The complex relationship between return-to-player percentage and problem gambling: A literature review and analytical framework

Per Binde, Ph.D.[1*]

[1]Department of Public Health Sciences , Stockholm University, Stockholm, Sweden
ORCiD: 0000-0002-4875-8115
*Corresponding author: Per Binde, per@binde.se

Abstract: Some gambling companies, regulatory authorities, and researchers consider a high return to player (RTP) percentage to be a risk factor for problem gambling (PG). If this is true, regulating RTP level could play a crucial role for preventing PG. However, there are no empirical studies confirming this assumption. The aim of this article is to review the literature and on basis of that discuss in what ways and to what extent RTP percentage might relate to the risk of PG. The method used is inductive reasoning based on the synthesis of earlier research, consideration of general theories on gambling behavior, and observations regarding gambling markets. The discussion is facilitated by a proposed analytical framework for understanding and exploring the complex relationship between RTP and PG. The main result of the analysis is that high RTP forms of gambling are associated with PG primarily because of well-known PG risk factors that are commonly co-occurring with high RTP, such as rapid game frequency, high play continuity, and conspicuous sensory stimuli stimulating gambling. RTP in these forms of gambling cannot be significantly lowered because it would be commercially unviable. In forms of gambling in which RTP is relatively low but can be substantially increased, this may have effects that both heighten and lower the risk of PG. None of these effects are likely to be strong and might cancel each other out. The conclusion is that high RTP alone does not significantly contribute to the risk of PG.

Keywords: Gambling, Problem Gambling, Price of Gambling, Gambling Regulation, Return-to-Player, Risk.

Introduction

Return to player (RTP) refers to the percentage of wagered money paid back to gamblers over time. RTP is also known as the "payout ratio" or "payback percentage," while "hold percentage" and "house edge" are the inverted measures for the proportion of wagered money kept by a gambling company. These quotas represent the price of gambling, what players pay to participate in gambling. Therefore, in principle, a high RTP means a low price of gambling.

This article takes as its starting point the assumption made by some gambling companies, regulatory authorities, and researchers that high RTP is a risk factor for problem gambling (PG). The assumption will be discussed, with examples from the Swedish gambling market, and an analytical framework, for exploring and understanding the complex relationship between RTP and PG, will be proposed. The framework formalizes and organizes standpoints and conclusions from earlier research. This seems to be the first academic text published in a peer-reviewed journal focusing on the relationship between RTP and PG. The arguments and analytical framework presented are of interest to policy makers and gambling regulators, and to gambling scholars with an interest in the determinants of gambling behavior. The discussion is also valuable more generally for gambling studies, as it concerns factors that are commonly assumed to be correlates of PG and addresses the question of how the price of gambling might influence harmful gambling consumption.

Background: RTP and PG

The assumption that high RTP is a notable PG risk factor

In Sweden, it has been argued that high RTP is a risk factor for PG, and consequently, that games with high RTP should be regulated more strictly than low RTP games, and/or a highest RTP level should be set for each form of gambling.

For example, the Swedish horse betting company ATG argued, when outlining its preferred principles for Swedish gambling regulation, that a highest RTP level should be set for each form of gambling, with no form being allowed to offer more than 90% RTP (ATG, 2015). The company considered such a principle to be important for PG prevention as it assumed that the higher the RTP, the greater the risk for a form of gambling to cause or maintain PG.

