## Features or Variables Related to Gambling Used for AI Analysis

Given the combination of public health concerns, corporate interests, regulatory pressures, and media attention at play, there has been significant pressure within the gambling industry to understand better how such ML models work (Percy et al., 2016). Lying in the center of discussion are the questions about how to best interpret the increasingly large quantity of data and transform raw gambling data into meaningful, descriptive variables for AI analysis, and how to relate the features to the risk levels of problem gambling. AI has been proven a new effective way to automate the analysis of medical data and to extract new combinations of biomarkers useful for early diagnosis (Cerasa, 2016), whereas gambling disorder has poorly been applied (Cerasa et al., 2018). Identifying potential risk factors for gambling disorder is of primary importance for planning preventive and therapeutic interventions (Cerasa et al., 2018). A plethora of studies has begun exploiting patterns that might play a role in determining an individual's risk of developing a gambling disorder. Variables that are being investigated include:

1) behavioral features during a specific period of time, such as time or amount spent gambling, the rate of won and lost money, frequency of deposits made, and frequency of play (Dragicevic et al., in press; Gustafson, 2019; Percy et al., 2016),

2) personality biomarkers of pathological gambling (e.g., age, sex, neuroticism, extraversion, openness, agreeableness, conscientiousness, etc.) (Cerasa et al., 2018),

3) past betting odds and results (Hassanniakalager & Newall, 2019).

4) psychological and emotional profiles (Lazcano et al., 2018),

5) game types (Hassanniakalager & Newall, 2019; Sarkar et al., 2016),

6) social responsibility tools (Percy et al., 2016).

"Variability" and "intensity" are two risk flags built on these measures to diagnose the risk levels of problem gambling (Percy et al., 2016), and accordingly gamblers receive scores that match their risk levels. These variables have also been used to track the changes or the trend of gambling behaviors over time through the analysis of the night-play ratio or the deposit-decline ratio (Dragicevic et al., 2019). The results help casino operators to create PG prevention strategies when their patrons show symptoms related to the early stage of PG.

Patterns identified can be used to build ML models that have practical implications for RG practices. A recent study (Dragicevic et al., 2019) applied supervised learning models to identify players whose recent playing behavior showed a pattern closely matching that of problem gamblers, for example, those who formally requested "serious self-exclusion." Such "serious self-exclusion" is a proxy that captures a subset of players experiencing harm, typically those who have gambled on a site for several weeks. With a pattern-matching philosophy, gambling operators are able to identify a separate subset of players who might be experiencing harm even if they would be unlikely to self-exclude (Dragicevic et al., 2019).

## Challenges Surrounding the Use of AI

As a disruptive technology with a wide range of influences, AI involves many issues that challenge its use, such as security, privacy, and social ethics (Chen, 2019). While programmers

may design data collection algorithms to comply punctually with each statutory provision on data privacy, computers always seek a more efficient way to fulfill tasks without the awareness of legal and moral limits that an average human being would have (Lazcano et al., 2018). Because of the self-evolution of AI, its applications could be out of human control, bringing important risks to society. Poor choices may result in regulation that not only fails to truly improve accountability but also stifles the many beneficial applications of AI systems (Wachter, Mittelstadt, & Floridi, 2017).

In the gambling sector, AI technologies are often used to promote gambling products, potentially enticing people with gambling problems or other vulnerable conditions to visit venues or betting sites more often. For instance, EGMs are markedly the domain of the loss-chasing behavior, the core characteristic of problem gambling, as these interactive, computerized gambling platforms enhance the illusion of control of the players about the outcome of the game (Santos, 2017). Approximately 13% of EGM gamblers meet diagnostic criteria for PG, which is one of the highest rates among all other forms of gambling (Santos, 2017). Once bots, an AI program, learn how to beat real players in all types of games, the gambling industry will experience huge losses in money and the number of players (HEFFX Australia, 2020). In this regard, advancements in AI and its use will create new security and safety challenges, including the unpredictable and harmful behavior of the AI agent (Hyman & Ladanyi, 2019).

