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Risk awareness and complexity in students' gambling

Giuseppe Coco [*], Daniele Di Simone [†], Laura Serlenga [‡] and Sabrina Molinaro [§¶]

Abstract

Gambling is widespread among teenagers, requiring intervention to protect especially problem gamblers. The primary aim of the present study is to understand whether young problem gamblers are aware of the economic risks associated with gambling. Secondly, we introduce two gambling indicators that are new in the literature and are useful to public policy assessment: a measure of popularity of different gambling products in Italy and a gambling-pattern index. We analyzed 4025 students aged 15 to 19 years in a large-scale survey from the ESPAD®_Italia 2018 project (European School Survey Project on Alcohol and Other Drugs). An Ordinal Logit Regression is applied considering the SOGS-RA problem gambling indicator together with socio-behavioural sphere, gambling context and family related variables and a specific indicator pertinent to economic risk perception. The gambling context variables have been created using the bipartite network and complexity measures defined by Hidalgo-Haussman (2009), considering the number of games played by each student and how popular these gambling products are among the players. The results show that problem gamblers are aware of the economic risks associated with gambling, and at the same time tend to play more games and more unpopular games than non-problem gamblers. The likely effectiveness of different policies is discussed in the light of this evidence.

Keywords: Gambling risks, Risk awareness, Complexity, Network analysis.

JEL Classification: D81; D83; I12

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1 Introduction

Adolescence is characterised by a general exposure to risks (Furby and Beyth-Marom, 1992; Steinberg, 2007) such as drugs (Hawkins et al., 1992), smoking (Arnett, 2000; Reyna and Farley, 2006) and sex misconducts (Fergus et al., 2007; Tapert et al., 2001). Gambling disorder is one of those risks, which is defined by Diagnostic and Statistical Manual of Mental Disorders (DSM-5, 2013) as a "persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress". Gambling is widespread all over the world among young people. Several studies in Canada, Australia and the USA (Council, 1999; Splevins et al., 2010; Volberg et al., 2011; Welte et al., 2008; Yip et al., 2011) show a prevalence of youth gambling in the last 12 months ranging from 60 to 90%, with estimates of risk and problem gambling ranging from 10-15% and 4-8%, respectively (Blinn-pike et al., 2010; Gori et al., 2014). Italy is a particularly interesting case because from 1997 to 2010, following the introduction of new concessions and new types of gambling products, the gambling offer increased considerably (Resce et al., 2019). This deep liberalization led to large revenues for the Italian Treasury, making Italy one of the countries most involved in gambling, where about the 22% of total global spending occurs (Guiso, 2016; Resce et al., 2019) and where the treasury revenues are the highest in Europe (UPB, 2018). This increase in gambling expenditure (Figure 1) concerns both adults and the younger population group (Bastiani et al., 2011). Colasante et al. (2013) show a percentage of Italian adolescent players at risk of 14.8% and problematic players at 7.8% using the South Oaks Gambling Screen - Revised for Adolescents (SOGS-RA) psycometric test (Poulin, 2002; Winters et al., 1993).

Shead et al. (2010) highlight how often starting to gamble with friends and partners can become synonymous of normality and safety, with the consequent decrease in the perception of risk. A number of studies (Dickson et al., 2008; Ellenbogen et al., 2007; Labrador and Vallejo Achón, 2020) shows that young males are more likely to be risky or problematic gamblers than girls. Several analyses have also shown comorbidity among adolescents of problem gambling and other illegal or violent behaviour (Cook et al., 2015; Johansson et al., 2008; Temcheff et al., 2011) and higher consumption of alcohol (Hardoon et al., 2004; Rahman et al., 2014), stimulants (Geisner et al., 2016; Richard et al., 2019), tobacco or cannabis (Barnes et al., 2015; Cook et al., 2015; Khan et al., 2012). Recent studies have also demonstrated a relationship between gambling and cyberbullying (Escario and Wilkinson, 2019; Lee and Shin, 2017). The family and its structure also play an important role (Griffiths and Delfabbro, 2001; Reith, 2012). Greater emotional support from parents and greater control over their children are negatively associated with gambling (Hardoon et al., 2004; Molinaro et al., 2014), whereas having a gambling relative encourages gambling and problem gambling (Canale et al., 2016; González-Roz et al., 2017).

Among the new forms of betting available, online gambling, is correlated with problem gambling more intensively than on-site gambling (Kuss and Griffiths, 2012; Olason et al., 2010; Petry, 2006; Wood and Williams, 2007). Several possible explanations are discussed in the literature, such as the 24/7 availability, the absence of spatial/geographic limits and the poor age verification check (Derevensky and Gupta, 2007; Griffiths and Barnes, 2008). Labrador and Vallejo Achón (2020) show how online gamblers tend to bet more often, spending more time and money. Online gambling seems to be also positively associated with excessive use of video games and internet abuse (Hayer and Griffiths, 2015; Parker et al., 2013). Those issues appear even more important during the pandemic phase of COVID as people are more internet connected than they used to be.