Another example is the 2008 Swedish governmental inquiry into gambling regulation, which considered high RTP to be a PG risk factor (SOU, 2008, section 16.4.2). As a PG preventive measure, the inquiry proposed a taxation model that would limit the growth of high RTP forms of gambling.
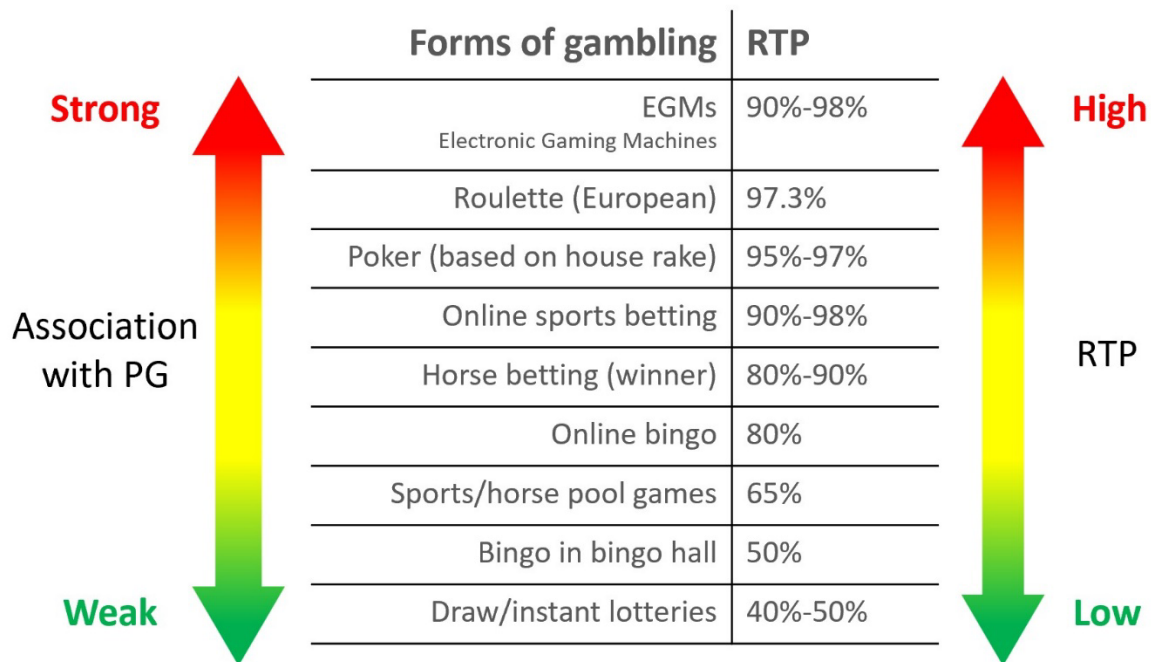
Not only stakeholders in the gambling market have assumed that high RTP is a risk factor for PG, but also researchers. The gambling risk

assessment instruments Gamgard (Cousins, 2018) and the Finnish Tools for Responsible Games (Airas, 2011) both include RTP as a specific risk factor. The similar instrument ASTERIG (Blanco et al., 2013) includes the risk factor "chance of winning a profit," which in practice often means RTP (Delfabbro & Parke, 2021).

High RTP covariates with high PG risk

The idea that high RTP is a risk factor for PG appears to be based mainly on the observation that RTP level often covariates with PG risk. Figure 1 shows typical RTP levels in various forms of gambling in Sweden, as well as the approximate strength of their association with PG (Binde et al., 2017; Wall et al., 2021). The precise order, from weak to strong association with PG of these forms, might vary between countries and time periods, but the general pattern shown in Figure 1 is currently valid for many jurisdictions in the Western world (Binde, 2011; Gainsbury et al., 2019; Williams, Volberg, et al., 2012).

Figure 1. Typical RTP levels of various forms of gambling in Sweden and the approximate relative strength of their association with PG

Forms of gambling	RTP
EGMs — Electronic Gaming Machines	90%-98%
Roulette (European)	97.3%
Poker (based on house rake)	95%-97%
Online sports betting	90%-98%
Horse betting (winner)	80%-90%
Online bingo	80%
Sports/horse pool games	65%
Bingo in bingo hall	50%
Draw/instant lotteries	40%-50%

Note: The figure does not include forms of gambling for which there are no data on PG prevalence in Sweden, such as the casino games Blackjack, Sic Bo and player-versus-house poker games.

A more theoretically grounded reason – derived from consumer studies – for assuming that high RTP is a risk factor for PG can be discerned in the argumentation of Swedish stakeholders and authorities: high RTP suggests that gambling is offered at a low price, and therefore consumption is assumed to be stimulated. Consequently, overconsumption – that is, PG – might increase (SOU, 2005).

Method and the organization of the article

Empirical data discussed here are mostly from Sweden and selected to exemplify general circumstances relating to RTP and PG. These data have been derived from government and other official publications and reports. The analysis of RTP and PG uses inductive reasoning, draws on and synthesizes earlier research, and considers general theories on gambling behavior.

An outline of the article's somewhat unconventional organization, compared with journal publications analyzing a particular data set, is in place. In the next section, a narrative review of the literature outlines what has been written on the relationships between RTP, gambling consumption, and PG. Then follows the inductive analysis, which has three parts. The first concerns fast-paced high-RTP games, the second part is about slow-paced games with variable RTP, and the third part presents and applies the analytical framework for understanding variable RTP in relation to PG risk. In the concluding section, the strengths and weaknesses of the analysis are pointed out, topics for future research are suggested, and a policy recommendation is made.

Narrative review of the literature

Most of the works included in this narrative review of the literature was collected by the author when he was, for more than a decade, involved in Swedish gambling regulation and wished to assess from an academic point of view the strength of stakeholder arguments regarding the relationship between RTP and PG.