There are almost no regulations that are designed or modified for AI (Socialnomics Trend, 2019; Clarke, 2018; Lazcano et al., 2018). The lack of enforcement, which may be a direct consequence of obscure legislation, has contributed to the dubious handling of personal data that clients and users have been forced to endure (Lazcano et al., 2018). AI systems of the casinos have to collect and process large amounts of personal data and outline the casino patrons

or high rollers profiles without any notification of them (Santos, 2017). Through devices and techniques, AI systems carry out a silent and continuous tracking of players' private habits, violating one of their primary requirements – the indispensable existence of consent of the holder of the personal data (Santos, 2017). The application of such inferences to decision-making, and to the performance of actions in the real world, raises serious questions about transparency (Burrell, 2016). A result of the loss of decision transparency is the undermining of organizations' accountability for their decisions and actions (Clarke, 2018). The unintended outcome would be that casinos will lose their loyal customers because patrons don't feel comfortable being watched and refuse anyone to see their data. The question of how to create accountable AI systems is important; accountability is an essential element of good public and private governance (Fox, 2007).

Another problem with the use of data is that while there is a great deal of player data available, there is no one set that is solely problem gamblers or those who are likely to become problem gamblers (Tottenham, 2019). And so, the AI software isn't able to identify anyone with any degree of accuracy, because it has nothing to learn from (Tottenham, 2019).

## Public Acceptance and Adoption of AI technologies

### Public Acceptance

In addition to achieving some level of adoption, AI-based applications face at least some degree of technical challenges, public skepticism, and resistance (Clarke, 2018), which may be due to many issues AI involves such as security, privacy, and social ethics. People tend to underuse such technological advances due to fear, ignorance, misplaced concerns, or excessive reaction (Floridi et al., 2018). Public acceptance and adoption of AI technologies occur only the benefits are seen as meaningful and risks as potential, yet preventable, minimizable, or at least

something against which one can be protected, through risk management (e.g., insurance) or redressing (Floridi et al., 2018). In a survey conducted by Gustafson (2019), the majority of respondents who are problem gamblers showed that they would accept a system that is created to help them. The result leads to the belief that, if conducted right, ML could be used to create a business in the area of RG in the future (Gustafson, 2019).

**Public Adoption**

When examining success factors that are highly related to AI adoption, Chen (2019) claim that the external environment, organizational capabilities, and innovation attributes of AI are important. The external environment includes the industry, competitors, regulations, and interactions with the government (Chau & Tam, 1997).

Not only the characteristics of AI technologies but also technology capabilities affect AI adoption (Chen, 2019). Technical capability refers to the physical assets that are essential to adopt innovations, such as computer hardware, data, and networking (Aboelmaged, 2014). Technical capability also includes intangible assets such as technical knowledge, IT development and collaboration strategies, and application processes that can effectively integrate new technologies (Garrison, Wakefield, & Kim, 2015). Because of its complexity, the knowledge of AI and the algorithms behind it escapes the grasp of most of the population (Lazcano et al., 2018). This translates into an absence of verifying processes and control systems (Lazcano et al., 2018) that could make AI systems remain under human control.

Also, the levels of AI adoption vary across countries. The extent of innovation and diffusion depends on economic, social, regulatory, and political factors (Caselli & Coleman, 2001). That Macau-based casinos are racing to implement the new technology speaks to the greater ease with data collection and sharing among Chinese consumers compared to those in

Europe or the U.S. (Hong, 2019). China is now in the early stages of setting up a data protection regulation (Sacks, 2019), and Chinese people are not as sensitive to their data being collected for commercial purpose. Building on such a lack of awareness about privacy (Sacks, 2019), Chinese tech companies are at the global forefront of using consumer data for everything from designing new products to expanding health insurance (Hong, 2019). In contrast, their counterparts in the U.S., like Facebook, are hamstrung by data protection regulation (Sacks, 2019).