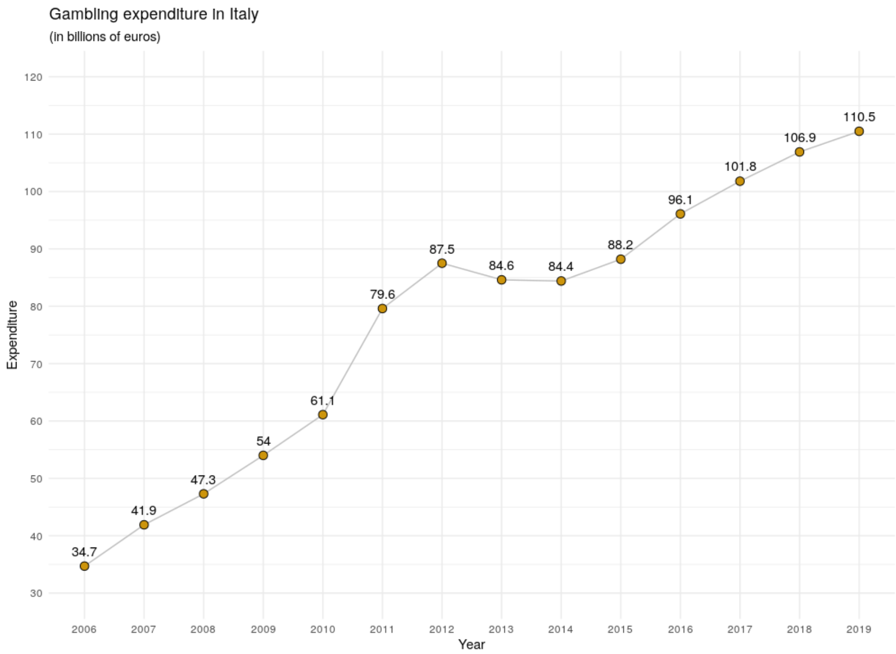


Figure 1: Gambling expenditure in Italy - Data Source: Forleo and Migneco (2017) and Italian Customs and Monopolies Agency (2019)

Traditional economic theory assumes that human behavior and decision making are based on rational choice (Becker, 1962; Gainsbury et al., 2018; Simon, 1955). Specifically, neoclassical economics asserts that people have consistent preferences and strive to maximize utility (Coats and Henry, 1991; Weintraub, 1999). In this world gambling is an anomaly to be explained. Some works have explored the possibility that gambling is associated to a specific "utility", though its compatibility with rational behaviour remains in doubt (Conlisk, 1993; Diecidue et al., 2004; Lewandowski, 2014), A lot of empirical research has increasingly provided evidence that individuals sometimes decide against their own long-term self-interest and gambling is a flawless example of this behavior, since "the dealer always wins" (Dassen et al., 2015; Gainsbury et al., 2018).

Behavioral economics asserts that people handles uncertain situations by exploiting a limited - and generally small - number of general heuristics (i.e. expedient that circumvents cost-benefit analysis) to simplify evaluations and make decisions more easily (Tversky and Kahneman, 1982a,b). These solutions generally work reliably, but they can also lead to errors denoted as "biases". Many biases are present in gambling, even between non-pathological gamblers (Blaszczynski and Nower, 2002; Delfabbro and Winefield, 2000; Miller and Currie, 2008). As indicated by Gainsbury et al. (2018), many common psychological biases referred to gambling originate from well-known heuristics. For instance, the phenomenon of the "gambler's fallacy" and the "hot hand" effect are based on the "representativeness heuristic". In other words, short sequences of events should represent the widest distribution of outcomes (Ayton and Fischer, 2005). Particularly, in the case of the "gambler's fallacy", after a sequence of the same outcome (e.g., four odd), negative autocorrelation is expected (e.g., even), whereas for the "hot hand" effect, after a sequence of wins or losses, positive autocorrelation is expected (Gilovich et al., 2002; Sundali and Croson, 2006). By analyzing the gambling scenario, examples of this effects are common, such as chasing losses, where players with a long losing streak believe that a win is coming, and in lottery players, where players avoid choosing consecutive numbers (Studer et al., 2015). The "illusion of control" heuristic is also widespread in betting, where players show increased confidence in their own ability (even though it is a game based on chance), related to the "overconfidence" effect and the "optimism" bias in behavioral economics (Langer, 1982). These gambling biases have been associated with increased spending and time spent gambling, despite the presence of losses (Graydon et al., 2012; Harrigan et al., 2014). Gambling places - and generally games of chance - seem to take advantage of these heuristics. For example, stop buttons on slot machines encourage illusory control beliefs (Chu et al., 2017). Roulette games exhibit a timeline of black/red outcomes (Barron and Leider, 2010) and slot machines often indicate losses camouflaged as wins (Dixon et al., 2010).

Some literature also emphasizes mistakes in perception. According to Delfabbro (2004) problematic gamblers tend to overestimate their winning skills. However, this evidence does not provide a clear and sufficient explanation of how individuals behave in relation to their risk perception (Spurrier and Blaszczynski, 2013). According to Grossman and Eckel (2009), lotteries with low probability but high return are more attractive than lotteries with the same expected gains and risks. The time available for choice has an effect on whether or not a risky decision is taken, indeed, as shown by Kirchler et al. (2017), subjects are more risk-averse for gains and more risk-averse for losses under time-pressure conditions. With regard to teenagers, a number of studies has analysed the perception of the problematic gambling. In particular, Cronce et al. (2008) find that i) the presence of one problematic gambler in family, ii) the maximum daily bet and iii) the peak gambling frequency are positively associated with the self-perception of problem gambling. Wong and Tsang (2012) find that adolescents tend to overestimate both positive outcomes, like social benefit and material gain, and negative outcomes, like being out of control; at the same time they tend to underestimate other types of negative outcomes like money loss and relational costs. Wickwire et al. (2010) report that more frequent and more problematic gambling is related to greater expectations of material gain, negative emotions and lower expectations of negative social consequences. Derevensky et al. (2009) found that problem gamblers, compared to non-gamblers and social gamblers, held more positive attitudes about gambling.