For this article, a comprehensive search for additional relevant academic works was conducted in Google Scholar (January 2024) and in Scopus (April 2024). A rigorous systematic review – listing types of studies, populations, statistical significances, et cetera – could not be made because of the absence of works focusing on the core question of the relationship between RTP and PG. Therefore, the review was broad and scoping.

Google Scholar – which has the advantage to include also "grey literature", such as reports of various kinds – was searched for the word "gambling" occurring together with any of the words and phrases "payback", "return to player", "hold percentage", "payout ratio" and "price". All nine works for which the search criteria were met in the title were examined. The about 13.700 works for which the search criteria were met anywhere in the article were sorted according to relevance, as judged

by Google Scholar. The first 300 items listed were examined; thereafter very few works were of any actual relevance.

The search in Scopus used the same combinations of words as the Google Scholar search, but limited, because of Scopus' search options, to these occurring in the title, abstract or keywords of works. The search yielded 347 hits, which were all examined. The Google Scholar and Scopus searches yielded three works that were previously unknown to the author and apposite to refer to in this article.

Empirical Studies

There appear to be no empirical studies specifically on the impact of various RTP levels on PG prevalence. However, at least 20 studies have investigated the impact of different RTP levels on gambling behavior in relation to Electronic Gambling Machines (EGMs). Most of these studies explored the effectiveness of responsible gambling measures or sought to find the optimal revenue generating RTP level for casinos. Some studies also investigated theoretical assumptions about the determinants of gambling behavior. For reviews of the studies, see Lucas and Singh (2011; 2021) and Parke et al. (2016). Most of these studies found that EGM players do not detect differences in RTP level of just a few percent but show declining persistence in gambling if RTP is lowered more than that. However, one study found that EGMs with a 98% RTP have the optimal configuration of play reinforcing factors, more than EGMs with slightly more or less RTP (Harrigan & Dixon, 2010).

Another body of research is economic studies on the demand for gambling, which focus on price elasticity, that is, the degree to which gambling consumers are sensitive to price changes on the gambling market and the factors determining their sensitivity. As said, the price of gambling is in principle a function of the RTP: high RTP means low price, and vice versa. A thorough review of these studies is offered by Gallet (2015). The studies have found that the price of gambling matters for the level of consumption and that elasticity varies depending on factors such as the forms of gambling and regional differences in gambling markets. Several studies have found that draw lotteries have high price elasticity. This means that consumption is relatively sensitive to changes in price. Higher price makes fewer people enter the lotteries and/or spending less on lottery ticket purchases. Lower price has the opposite effect. Casinos and horse betting, on the other hand, have been found to have low elasticities (Gallet, 2015). It has been argued that this can be explained by casino gambling (as well as horse betting) being more addictive than draw-lotteries, and therefore have a higher proportion of price-insensitive regular participants who gamble excessively because of having PG (Ibid).

Taxation of gambling influences its price, and there are several studies on how consumption reacts to changing taxation levels. For example, a study in the UK concluded that changes in tax rates had a high impact on the demand for sports betting (Paton et al., 2004). It has been

argued that increased taxation of gambling might make gambling companies lower the RTP, which may lead to gamblers losing more money and a greater number of them experiencing harm from excessive losses (Newall & Rockloff, 2022).

A few studies have investigated consumer knowledge of RTP. For example, a Danish population study found that people with PG had slightly better knowledge of RTP levels of various forms of gambling than people without PG (Bonke, 2007, p. 51-53). Various modes of displaying RTP to gamblers, providing them with information that might help them make better choices if and on what to gamble, have also been explored (Beresford & Blaszczynski, 2020; Collins et al., 2014; Walker et al., 2019). However, people may not understand what RTP means, for example believing that a 90% RTP means that nine out of ten gambles will be a win or that out of ten gamblers, nine will be winners. Studies have shown that such misunderstandings decrease if house-edge information is given instead of RTP information (Newall, Walasek, Ludvig, et al., 2020). More generally, these and other studies suggest that informing gamblers about RTP in raw numbers has the drawback of high-RTP forms of gambling appearing to be a good consumer choice, while it may actually be a risky choice.