Government involvement and control are also said to be one of the factors that contribute to the higher level of technological adoption in China (Chen, 2019), also the unique regulatory environment (Sacks, 2019). While Chinese citizens will soon have broad protections from commercial data collection, they likely continue to experience growing government surveillance (Sacks, 2019). Under recent legislation, China's authorities have enshrined the right to law enforcement access to data without due process (Sacks, 2019). China's government has a nationwide network of surveillance cameras that utilize facial recognition (Hong, 2019). Such surveillance is claimed as a government strategy that aims to increase privacy protections for consumers (Sacks, 2019). Chinese data protection regime is uniquely suited to China. It builds consumer trust in a thriving digital economy but does not undermine the government's ability to maintain control (Sacks, 2019). In summary, reputation, ethics, and laws play an essential role in the involvement of AI in the gaming sector (Lazcano et al., 2018), thus should be considered.

## Considerations

### Ethics

Ethics is a branch of philosophy concerned with concepts of right and wrong conducts (Clarke, 2018). Although discussed in the casino's legal responsibilities, RG is one of the most important ethical responsibilities (Chen McCain, Lolli, Liu, & Jen, 2019). Carroll's (1979)

proposed four dimensions of CSR under the social performance model: economic, legal, ethical, and philanthropic. RG provides further insights into understanding CSR in the context of the casino (Song et al., 2012). Gambling researchers (Song et al., 2012; Lee et al., 2013) suggest RG be incorporated into the ethical dimension of the CSR framework as both RG and ethical CSR dimensions refer to ethically-driven activities associated with the company's business. Outside academe, most publications that offer advice appear to be motivated not by the avoidance of harm to affected values, but rather the protection of the interests of organizations conducting analyses and using the results (Clarke, 2018). As the scope of AI is not yet truly comprehended or regulated (Doshi-Velez et al., 2017; Lazcano et al., 2018), AI can become a sophisticated and dangerous tool to promote gambling (Lazcano et al., 2018). Ill-advised uses of AI need to be identified in advance and nipped in the bud, to avoid harm to important values, both corporate and social (Clarke, 2018). Accordingly, it is very important to implement strategies that enable a gambler to remain in control during the gambling session so that gambling-related decisions are made in a rational manner (Santos, 2017). In other words, AI technologies have practical value, and they should be applied in ways that achieve benefits without incurring disproportionate harms or giving rise to unjustified risks (Clarke, 2018).

The key areas of challenge and opportunity regarding RG fall clearly into three categories: enabling informed choice, improving self-awareness, and creating supportive environments (Revealing Reality, 2017). Informed decision making is critical to mitigating risks associated with PG behaviors, and providing information on product risk could serve freedom-preserving public health intervention (Hassanniakalager & Newall, 2019). It is fundamental that the individual is presented with all relevant information, in a timely fashion, to make an informed choice (Parke, Harris, Parke, Rigbye, & Blaszczynski, 2014, p. 31).

As a consequence, some organizations and gaming operators are beginning to offer players information about common gambling myths and erroneous beliefs (Santos, 2017). AI has been integrated into game design, and various other applications and RG tools. Interactive pop-up messages and animated information that provide proper and sound guidance during gambling sections can change both irrational beliefs and behaviors (Auer & Griffiths, 2014; Auer et al., 2015). Animated educational information on slot machines (EGMs) can be effective in enhancing user adherence to pre-set limits (Auer & Griffiths, 2014; Auer et al., 2015). The personalized feedback system has been developed for RG purposes through simulation-based AI. Personalized behavioral feedback within a motivational framework appears to be both an effective and accurate path of changing gambling behavior in a positive way (i.e., players notably curbed the amount of time and/or money they spent gambling after receiving personalized feedback (Santos, 2017).

Furthermore, players can now access general advice on healthy and responsible gambling, which is now often available on online gambling websites (Auer & Griffiths, 2014; Auer et al., 2015). Bonello & Griffiths (2017) conducted research examining the RG practices of 50 of the world's biggest online gambling operators, with some measures worthy of replication. Each online gambling operator's website was examined in further detail by checking for a wide range of RG practices including whether the operator provided (a) dedicated RG page, (b) warning(s) that gambling can be harmful, (c) reference or referral to a problem gambling help organization and/or self-help groups, (d) a self-assessment test for problem gambling, (e) information about the RG tools offered by the operator, (f) links to gambling filtering software such as GamBlock and/or Betfilter, (g) initial age checks during the account registration phase,

and (h) availability RG tools (e.g., limit setting facilities, cooling-off periods, self-exclusion periods, etc.).