As the literature reveals, it is crucial to understand whether or not young students with problem gambling habits are aware of the economic risks. In fact there are not many published studies focused on this topic and - at best of our knowledge - there are no previous studies conducted in Italy, where gambling is a widespread and alarming phenomenon. In particular, it would be interesting to understand whether problem gamblers, while betting, do realize the economic risks associated with their conduct or whether they are unaware, and therefore need to be properly informed and instructed on gambling. Moreover we want to study how problem gamblers relate to the available games, in particular assessing whether problem gamblers are attracted to popular games or whether they tend to specialise in niche ones.

Family and environmental variables were considered in order to include teen's specific life context and to isolate the different effects on problem gambling. To the same purposes, two different configurations of gambling predilections were defined: 1) specifying the quantity and the popularity of gambling products utilized by each student and 2) using a single gambling-pattern index. Both configurations are new to the literature and they were used separately in two different regressions to test their explanatory power and to check differences. In this paper we will refer to "gambling products" and "games" as synonyms, to make the paper easier to read. However, it is important to note that the term "games" does not refer to video games, but only to gambling products.

The paper is organized as follows: the second section deals with data and methods, it describes the data, defines the variables implemented in the empirical application and the methods; the third section shows the results and finally conclusions are drawn.

2 Data and Methods

We exploit data from ESPAD®_Italia 2018, a school-survey conducted annually by the Institute of Clinical Physiology of the Italian National Research Council (CNR) since 1995; the national survey is included in a larger cross-national research project (ESPAD) aimed at collecting representative and comparable data on alcohol and drug consumption patterns in as many European countries as possible. Data collection was performed using standardized methodologies according to the ESPAD methodology (Hibell et al., 2001). The investigators contacted the sampled schools, asking teachers responsible for health education to present the research project to the school board. The school director was required to provide an authorization to allow students to complete the questionnaire. The survey, edited and approved by the collegial bodies comprising teachers, parents, and students (Legislative Decree no. 297/1994), was included in each school's annual Teaching Programme (Decree of the President of the Italian Republic no. 275/1999, Art. 8). Parents provided passive consent and students were informed that participation is anonymous and voluntary. Data collection was completed in a classroom with group-administered questionnaires, under similar circumstances as a written test[1]. Participation was voluntary, each participant being informed about research procedure and aims, and there is no way to identify any student. A total of 15'732 Italian adolescents (aged 15 - 19 years) partecipated, the mean age of partecipant was of 17 and 51% of these were male. The present analyses are conducted on a subsample of ESPAD®_Italia 2018 (4025 students), we used only information of students who fully completed the SOGS-RA questionnaire and hence have played at least once in the past 12 months.

The analysis is carried out by analyzing the relationship between the risky gambling and different variables related to the family, the social relations, the propensity to risk and the style of play. The risky gambling indicator is the SOGS-RA (Poulin, 2002; Winters et al., 1993), which classifies each student who gambled in the last 12 months as not at-risk, at-risk or problematic. This indicator has been empirically validated in Canada (Poulin, 2002), Lithuania (Skokauskas et al., 2009) and Italy (Colasante et al., 2013). Family variables refer to the parents knowledge about where their son/daughter spends the evening (1 yes, 0 no) and to parents with gambling experience (1 at least one yes, 0 no). Other variables are associated with social behavior, in particular with having smoked cigarettes or having been drunk in the last 12 months (1 at least one time, 0 no), with cyberbullying (1 whether cyber-bully or cyber-victim, 0 otherwise) and with time spent on the internet (1 whether you often realize you are staying online longer than you want to; 0 otherwise).

In order to define a measure of risk appetite, we considered each onsite game that the students played in the last 12 months (g_i) and we compared it with their own personal assessment of the dangerousness of that gambling product (d_i)[2]. In particular, to the question "how much a person who plays the following games is likely to be financially damaged", the students responded by choosing one of five values ranging from "Not at all", "A little bit", "Pretty much", "Much" and "Very much". For each game i we built a specific risk propensity indicator[3] that is the product between g_i and d_i.

[1]Hence, only teens attending the school were interviewed. No information is available on adolescents who dropped out of school.

[2]See Table 2 for the gambling products list. Only onsite games were considered since we do not have information on personal assessment in the questionnaire for online games.

[3]We have defined this indicator as a risk propensity because it is the result of the interaction between the intensity of games and their relative economic risk perception. The underlying idea is that if a student considers risky to bet on a game, and he does play anyway, then he is propense to risk. However, it is important to underline that we have not considered any other psychological condition and/or attitude to accept risks.

It ranges from 0 to 5, where it is 0 if the student never gambled at that game ($g_i = 0$), 1 if he played it but does not consider it dangerous ($g_i = 1$ *and* $d_i = 1$) up to 5 where he played it and considers it very dangerous ($g_i = 1$ *and* $d_i = 5$). After calculating these measures for n gambling products, a global risk propensity indicator has been constructed as an arithmetic mean of the different game indicators:

$$Risk\ \ propensity = \frac{1}{n}\sum_{i=1}^{n} g_i d_i = \frac{g_1 d_1 + g_2 d_2 + \cdots + g_n d_n}{n} \tag{1}$$

Hence, a higher value in this indicator relates to higher global risk appetite of the subject, as well as a higher the awareness of the economic risks related to the games used.