Discussions on RTP and PG

There seem to be only two previous substantial discussions on the influence of RTP percentage on the extent of PG, neither of them published in a peer-reviewed journal. Jonathan Parke (2010) reviewed the literature on RTP impact on PG and did not find any empirical study that specifically considered this impact. However, Parke found 13 empirical studies, all of which were experimental and focused on EGMs, that investigated the influence of RTP on gambling behavior. He concluded that none of these studies suggested that differences in EGM RTP, within a commercially realistic range, had an influence on gambling behavior. Parke also reviewed two studies on expert opinions and concluded that these key informants strongly supported the view that the level of EGM RTP percentage was unimportant compared with other game features influencing PG risk. Parke noted that there were two opposing views in the gambling field; one that maintains that increased RTP could contribute to PG by stimulating gambling demand and increasing the net expenditure of gamblers, and the other view that increased RTP might reduce net expenditure and PG risk.

A second substantial discussion on RTP and PG is a report by economist David Forrest (2010). Forrest was convinced that free competition in the gambling market leads to higher RTP. However, whether this would stimulate gambling consumption would be an empirical question that relates to the price elasticities of various forms of gambling.

In line with Parke (2010), Forrest (2010) maintained that a lower price of gambling may lead to a decrease, as well as an increase, in net gambling expenditure. In the first scenario, gamblers are content to gamble as much as before, but will pay less. In the second scenario, gamblers will

gamble more when price is lowered, but Forrest believed it was unrealistic to expect a significant increase in net expenditure. Forrest's reasoning implies that in the collective of gamblers, some individuals would belong to the first scenario, while others would belong to the second one. The proportion between these groups would be an empirical question, as would be the scenario proportions between forms of gambling.

Finally, Forrest (2010) discussed whether people with PG react especially strongly to a lowered price of gambling. He believed it to be the opposite: people addicted to gambling are less price-sensitive than others because they have an urge to gamble so strong that price means little.

In addition to these two reports, there are a small number of broader publications that include discussions on RTP and PG. The Australian Productivity Commission (1999, Section 19.6) discussed the price sensitivity of different types of gamblers but did not draw any clear conclusion. Robert Williams and colleagues (2012, p. 56–57) briefly reviewed the literature and came to the same conclusion as Parke (2010) and Forrest (2010): little is known about this issue, and there are arguments both for and against increased RTP leading to an increase in PG. They observed that for each form of gambling, there is an RTP range with the low end where players get just enough stimuli to keep them in action and the high end where players would be highly motivated to gamble but gambling companies would not make much of a profit. This has also been noted by other authors (Parke et al., 2016; Schwartz, 2013).

In the report "Key issues in product-based harm minimization" (Parke et al., 2016, section 7.2), the authors state that increased RTP may, in theory, have the effect of both stimulating gambling and lowering gamblers' net expenditure. They also argue that features of gambling games – such as RTP, volatility, event frequency, payout interval, near-miss events, losses-disguised-as-wins, and stake size – are interdependent and together impact player behavior and net loss.

Among these factors, volatility appears to be a particularly important factor influencing the relationship between RTP and gambling behavior (Palomäki et al., 2023). Volatility is the extent to which the actual outcomes of gambling sessions deviate from theoretical RTP. Blackjack is an example of a high-RTP low-volatility game, as players cannot win more than 1.5 times (3:2 payout) the money wagered in each deal of cards; a draw lottery is an example of a low-RTP high-volatility game, as the player in big lotteries may win a sum greater than a million times the cost of a lottery ticket. In low-volatility forms of gambling, the player gets an idea of the RTP level faster and more clearly than in high-volatility forms; in traditional draw lotteries, with a big top prize, it is virtually impossible for players to get an idea of RTP level from own playing experience (Turner & Shi, 2015). Thus, volatility is a crucial mediator between theoretical RTP and player experience of RTP.

Another such mediator is the payout table of games, that is, the proportions between high volatility big wins and low volatility small wins,

and wins in between (Turner, 2011). In draw lotteries the payout table is fixed but in multiline EGMs the player is free to choose payout proportions by selecting the number of "lines" (on the spinning reels) to bet on, as well as the size of each bet. Frequent players often chose the "min-max" strategy, that is, betting as low as possible on each line but on as many lines as possible. For a given amount of money, this strategy gives them longer time on the machine as well as more frequent wins, albeit small. Theoretical volatility is unchanged, but perceived RTP is likely to increase (Harrigan et al., 2014). The psychological motive for following the min-max strategy is evidently a desire to increase the reinforcement rate of a gambling session (MacLaren, 2015).

The min-max strategy increases the number of losses disguised as wins (LDWs). These are play outcomes that, by the EGM, by means of merry sounds and visual effects, is announced as a "win", although the net sum won is lesser than the sum staked. Research indicates that this EGM feature works as intended: "players physiologically respond to LDWs as if they are wins, not losses" (Dixon et al., 2018). Thus, a relatively low RTP may be disguised to the player by LDWs.