Also, concerns have arisen regarding the ethics of the use of machine learning and other data science techniques (Nadler, Raz, & Zalmanovici, 2019). There is an unreachable core of privacy that is deeply intertwined with the universe of personal data of the casino (Santo, 2017). Patil, Mason, and Loukides (2018) provide ethical guidelines for the development of ML-based systems. They emphasize "The Five Cs": consent, clarity, consistency and trust, control and transparency, and consequences. Of these, significant emphasis is put on obtaining truly informed consent for the use of personal data (Patil et al., 2018).

**Regulations**

There are currently no AI-specific laws regarding gambling (Socialnomics Trend, 2019; Clarke, 2018; Lazcano et al., 2018). Applications of new technologies are generally subject to existing laws (Clarke, 2018), of which the various forms of commercial law, particularly consumer rights laws, and copyright and patent laws, are guiding the use of AI (Clarke, 2018). In some contexts (such as robotics, cyborg artifacts, and AI software embedded in devices), product liability laws may apply (Clarke, 2018). Other laws that assign risk to innovators may also apply, such as the tort of negligence, as may laws of general applicability such as human rights law, anti-discrimination law, and data protection law (Clarke, 2018). The obligations that the corporation law assigns to company directors are also relevant (Clarke, 2018). Further sources of regulatory impact are likely to be the laws relating to the various industry sectors within which AI is applied, such as road transport law, workplace and employment law, and health law (Clarke, 2018).

Genuinely disruptive technologies have features that render existing laws ambiguous and ineffective (Clarke, 2018). When a machine learns on its own, programmers have less control (Hyman & Ladanyi, 2019). Mishandling of personal data and issues about data security and privacy will happen if there is a lack of enforcement due to obscure legislations. The ML results are only as good as the data on which they were trained and the data they receive during production (Nadler et al., 2019). On the other hand, data governance laws and policies need to dictate when and how personal and other sensitive data may be used (Nadler et al., 2019).

Laws regulating how data, especially personal and other types of sensitive data, may be used vary in different countries and industries (Nadler et al., 2019). In the United States, the supreme court provides fairly strong privacy protections against government data collection, but the country still lacks a comprehensive consumer privacy law (Sacks, 2019). In practice, privacy laws have typically been industry-based, for example, with HIPAA governing the health care industry as it relates to digital health data (Nadler et al., 2019). Only the state of California has passed a new privacy law that will go into effect in 2020 (Nadler et al., 2019).

Different from the U.S., Europe focuses on strong controls on businesses and relatively high trust in government data collection practices (Sacks, 2019). The European Union (EU) has made efforts that lead to the creation of the General Data Protection Regulation (GDPR), a data privacy law effective on May 25, 2018 (Clarke, 2018; Lazcano et al., 2018; Nadler et al., 2019; Sacks, 2019). It aims to strengthen data subject privacy protection, unify the data regulations across the member states, and broaden the territorial scope of the companies that fall under its jurisdiction to address non-EU companies who provide services to EU residents (Nadler et al., 2019). Also, in China, regulators have been building out a framework with rules for consent, personal data collection, use, and sharing, and user-requested deletion of data (Sacks, 2019). The

first milestone in China's data protection system, a standard called the Personal Information Security Specification, took effect in May 2019 (Sacks, 2019). With U.S. inaction on federal data privacy and consumer rights, China and Europe currently stand as the only two models offering guardrails against invasive data collection (Sacks, 2019).

While the laws and standards differ, they tend to be similar in their goals of (1) ensuring transparency about what personal data is collected and/or processed and for what purpose, (2) providing more control to data subjects about the purposes for which their personal data may be used, (3) enabling the data subject to receive, repair, request the deletion of personal data in some situations, and (4) data minimization (Nadler et al., 2019).