We decide to include information about gambling habits in the regression to highlight the different gambling context of each student. To this goal, two different gaming configurations were defined: the first consists of using two indicators related to the quantity and popularity of the games used by each adolescent. The second configuration involves the use of a single indicator that expresses the gambling pattern of each student. Both configurations come from the use of network analysis, in particular using the approach defined by Hidalgo and Hausmann (2009), who study the economic complexity of various Nations in international trade. In particular - in their study - a complexity measure is computed starting from a bipartite network where a measure of diversification (for each country) and ubiquity (for each product exported) are defined. The more diversified a country is and the less ubiquitous the products exported are, the higher is the country's complexity; by the same logic, the scarcer a product is and the more diversified the countries exporting it, the higher is the product's complexity (Hidalgo and Hausmann, 2009).

We believe that this approach might be adopted to associate games to students. Thus, we follow Hidalgo and Haussman proposal and define a bipartite network (Figure 2) in which students are connected to the games they used in the last 12 months. This network can be represented mathematically with a matrix M_{sg} where the student index varies along the rows and the game index along the columns. $M_{sg} = 1$ if the student s played to the game g; 0 otherwise.

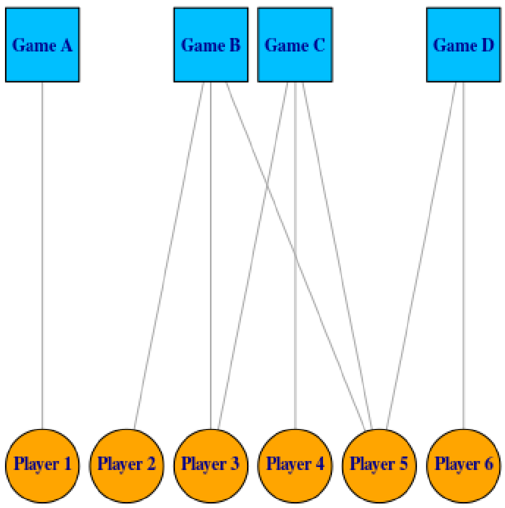


Figure 2: Example of the bipartite graph with players and games

In particular, the player differentiation is defined as (2) and outlines the number of games used by the student s; the game popularity as (3) indicating the number of students using the game g.

$$k_{s,0} = \sum_{g} M_{sg} \quad (2) \qquad\qquad k_{g,0} = \sum_{s} M_{sg} \quad (3)$$

These two measures - by means of the Method of Reflection (Hidalgo and Hausmann, 2009) - return complexity indexes. In particular this method consists in sequentially combining the index of game differentiation and game popularity over a series of N iterations:

$$k_{s,N} = \frac{1}{k_{s,0}} \sum_{g} M_{sg} k_{g,N-1} \quad (4) \qquad\qquad k_{g,N} = \frac{1}{k_{g,0}} \sum_{s} M_{sg} k_{s,N-1} \quad (5)$$

The more we increase the iterations ($N \to +\infty$), the more difficult it is to interpret the theoretical meaning of the generated variables. For the first two iterations we have useful information:

- $k_{s,0}$: number of gambling products used by the student s (i.e. differentiation)
- $k_{g,0}$: number of students who used the gambling product g (i.e. popularity)
- $k_{s,1}$: average popularity of the gambling products used by student s
- $k_{g,1}$: average differentiation of the students using gambling product g

The different iterations of k_s refer to students, those of k_g to games. For students, even indexes (e.g. $k_{s,0}$,$k_{s,2}$,$k_{s,4}$) are generalized measures of diversification, whereas odd indexes (e.g. $k_{s,1}$,$k_{s,3}$,$k_{s,5}$) are generalized measures of the popularity of their used games. For the gambling products the reverse is true, even indexes are related to their popularity and to the popularity of other games, whereas odd indexes are referred to the differentiation of students playing those games. So there is concordance between k_s and k_g considering an iteration of difference, when both are related or to differentiation, or to popularity (e.g. $k_{s,1}$ and $k_{g,0}$, or $k_{s,1}$ and $k_{g,2}$).

Iterations are stopped when the ranking of students and gambling products are stable from one step to another (i.e. no additional information can be extracted from the bipartite network). In particular, after some iterations the indexes values converge to similar values except for some decimals. These small deviations contain a great amount of information allowing to quantify measures of complexity (Hidalgo and Hausmann, 2009). For practical purposes, Hidalgo recommends a number of iterations ≥ 12 (Basile et al., 2019); following the settings suggested in the EconGeo R package (Balland, 2017) we decided to compute 20 iterations. Specifically, after 20 iterations we obtained a complex indicator $k_{s,20}$ for each student and after 19 iterations a complexity measure $k_{g,19}$ for each game ($k_{g,19}$ and $k_{s,20}$ are concordant). The first one can be interpreted in our framework as a gambling-pattern index, in fact the more a student plays different games and - at the same time - the more these games are not used/not popular among players, the higher the value of this index is. The latter indicates how much a game is complex, in particular the more a gambling product is unpopular, and - at the same time - the more the players who use it are differentiated, the more the game complexity index increases (see Figure 3).