Theoretically, however, an increase in reinforcement rate does not necessarily means that gambling behavior would become more persistent. As Skinner showed in animal studies, a leaner, yet less predictable rate of reinforcement, might be the most effective in sustaining behavior (the unpredictable variable ratio, Skinner, 1953).

It may be unfeasible to formulate a general model of the interactions between volatility, RTP, payout table structures, reward characteristics of games, player behavior, and PG. Rather, each specific form of gambling might need to be considered by itself to determine the interactions between these factors (Percy et al., 2021). In the following inductive analysis, we will simplify matters by focusing solely on the RTP – PG relationship.

Inductive analysis

The basic approach in the inductive analysis – which gives it an advantage compared to previous advances in these question – is to separate two categories of games. First, fast-paced forms of gambling in which RTP is high but cannot be much lowered because that would make the games commercially unviable. Second, relatively slow-paced forms in which RTP can have notably different levels and still attract players when RTP is quite low.

Fasts-paced and high-RTP games

Almost all fast-paced and high-RTP games have three specific features: high event frequency, high continuity with long duration, and intense sensory stimuli. Examples of such games are EGMs, roulette, blackjack, and poker.

Event frequency refers to the speed of the game, the time it takes to complete each full sequence of (1) staking money, (2) the gambling event starts, runs, and terminates, (3) the result of the gamble is announced, (4) gamblers who have won receive money or credits, and (5) gamblers are allowed to make new stakes. For example, the event frequency of EGMs is high with about five seconds between reel spins, and the event frequency of blackjack, with three players at the table, can be up to two deals per minute. As a comparison, the event frequency of traditional draw lotteries is low, typically with one draw a week.

Continuity and duration. These two concepts are related. Continuity is the length of time between the outcome of a bet and the possibility to place a new bet. Duration is for how long time a player can go on gambling without having to quit when the physical of digital gambling establishment is shut down, for the night or for some other reason. For example, EGM and roulette have high continuity and long duration as players can continuously keep on gambling without interruption for many hours. In draw lotteries, continuity and duration is low, as the gambler typically must wait for days until the next draw.

Sensory stimuli are, for example, the constant sounds and visual effects of physical or online EGMs with the intention to stimulate play, or the ritualized movements and verbal announcements of a roulette croupier or a blackjack dealer in a physical casino. On the venue scale, casinos are designed to create environments perceived by guests as special, attractive, and exciting (Kranes, 1995). In contrast, draw lotteries offer few sensory stimuli.

In fast-paced games, the RTP cannot be significantly lowered. For example, a roulette with a 50% RTP would pay out only 0.5 to 1 for wins on red or black, not 1 to 1. It would not take long for most players to understand that they have no chance, in the long run, to avoid constantly losing money at a rapid pace. There seem to be no examples from the world of commercial gambling in which fast-paced, high-continuity and low-RTP games have been permanently operated.

High RTP is thus a requirement for commercially viable high event frequency and high continuity with long duration forms of gambling. However, such repetitive games run the risk of becoming boring to players, hence the need to add intense sensory stimuli to them. For example, an EGM without spinning reels with fancy symbols, with no sounds and no enticing visual effects, which silently displayed the amount lost or won on a tiny black-and-white digital display, would certainly not be attractive to players.

These three structural game features are without a doubt PG risk factors (for overviews, see: Goodie & Fortune, 2013; Parke et al., 2016; Walker, 1992). In high event frequency and high continuity with long dduration games, the gambler risks to become immersed and trapped in the action, a phenomenon known as being in the "zone" (Oakes et al., 2020), experiencing "flow" (Lavoie & Main, 2019) or, when particularly harmful, experiencing "dark flow" (Dixon et al., 2018). The design of EGMs is a

technical art form, in which all cognitive and behavioral features known to reinforce gambling behavior are utilized with the aim to make players stay on the machine as long as possible (Dow Schüll, 2013).

Furthermore, in long duration games there is no predetermined end to a gambling session, apart from the player having lost all money, as there is in a weekly draw lottery when the winning tickets have been drawn, or in a horse race when the horses have crossed the finishing line. In long duration games, the player must decide when to stop, which is a decision likely to be influenced by a variety of cognitions that, in theory, might be irrational but may appear reasonable during play. The gambler may believe himself or herself to be on a "winning streak" (Carlson & Shu, 2007) and therefore decide to continue playing. Alternatively, gamblers may believe that they have had a "bad beat" (Rosenthal, 1995), and therefore lost money repeatedly, which may lead to the belief that luck will soon change, that losses soon will be followed by wins, and for that reason, continue to play (Matarazzo et al., 2019). There are many such reasons to continue playing (Goodie & Fortune, 2013).