In addition to laws that supervise the use of AI, self-regulation has also gained the attention of researchers. Some researchers claimed that self-regulation is very useful (Lazcano et al., 2018). According to Lazcano et al. (2018), in the development of the gaming industry over the years, no private company or entity has the authority to unilaterally establish standards and certifications that are reliable and will effectively guarantee the safety of consumers. Self-regulation allows the experience acquired by different entities belonging to the same industry to establish certain basic guidelines, especially regarding consumer protection (Lazcano et al., 2018). While other researchers (see e.g., Clarke, 2018) view organizational self-regulation as almost always ineffectual from the viewpoint of the supposed beneficiaries, and often not even effective at protecting the organization itself from bad publicity. While different in option, both recommend risk control practices and trustworthy certification since the scope of AI is not yet truly comprehended or regulated.

## Summary

Despite various benefits AI technologies bring to society, there are still risks associated with the use of AI. Multiple factors contribute to wrong reasons that lead to the underuse, overuse, or misuse of such technological advances. We are facing a lack of regulations to prevent the misuse of technological advances. Other challenges facing AI include a lack of transparency and interpretability in decision-making, issues of data quality and potential bias; safety and security implications; considerations regarding accountability; and, its potentially disruptive impacts on social and economic structures (Hyman & Ladanyi, 2019). In order to provide safe environments for gamblers (both online and offline), the government, the gambling operators, and those advocating individual harm minimization must progress together to address AI-related technical, ethical, and legal issues (Blaszczynski et al., 2011). Such collaborations need to foster the alignment of standards and codes of conduct while ensuring the interoperability of laws and regulations.

Existing literature points out that organizations should follow data security and privacy policies to implement AI technologies. Mindful and comprehensive regulations need to be set to establish clear boundaries for AI functions and to establish proper accountability in case this results in a breach (Lazcano et al., 2018). In addition, without the existence of a prior regulatory framework, principles and recommendations are necessary to guide risk management and management processes. The topics are broad. It could be ethical considerations in deployment and design, ensuring the interpretability of AI systems, empowering the consumer responsibility in the deployment of AI systems, ensuring accountability, and, creating a social and economic environment that is formed through the open participation of different stakeholders (Hyman & Ladanyi, 2019). The most important is the need to take action to establish control measures to

ensure AI remains at the service of humankind. Based on the literature review, several high-level principles and recommendations will follow in the next section, with the focus on the AI applications, particularly in the gambling industry.

# PART THREE

## Introduction

A large number of gambling operators have incorporated specific responsible gambling (RG) measures as a unique approach to enhance their corporate social responsibility (CSR). Artificial intelligence (AI) based technologies are often used as a vehicle implementing these measures. The use of AI for RG serves two purposes: increased player protection and more stable, long-term revenue flows to gambling operators (Percy et al., 2016). The second one can translate to increased patronage because of greater security and satisfaction. As a critical approach to AI, machine learning (ML) algorithms can exploit the correlation and interaction between variables in a multivariate way, an utmost difficult task for humans, to identify risky patterns and determine which player attributes correlate with positive behavioral changes. RG measures are only applicable in gambling environments where players can be identified or tracked behaviorally (Auer, Litler, & Griffiths, 2015). Thus, the technological mechanisms set by AI can help to develop better RG strategies and safe play guidelines for players.

However, AI technologies encountered a low degree of acceptance and adoption in the gambling industry. This paper aims to recommend the best practices that can address the issues facing the use of AI in RG practices. Within the literature explored in this paper, such issues include a lack of transparency and interpretability of AI systems, issues of data security and quality, legal and ethical considerations, accountability, and other issues. The focus of discussion in this chapter will be on finding the gaps in existing literature, exploring the feasibility of each proposed AI solution in RG practices, and coming up with the possible ways of combining AI and RG. Implications for future research will be provided in the end.

## Results

AI is a new and complicated field that goes beyond the grasp of most of the population, leading to the underuse and misuse of AI. The misuse of AI in gambling could bring harm to society. Security issues and potential losses to organizations also occur when a machine learns on its own to escape human control. Within the literature explored in this paper, technical, ethical, and legal concerns are the main factors that have to be addressed to enhance the effective and responsible use of AI.