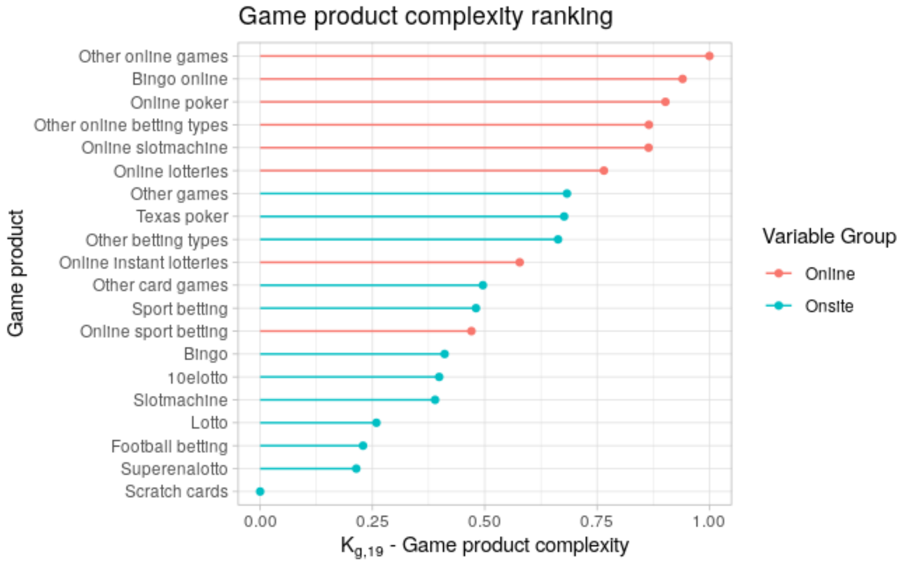


Figure 3: Complexity measures of games

In this study, 4025 students who completed the SOGS-RA test were analyzed[4]. Among them 3226 are not at risk, 538 are at risk and 261 are problematic subjects.

Variable	**No** **N = 3226**	**At risk** **N = 538**	**Problem** **N = 261**	**Total** **N = 4025**
Proportions				
Sex (female)	38.7	20.5	13.2	34.7
Parents know where I am in the evening (yes)	86.5	76.7	68.2	84.1
At least one parent gambled (yes)	35.1	43.9	49.8	37.2
Involved in cyberbullying (yes)	40.1	50.8	58.0	42.7
Drunk at least once in the last 12 months (yes)	45.2	59.7	66.5	48.5
At least one cigarette in the last 12 months (yes)	46.2	59.7	57.9	48.8
Too much time on the internet (yes)	20.9	26.0	34.0	22.4
Means (SDs)				
Age	17.17 (1.41)	17.40 (1.42)	17.33 (1.37)	17.21 (1.41)
Risk propensity	0.61 (0.53)	1.01 (0.73)	1.43 (1.08)	0.72 (0.64)
Gambling differentiation ($k_{s,0}$)	2.95 (2.22)	4.69 (3.16)	6.82 (4.52)	3.43 (2.78)
Mean popularity of played games ($k_{s,1}$)	2004.17 (771.54)	1603.91 (583.64)	1382.67 (479.48)	1910.37 (758.33)
Gambling-pattern index ($k_{s,20}$)	-0.12 (1.01)	0.39 (0.82)	0.70 (0.69)	0.00 (1.00)

Table 1: Descriptive statistics - proportions and means

In the Table 1 the proportion of females is roughly 34% among the players and this rate becomes lower as the degree of problem gambling increases. The mean age is stable between the three configurations and most players have parents know where they spend the evening (84.1%). Having a parent with gambling experience is a frequent condition almost 50% of the time among problem

[4]In total 4333 students reported a gambling experience in the past 12 months, 4025 responded to the SOGS-RA while 308 did not (around 7%).

gamblers, 43.9% for at-risk gamblers and 35.1% for non-risk gamblers. Having had a cyber-bully or cyber-victim experience and getting drunk at least once in the last 12 months are more frequent conditions among at-risk and problem gamblers (50.8% and 58%; 59.7% and 66.5%). Having smoked at least one cigarette in the last year is more frequent among at-risk and problem players (59.7% and 57.9%) and the same goes for internet misuse (26% and 34%). The averages for risk propensity, gambling differentiation and gambling-pattern index[5] are positively associated with the increase in the intensity of problematic gambling. Specifically, we can observe that on average, not-at-risk players have played nearly three games in the past 12 months, at-risk players nearly five, and problem players almost seven. On the contrary mean popularity of played games decrease with the gambling intensity, suggesting that unpopular games are played by problem gamblers.

This relation is notable in Figure 4: the more differentiation increases, the more the average popularity of gambling products decreases.

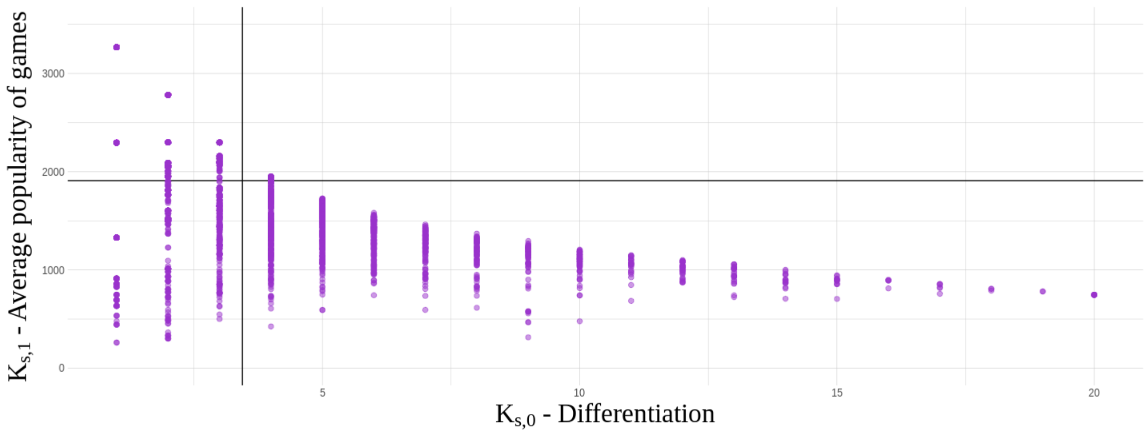


Figure 4: $k_{s,0}$ and $k_{s,1}$ diagram divided into four quadrants defined by the empirically observed averages of $k_{s,0}$ and $k_{s,1}$.