Moreover, sensory stimuli reinforce gambling behavior by connecting gambling activities with distinctive sounds, images, and environments. Activities that in themselves are quite trivial – such as placing a sports bet or pressing a button on an EGM and watching the reels spin – are imbued with positive significances and multifaceted symbolic meanings (Andrade, 2013; Lopez-Gonzales et al., 2017; Raento & Flusty, 2006).

In summary, high RTP emerges as a necessary component of gambling forms with well-known PG risk factors; therefore, RTP covariates with PG risk, as shown in Figure 1. These risk factors may sufficiently explain the association between high RTP and high PG prevalence in fast-paced, continuous forms of gambling, especially when they have intense sensory stimuli that facilitates behavioral conditioning of the player.

Slow-paced games with variable RTP

People participate in slow-paced forms of gambling, such as draw lotteries, sports pool games, and sports and horse betting, even if the RTP is relatively low, or at least not as high as it could be. As shown in Figure 1, such games have a weak or medium-strong association with PG.

Draw lotteries, including lotto, are often the most popular games in gambling markets, despite the RTP typically being as low as 40% to 50%. This can be explained by the distinctive feature of many of these lotteries: a top prize of often several million EUR or USD. People can buy a cheap lottery ticket, which for a while allows them to indulge in pleasant fantasies about how their lives would change for the better if they hit the jackpot (Binde, 2013; Howland, 2001; Kaplan, 1987). Thus, slow pace and discontinuity are essential for the attractiveness of draw lotteries.

In theory, it would be possible to offer a traditional draw lottery with a 90% RTP. In practice, however, gambling companies prefer to offer

lotteries with much lower RTP because people participate anyway. Furthermore, the operation of traditional draw lotteries is in many jurisdictions reserved for state-owned companies and non-profit organizations serving the common good. This means that there is no market competition that drive prices down (i.e., increase RTP).

The RTP of sports and horse pool games is in Sweden about 65%. In these games, gamblers usually participate using permutation systems, which cover many different outcomes of sports events or horse races. For instance, the Swedish weekly "Stryktipset" includes 13 soccer matches that may end with a home win, a draw, or an away win. In this game, a gambler may choose, for example, a 64 "line" permutation system in which two different outcomes are covered in six of the 13 matches, which costs about EUR 6. As there is in these types of games often a "quick-pick" option, in which the gambler buys a computer-crafted permutation system for a select cost, they can be like lotteries.

Betting on single sports events or horse races typically has a relatively high RTP. Some gambling companies offer 90% RTP or even higher, while others have customers who do not care about the precise RTP level, presumably because they gamble habitually or are loyal to the company and its brand. However, many betting companies offer combination bets, such as "exotic" bets in horse racing (e.g., the trifecta: selecting the first, second, and third finishing horse in a race) and complex soccer bets (e.g., player X to score a goal AND team Y to win). Even if these combination bets may appear as attractive to gamblers, they typically have considerably lower RTP than single bets (Newall, 2015). For example, the Swedish horse betting company ATG offers the Raket ("rocket") game, in which players choose the winner in up to seven consecutive trotting races. A win from race one is invested in race two, and so on until a race is lost or all races have been won. Because the RTP for a single race is 85%, the RTP of a seven-race Raket is only $0.85^7 = 32\%$. This is one of the most unfavorable gambles on the Swedish gambling market.

One should note, however, that some online forms of sports betting are nowadays quite fast-paced and continuous (Parke & Parke, 2019). People may bet not only before but also during sports events, while watching them on television, on various things to occur in the events, such as who scores the next point in tennis – this is called micro event betting. Bettors may deposit and cash out winnings almost instantly. One study found that micro event betting in Australia attracted almost exclusively people with PG (Russell et al., 2019). As the RTP of these bets is similar to those of ordinary sports bets, fast-paced and continuous sports betting, combined with the sensory stimuli of watching live sports events, seem to have created a relatively strong association to PG.

An analytical framework for understanding RTP impact on PG risk

We have earlier concluded that in fast-paced games, nothing suggests that a high RTP in itself is a notable PG risk factor and that other factors, co-varying with high RTP, give a good explanation for the association between such games and high PG risk. The question remains: how about slow-paced games, described in the previous section? The RTP of these games – such as draw lotteries, sports pool games, and sports- and horse betting – may vary from relatively low to relatively high. Would changes in RTP level in these games affect the prevalence of PG among those who regularly participate?