### Technical

Machine learning algorithms have proved efficient in analyzing and identifying patterns (Cerasa et al., 2018; Gustafson, 2019; Hassanniakalager & Newall, 2019; Percy et al., 2016). Various gambling studies have explored features that can be used to predict PG, such as behavioral features, personality biomarkers, game types, player profiles, and RG tools. As the complex interaction among these factors is poorly known and highly heterogeneous (Cerasa et al., 2018), differences that are important to differentiate PG gamblers from others remain undetected. ML algorithms can exploit the correlation and interaction between variables, the importance of which is reflected in the literature (Auer and Griffiths, 2014; Cerasa et al., 2018) reviewed in this paper. Cerasa et al. (2018) mentioned that personality traits should be considered, together with other factors, as a marker for gambling symptoms, which can potentially be used to assess individuals' vulnerability in the clinical setting. Auer and Griffiths (2014) argued that it is important to understand the interaction between player attributes and other factors, such as game types, to implement RG tools successfully. Different parameter choices for the gambling behavioral markers or the inclusion of additional behavioral markers may result in higher-performing models (Percy et al., 2016).

In terms of what algorithms to apply, supervised ML is the most common one in use. Supervised ML can factor in complex interrelationships and interactions between the independent variables to improve prediction (Philander, 2014). Thus, it is recognized as a more effective algorithm in prediction than other ML approaches. Among supervised learning methods, random forests make the most accurate prediction (Gustafson, 2019; Percy et al., 2016; Philander, 2014; Sarkar et al., 2016), and the best performing decision tree was generated from neural networks (Sarkar et al., 2016).

While the ML methods offer good prediction performance, their effectiveness will be limited by the machine's inability to explain its decisions and actions to users, raising serious questions about transparency. A result of the loss of decision transparency is the undermining of organizations' accountability for their decisions and actions (Clarke, 2018). A set of control practices need to take place to hold AI systems accountable and keep them under human control.

**Ethical**

There are pros and cons that are associated with the use of AI. How to use AI system in gambling responsibly? Ethical considerations in this paper include two parts: RG practices, which is the ethical dimension of CSR, and the responsible use of AI systems. The first one aims to minimize risks associated with problem gambling behaviors, and the second one focuses on reducing the harm related to the misuse of AI technologies. Gambling operators and regulators need to consider both when coming up with the control measures for the use of AI in RG practices.

From the RG perspective, the key areas of challenges and opportunities fall into three categories: enabling informed choice, improving self-awareness, and creating supportive environments (Revealing Reality, 2017). As such, gambling operators have incorporated a set of

RG measures and various AI-based social responsibility tools. It could be loss or deposit limits, time-outs, self-exclusion, markers of harm, or the new UK credit card ban (Johal, 2020). Information about important aspects of gambling (e.g., the knowledge about gambling products, services, and PG prevention tools, as well as the information related to the associated risks) has become a cornerstone of responsible gambling that operators regularly offer (Auer, Litler, & Griffiths, 2015). Auer, Litler, and Griffiths (2015) have examined social responsibility tools through extensive literature review and pointed out the personalized feedback, the setting of time and money limit are the most useful features. Setting of limits can be designed as an involuntary or voluntary system, with voluntary limit setting the preferred option by players (Auer et al., 2015).The pop-up messages during the gambling section are more effective than static messages to display RG information to improve players' awareness about RG, and to implement RG intervention strategies as well (see Gustafson,2019).

**Regulatory**

ML approaches often use large amounts of data, commonly referred to as “Big Data.” (Chen, 2019; Hong, 2019), quietly tracking player activities and profiles (Santos, 2019). Such an application raises questions about the risks of oversharing of information at the expense of user privacy (Hyman & Ladanyi, 2019). As there are no AI-specific laws, the ecosystem overlaps with subjects related to internet governance and policy, such as privacy and data laws (Clarke, 2018; Hyman & Ladanyi, 2019; Lazcano et al., 2018), which are not efficient to solve issues regarding data handling (Lazcano et al., 2018). Self-regulation is proposed as a strategy to assist privacy regulations in guiding the use of data (e.g., see Lazcano et al., 2018; Sacks, 2019). No private companies or entities have the authority to unilaterally establish reliable standards and

certification to guarantee the safety of consumers, raising the question about the trustworthiness and reliability of self-regulation (Clarke, 2018; Lazcano et al., 2018).