In order to analyze the problem more specifically, we can consider the relationship between players and specific gambling products. In particular, it is possible to observe in the Table 2 how the at-risk and problem players make more bets but - at the same time - have a perception of economic risks substantially equal to the other players. In fact, in the Table 2b we can notice that there is not a statistically difference between the groups, with the exception of Scratch cards, Football betting, Texas poker and other games (e.g. roulette, dices). Table 2c shows the values of the risk propensity index for each game considered.

Moreover, we can also describe how the different games are distributed among the students crossing $k_{g,0}$ (number of students who used the game g) and $k_{g,1}$ (average differentiation of the students using game g). This helps us to understand the main preferences of the players. In particular

[5]Since the values of gambling-pattern index are distinguished by tiny values, the variable has been standardized for a better interpretation.

- by drawing the average values of $k_{g,0}$ and $k_{g,1}$ - we obtain four quadrants represented in the Figure 6. In the lower right box is possible to find games that are popular and played by low-differentiated students; in the lower-left box there are games not popular and used by low-differentiated students; same information in the upper-left box, but in the case of high-differentiated students.

It is useful to remark how online games tend to be used by players with a high degree of differentiation and - at the same time - they are played by relatively few students (compared to onsite games). As a consequence we expect a higher average gambling-pattern index value for those who use online games and, since online gaming is positively associated with a problematic game (Kuss and Griffiths, 2012; Olason et al., 2010; Petry, 2006; Wood and Williams, 2007), we expect to observe a positive association between a high level of gambling-pattern index and problematic gambling.

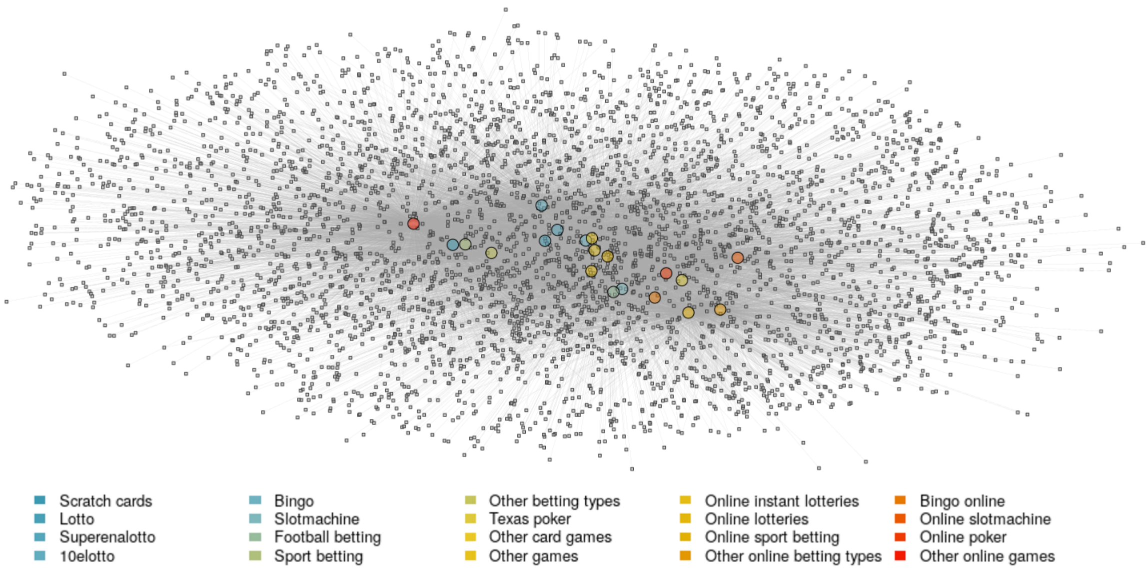
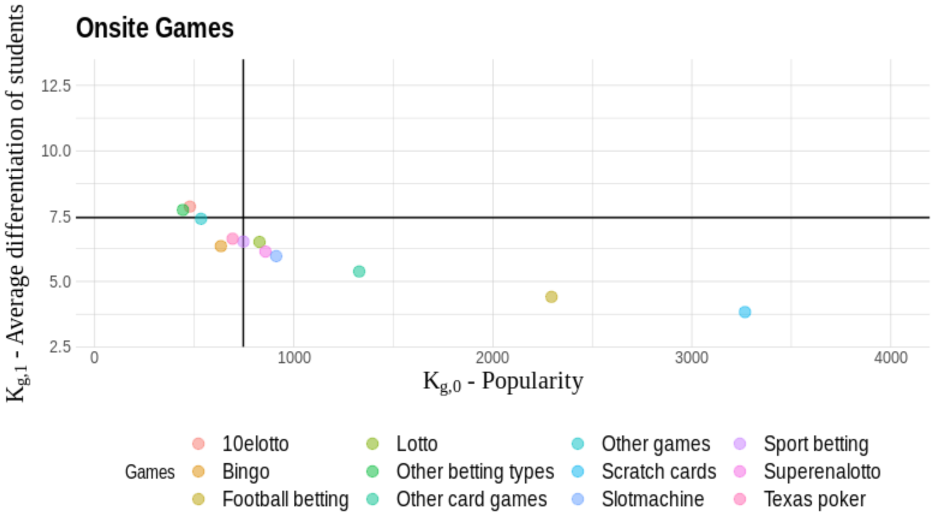


Figure 5: The bipartite network. Colored vertices represents gambling products, grey vertices the students.