Theoretically, at least three factors might heighten PG risk if RTP is increased in relatively slow-paced forms of gambling, and at least three other factors may decrease or not affect the risk. This is shown in Figure 2, which is intended to portray a balance scale.

Figure 2. Balance scale depiction of factors increasing or decreasing/not affecting PG risk if RTP is increased in slow-paced forms of gambling
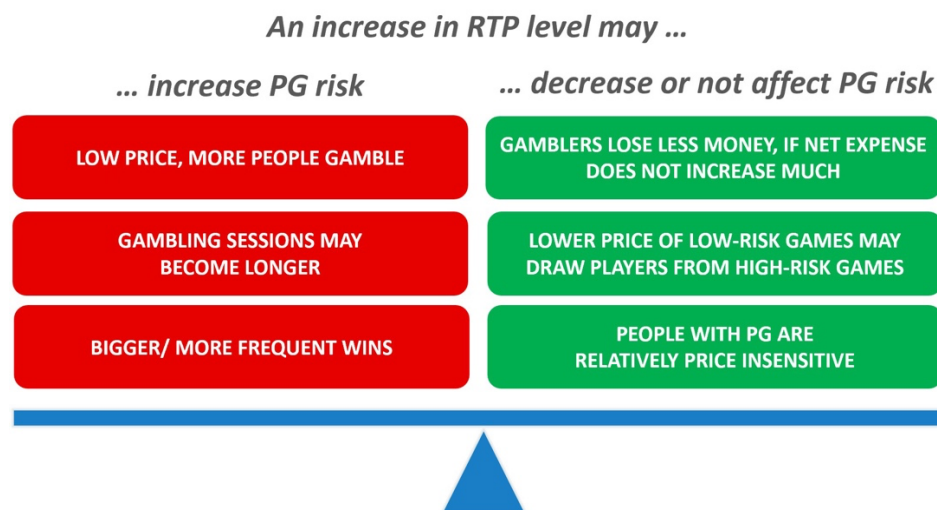
At the top left in Figure 2, we see that lower price might encourage more people to participate in a form of gambling. Consequently, the number of people with PG may increase if the total consumption model applies to that form of gambling (Kesaite et al., 2024; Rossow, 2019). Higher RTP may be in the form of bigger bonuses and accumulated jackpots, which are game features heavily promoted by gambling companies and known to be particularly effective in stimulating play (Binde & Romild, 2019; Hing et al., 2018; Lopez-Gonzales et al., 2020). However, a rise in RTP of that kind would not much affect players' net loss in everyday gambling.

Gambling sessions may become longer if RTP is increased, and the gambler sticks to his or her usual stakes. For example, horse bettors who have set aside a specific amount of money for a day at the races could, on average, continue betting at races for a longer period if the RTP would be increased. Probably, the risk of PG increases proportionally to the time spent gambling, because people with PG typically gamble for longer periods than recreational gamblers (Baggio et al., 2017; Williams et al., 2015).

An increase in RTP will result in bigger or more frequent wins, or both, depending on the prize structure of the game. This may reinforce gambling behavior. Behavioral conditioning will be more effective, which is a risk factor for PG (Clark, 2014; Haw, 2008). Additionally, "near misses", in which the gambler believes (rightly or wrongly) that he or she was close to winning, might become more common, which could increase the risk of developing or maintaining PG (Anselme & Robinson, 2013; Clark et al., 2009; Côté et al., 2003).

Moving now to the top row of the right-hand side of the balance scale in Figure 2, higher RTP means that the price of gambling is lowered. Thus, it becomes cheaper (net expense) to buy a specific "dose" of gambling, for example, to habitually bet on a football pools 64-line permutation system. Gamblers lose less money, and PG might decrease because losing much money is a key feature of PG. Furthermore, the incitement for "chasing losses" – that is, gambling more in the hope that money lost would be recovered by wins – would become weaker, as losses would become smaller and/or fewer. Chasing losses has been found to strongly correlate with PG (Gainsbury et al., 2014; Temcheff et al., 2016). As economic harm is the most common and direct harm caused by PG, it is reasonable to assume that, to some extent, an increase in RTP in some forms of gambling might prevent and counteract PG and gambling harm.

An example of the effects of a price cut in gambling is when the RTP of the Swedish soccer pool game Stryktipset in 2010 was increased from 46% to 65%. Gross turnover significantly increased, but at the same time, the long-term trend of decreasing net turnover continued (Svenska Spel, 2011, p. 27). Thus, the increase in RTP made people gamble more at Stryktipset but at the same time lose less money. In the years prior to 2010, Stryktipset was a medium PG risk game on the Swedish market (Binde, 2011), and nothing suggests that this changed in the following years.