## Conclusion

### Data Privacy, Security and Governance

The possibility of AI evolving and altering its tasks beyond initial configuration by itself or autonomously communicating with other systems that had not been authorized by users is something that needs to be carefully revised (Lazcano et al., 2018). In addition to privacy and data laws that currently guide the use of data, trustworthy certifications, and risk control practices need to take place to enhance an organization's self-regulation. In the gambling industry, different stakeholders such as gambling regulators, operators, public health institutes, and other parties of interest should work together to establish clear boundaries for AI functions.

Clarke (2018) claimed, "The responsible application of AI depends on risk assessment processes being conducted from the perspective of each stakeholder group, to complement that undertaken from the organization's perspective." The intervention of the respective authority or regulator will always be required to guarantee the consumer's protection (Lazcano et al., 2018).

Regulations must be put in place so that any protected terms collected by AI system designers are used only to ensure that the AI system is designed correctly, and not for other purposes within the organization (Doshi-Velez et al., 2017). Gambling companies need to establish a process to adopt new standards as legislation and regulation changes. The cooperation across all gambling platforms enables better player protection in a more efficient way. For example, gambling companies can connect the API so that the API can send notifications to or disable gambling on all platforms for players who receive the highest possible score on the red-flag scale (Gustafson, 2019). Gambling operators with a consistent performance in the

responsible use of AI systems will receive trustworthy certifications that are recognized by the public and customers. Only authoritative third parties, such as regulatory institutes or treatment providers, are qualified to award such certifications. The collaboration among different stakeholders enables the interplay of mindful and comprehensive regulations, organizations' internal policies and process (e.g., RG programs and AI system design), and strict auditing standards by third parties, and eventually keep the use of AI under human's control.

**Ethical Considerations in Deployment and Design**

Moral boundaries regarding AI need to be set out for the sake of the long-term stability of gaming leisure (Santo, 2017). Gambling companies should set out a policy that restricts the mischievous use of AI-led technologies, and instead use machine intelligence to inform responsible gambling strategies (Santo, 2017).

A central focus of the current governance efforts relates to the ethical dimensions of artificial intelligence and its implementation (Hyman & Ladanyi, 2019). Patil, Mason, and Loukides (2018) provide ethical guidelines for the development of ML-based systems, with an emphasis on "The Five Cs": consent, clarity, consistency and trust, control and transparency, and consequences. They highlight the importance of obtaining truly informed consent for the use of personal data, consistent with the standpoint held by Hassanniakalager and Newall (2019), who claimed that enabling informed decision making is critical to perform effective RG implementation. Gambling companies need to establish a set of strategies to ensure informed choice. A useful reference could be the measures proposed by Bonello and Griffiths (2017) when examining the RG practices of 50 of the world's biggest online gambling operators (refer to part two of literature review). Various RG tools, which are enabled by artificial intelligence, ambient intelligence, and surveillance, are available to inform policy, training, and enforcement content

more effectively, and eventually help players control their gambling. The combination of AI tools and RG measures enables informed choice, improves self-awareness, and creates supportive environments, three critical factors that affect the effectiveness of RG practices.

**Data Quality**

To effectively advance the field of responsible gambling data mining, progress in two areas are essential: expanding the behavioral marker literature and improving the efficiency of existing models (Philander, 2014). In other words, the appropriate choice of both ML measures and ML algorithms is important. The comparison of various studies shows that adding more inputs should boost predictive power. However, Hassanniakalager and Newall (2019) claim that adding more inputs can increase the risk of 'overfitting', where chance random associations are discovered and erroneously predicted to recur in the prediction phase, hence leading to poor prediction-phase performance. Appropriate machine learning model choice thus depends on the underlying data's statistical properties (Hassanniakalager & Newall, 2019).

To better retrieve features for ML models, data collection strategies are equally important. It could be either a thorough identity check during players' registration process in an online gambling environment (Auer, Litler, & Griffiths, 2015) or a user-friendly API platform (Gustafson, 2019) that makes it easier to collect reliable player data. A multi-functional API needs to be integrated into a corporation's gambling platform, allowing operators to gather real-time information about users and notify the user immediately if identified markers of addictive behavior are taking place.