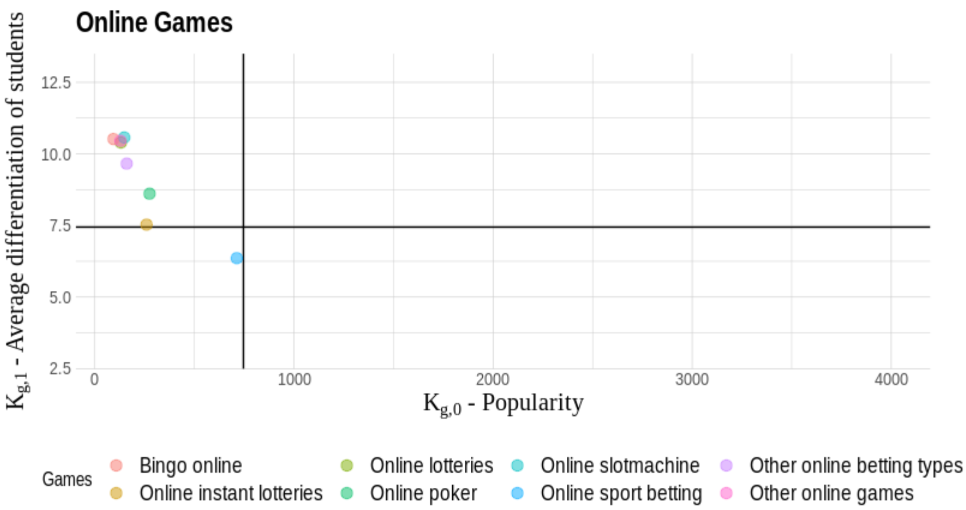


Figure 6: $k_{g,0}$ and $k_{g,1}$ diagram divided into four quadrants defined by the empirically observed averages of $k_{g,0}$ and $k_{g,1}$. Specification for online and onsite games.

Game	No N = 3226	At risk N = 538	Problem N = 261	Total N = 4025	P-value
a) Played games in the last 12 months					
Scratch cards	75.6	74.0	77.4	75.5	<0.001
Lotto	16.8	23.6	34.1	18.8	<0.001
Superenalotto	18.4	22.1	28.7	19.6	<0.001
10 e lotto/Win for Life	8.3	15.2	28.0	10.5	<0.001
Bingo	11.9	21.4	33.0	14.5	<0.001
Slot machines/Videolottery	15.7	36.1	54.4	20.9	<0.001
Football betting	47.3	74.5	85.1	53.4	<0.001
Sport betting (e.g. horse betting, tennis)	13.5	27.7	47.5	17.6	<0.001
Other betting types (e.g. virtual betting)	7.0	17.1	36.0	10.2	<0.001
Texas poker	13.4	21.7	35.2	16.0	<0.001
Other card games (e.g. burraco, bridge)	27.8	37.9	48.7	30.5	<0.001
Other games (e.g. roulette, dices)	9.1	21.4	32.2	12.2	<0.001
b) Personal assessment of dangerousness					
Scratch cards	2.60 (1.21)	2.87 (1.18)	2.81 (1.28)	2.65 (1.21)	<0.001
Lotto	2.68 (1.17)	2.76 (1.14)	2.83 (1.25)	2.70 (1.17)	0.093
Superenalotto	2.72 (1.18)	2.79 (1.16)	2.85 (1.24)	2.74 (1.18)	0.166
10 e lotto/Win for Life	2.77 (1.19)	2.81 (1.16)	2.84 (1.25)	2.78 (1.19)	0.593
Bingo	2.97 (1.21)	3.01 (1.25)	3.04 (1.32)	2.98 (1.22)	0.603
Slot machines/Videolottery	3.84 (1.17)	3.91 (1.15)	3.81 (1.31)	3.84 (1.17)	0.300
Football betting	2.97 (1.24)	3.00 (1.22)	3.22 (1.28)	2.99 (1.25)	0.012
Sport betting (e.g. horse betting, tennis)	3.01 (1.23)	2.97 (1.18)	3.08 (1.26)	3.01 (1.23)	0.586
Other betting types (e.g. virtual betting)	3.03 (1.21)	2.96 (1.16)	3.05 (1.30)	3.02 (1.21)	0.504
Texas poker	3.67 (1.19)	3.63 (1.22)	3.41 (1.36)	3.65 (1.21)	0.025
Other card games (e.g. burraco, bridge)	3.48 (1.25)	3.47 (1.24)	3.29 (1.39)	3.47 (1.26)	0.155
Other games (e.g. roulette, dices)	3.74 (1.21)	3.68 (1.19)	3.34 (1.39)	3.70 (1.23)	<0.001
c) Risk propensity of games					
Scratch cards	1.87 (1.47)	2.07 (1.61)	2.22 (1.66)	1.92 (1.51)	<0.001
Lotto	0.40 (1.02)	0.64 (1.25)	1.01 (1.58)	0.47 (1.11)	<0.001
Superenalotto	0.45 (1.06)	0.55 (1.16)	0.88 (1.55)	0.49 (1.11)	<0.001
10 e lotto/Win for Life	0.21 (0.77)	0.42 (1.10)	0.84 (1.51)	0.27 (0.91)	<0.001
Bingo	0.34 (1.03)	0.67 (1.44)	1.08 (1.71)	0.43 (1.16)	<0.001
Slot machines/Videolottery	0.57 (1.43)	1.41 (2.00)	2.18 (2.18)	0.78 (1.64)	<0.001
Football betting	1.26 (1.57)	2.16 (1.65)	2.69 (1.63)	1.47 (1.65)	<0.001
Sport betting (e.g. horse betting, tennis)	0.36 (1.02)	0.84 (1.50)	1.49 (1.80)	0.49 (1.20)	<0.001
Other betting types (e.g. virtual betting)	0.19 (0.77)	0.50 (1.20)	1.14 (1.69)	0.29 (0.96)	<0.001
Texas poker	0.48 (1.29)	0.81 (1.64)	1.15 (1.77)	0.56 (1.39)	<0.001
Other card games (e.g. burraco, bridge)	0.89 (1.59)	1.34 (1.88)	1.53 (1.86)	0.99 (1.66)	<0.001
Other games (e.g. roulette, dices)	0.32 (1.09)	0.77 (1.57)	1.04 (1.72)	0.43 (1.23)	<0.001