Lower prices of low-risk games may draw players from high-risk games. For example, cheaper sport- and horse pool games may attract players who otherwise would participate in riskier forms of gambling. Research has shown that there is a variety of ways in which one form of gambling can substitute for another (Marionneau & Nikkinen, 2017); in economic terms, there are cross-price elasticities (Gallet, 2015).

Finally, it is probable that people with PG are relatively price insensitive. In severe cases, they often gamble until they have lost all they have. A bit higher or lower RTP is not likely to matter much to them. Furthermore, they tend to be attracted to high RTP games, such as EGMs,

which is a form of gambling with an RTP about as high as it can be. People with mild or episodic PG may also be less sensitive to the price of gambling than people without, as impaired control over gambling means that gambling decisions are not well considered. As it may be recalled from the literature review, people gambling at casinos or on horseraces, which are high PG risk games, are less sensitive to the price of gambling than those who enter draw lotteries, which have low PG risk (Gallet, 2015).

As illustrated in Figure 2, there are arguments both for and against an increase in RTP would increase PG risk in relatively slow-paced forms of gambling. None of the factors are likely to have a strong impact on PG prevalence. It may very well be that the factors – by and large – cancel each other out.

Concluding discussion

This article has reviewed the literature on the complex relationship between RTP and PG and, on basis on that review and through inductive reasoning making use of findings from gambling studies, an analytical framework has been proposed. The framework is based on two assumptions. First, forms of gambling can be separated into two groups: one in which a relatively high RTP cannot be lowered significantly because that would not be commercially possible, and a second group in which RTP can be altered. As for the first group of games, we conclude that their relatively strong association with PG seems to be adequately explained by game features that are tightly linked with high RTP, which are well-documented risk factors for PG. These factors are high event frequency, high continuity with long duration, and intense sensory stimuli. High RTP in itself need not be a risk factor. As for the second group of games in which the RTP can be raised significantly from a low level, the specific impacts on PG of such changes can be sorted into those that might increase PG risk and those that might reduce or not affect the risk. We conclude that neither of these effects would likely be strong, and the effects may cancel each other out. In this discussion, six specific impacts have been outlined, but others might be added.

The relationship between RTP and PG is complex (Parke et al., 2016, section 7.2; Turner, 2011), and the discussion here has only outlined the main possible connections and a few of the complications. The discussion has been much simplified to make it possible to address the issue of RTP and PG in the article format.

The scarcity of empirical research is a basic problem for discussing RTP influence on PG. More empirical research would be valuable, for example longitudinal studies of price changes in relation to PG indicators.

Gambling studies have researched many aspects of gambling, including game features, regulation, social and cultural contexts, and the psyche of gamblers. However, they have paid little attention to the price of gambling in relation to harmful consumption. This can be compared to alcohol studies, where the price of alcohol is widely considered to be one of

the key factors for the level of consumption of alcohol in society and hence for the population harms caused by this addictive substance (Anderson et al., 2009). Therefore, it would be valuable to theoretically and empirically consider similarities and differences in consumer behavior relating to the price of gambling compared with the price of alcohol.

The policy implication of this analysis is that it is largely pointless to consider the precise level of RTP in high event frequency and high-RTP games, such as EGMs, roulette, blackjack, and poker. It is impossible to significantly lower RTP and still offer these forms of gambling on a commercial market. As to other form of gambling, lowering, or raising, RTP percentage is not likely to have a strong effect on the prevalence of PG.

Statement of Competing Interests
None declared.

Ethics Approval
Not required. This is a literature review and analytical framework.

Declarations
An early version of the ideas in this article was presented at the EASG conference in Malta, 2018.
-   Binde, P. (2018) High return to player (RTP) percentage: A risk factor for problem gambling? (PPT-presentation). 12th European Conference on Gambling Studies and Policy Issues – European Association for the Study of Gambling (EASG). Valletta, Malta, September 11-14.

Research Promotion
Some gambling companies, regulatory authorities, and researchers consider a high return to player (RTP) percentage to be a risk factor for problem gambling (PG). This literature review and analysis found that high RTP forms of gambling are indeed associated with PG, but primarily because of well-known PG risk factors that are commonly co-occurring with high RTP, such as rapid game frequency, high play continuity, and conspicuous sensory stimuli stimulating gambling. The conclusion is that high RTP alone does not significantly contribute to the risk of PG.

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