**Transparency, Interpretability, and Accountability of AI Systems**

The industry does demand models that are interpretable for professionals and can provide information to affected users. Doshi-Velez et al. (2017) claimed that AI interpretability could be

a useful tool for holding AIs accountable, and proposed three considerations to achieve AI interpretability-more explainable models, the explanation interface, and psychological requirements.

Mapping inputs and intermediate representations in AI systems to human-interpretable concepts requires both the raw input and the associated concept are given (Doshi-Velez et al., 2017), where supervised ML has become increasingly relevant. Within the literature reviewed, the TREPAN knowledge extraction algorithm could be an explainable model, and the most successful extraction method (Percy et al., 2016; Sarkar et al., 2016). When paired with the use of more accurate supervised learning approaches such as neural networks, the TREPAN can enhance the interpretation of a complex model via a simple logical rule presentation and, in the meantime, keep the loss of accuracy minimal (Doshi-Velez et al., 2017). The reduced form model is human-readable and can be translated into a series of statements that are meaningful to domain experts (Percy et al., 2016). Simultaneously, it is possible to trace the route of an individual gambler through the decision tree to identify at which points they become more or less likely to be assessed as a self-excluder (Percy et al., 2016).

Making the interface explainable requires a careful design of API and RG tools with functionalities that enable gambling regulators, operators, and players better understand, thus effectively use AI systems. For example, the API should be user-friendly or have features that allow real-time information collection, translation, and notification. Innovative elements in RG tool design (e.g., visual ads in return-to- player warning labels) could boost gamblers' risk understanding (Hassanniakalager & Newall, 2019).

Some researchers also recommended that humans should be in control, to make AI systems accountable (Hyman & Ladanyi, 2019), and recommend "Human in the Loop" oversight

of algorithms (Percy et al., 2016). AI systems lack awareness of legal and ethical limits. The autonomous decision making of algorithmic power should not impede the final decision by a human operator. In the context of analysis of player communications data, operators need to track and categorize the frequency, intensity, and complexity of interactions of variables to see if any red flags emerge (Percy et al., 2016). Adding a human-in-the-loop check after the algorithm's result has increased the chances of identifying harm correctly while, at the same time, not inconveniencing the core player base (Percy et al., 2016).

## Recommendations

RG practices and the responsible use of AI systems are two independent fields in extant research. This study offers the opportunity for the first time to combine both in the analysis. This paper recommends solutions for the use of AI in RG from the technological, organizational, and environmental perspectives (the regulatory environment in this paper). In terms of data governance and quality, the solution lies in the right choice of innovative features, ML measures and algorithms, RG tools, and data collection platforms, as well as in the careful deployment and design of AI systems. Organizationally, gambling companies need to implement strict control practices such as RG measures, risk management, and process, and ethical policies. Enabling informed decision-making and adding a "Human in the Loop" oversight of algorithms are two essential factors in successfully implementing these controls. In the environmental context, different stakeholder groups need to collaborate to establish mindful regulations and policies that set boundaries for AI functions.

There are no existing answers in the literature reviewed for the research question, "what are the criteria and processes for the use of artificial intelligence tools in a casino's responsible gambling practices." The recommendations in this paper, through an extensive literature review

of both AI and RG, represent the first set of proposed solutions that have implications for the responsible use of AI in RG practices. This paper thus helps gambling regulators, operators, and players better understand AI systems, thus using them more effectively and responsibly. And, as the use of AI is a very new subject to responsible gambling, there is almost no literature in this field, and this study fills up this gap in the academic field.

The implication of this paper is limited to the lack of existing regulations and guidelines for the use of AI in RG practices. Among the articles reviewed, AI use in PG identification and various AI-based RG tools are relevant topics. Still, there are only a few studies on these topics. During the investigation, it is hard to find principles that can guide AI applications in RG practices, such as RG identification, education, notification, and intervention. The practices for the general use of AI are the primary references for the solutions proposed in this paper. The replication of the result of this study to RG practices needs further test and validation. To serve this purpose, more thorough research methods such as surveys and focus groups are necessary for future research, which also requires the participation of different stakeholders in the RG field, such as gambling regulators, operators, researchers, and treatment providers. In addition, how to use the API to notify players remains a question that needs further exploration.

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