Table 2: Descriptive statistics: proportions and means (with st. deviations).
Statistical test: in a) Chi-Square test; in b) and c) Kruskal-Wallis Rank Test.

3 Results

Since the SOGS-RA index is expressed as a categorical ordinal variable, we considered a Ordered Logit regression to study the dependent variable association with other variables. We applied two different regressions for each gambling configuration defined:

$$\begin{aligned} \textit{SOGS-RA} \sim f(&Sex, Parents\ control, Parents\ gambled, Cyberbullying, Drunk, \\ &Cigarette, Internet, Risk\ propensity, Gambling\ differentiation, \\ &Games\ popularity) \end{aligned}$$

$$\begin{aligned} \textit{SOGS-RA} \sim f(&Sex, Parents\ control, Parents\ gambled, Cyberbullying, Drunk, \\ &Cigarette, Internet, Risk\ propensity, Gambling\text{-}pattern\ ) \end{aligned}$$

In both models we used survey weights, based on age, gender and region of origin[6]. The assumptions of Ordered Logit models are respected (see Appendix), in particular the absence of multicollinearity has been tested with the VIF (Fox and Monette, 1992) and the parallel assumption with the Brant test[7] (Brant, 1990).

The independent variables are the same in both specifications, with the exception of the variables related to gambling. In particular, in the first model, the total number of games used ($k_{s,0}$) and their relative average popularity ($k_{s,1}$) are considered separately. Following the literature, we expect $k_{s,0}$ to be positively associated with at-risk and problematic gambling; $k_{s,1}$ to be negatively related[8]. In the second specification these two indicators have been replaced by the gambling-pattern index $k_{s,20}$. Although there is this change in the specification, we do not expect different results. In fact, $k_{s,20}$ contains jointly the information contained in $k_{s,0}$ and $k_{s,1}$; in particular, the higher the gambling-pattern index, the higher number of different games are used and the more preference is given to unpopular games. Hence a higher value of $k_{s,20}$ should be associated to an increase in likelihood to be at-risk or problem gambler.

To understand if $k_{s,20}$ contains all the information contained in $k_{s,0}$ and $k_{s,1}$, we applied the Likelihood Ratio test, to assess whether a statistically significant difference between the two models in terms of likelihood exists. It turns out that the first model, despite having one more regressor, has a better explanatory capacity (see Appendix).

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[6]Thus, the results are representative of Italian student population.

[7]The Brant test was applied on unweighted models, since - at the best of our knowledge - there is not an implementation for weighted models.

[8]In fact, niche games (and not the popular ones) are represented by online games (see Figure 6), and the latter are associated with at-risk and problematic gambling.

Variable	Beta	Odds Ratio	S.E.	P-Value	Sign.
First model					
Intercept (No - At Risk)	1.941	-	0.158	<0.001	***
Intercept (At Risk - Problem)	3.510	-	0.172	<0.001	***
Sex (female)	-0.779	0.45	0.113	<0.001	***
Parents know where I am in the evening (yes)	-0.379	0.68	0.112	<0.001	***
At least one parent gambled (yes)	0.312	1.36	0.093	<0.001	***
Involved in cyberbullying (yes)	0.287	1.33	0.094	0.002	**
Drunk at least once in the last 12 months (yes)	0.212	1.23	0.102	0.038	*
At least one cigarette in the last 12 months (yes)	0.288	1.33	0.102	0.004	**
Too much time on the internet (yes)	0.566	1.76	0.107	<0.001	***
Risk propensity	0.326	1.38	0.098	<0.001	***
Gambling differentiation ($k_{s,0}$)	0.438	1.54	0.072	<0.001	***
Mean popularity of played games ($k_{s,1}$)	-0.288	0.74	0.071	<0.001	***
Dependent variable: SOGS-RA; AIC: 3729.11					
Second model					
Intercept (No - At Risk)	2.300	-	0.150	<0.001	***
Intercept (At Risk - Problem)	3.839	-	0.166	<0.001	***
Sex (female)	-0.728	0.48	0.116	<0.001	***
Parents know where I am in the evening (yes)	-0.403	0.66	0.113	<0.001	***
At least one parent gambled (yes)	0.328	1.38	0.092	<0.001	***
Involved in cyberbullying (yes)	0.295	1.34	0.093	0.001	**
Drunk at least once in the last 12 months (yes)	0.234	1.26	0.102	0.021	*
At least one cigarette in the last 12 months (yes)	0.271	1.31	0.102	0.007	**
Too much time on the internet (yes)	0.544	1.72	0.107	<0.001	***
Risk propensity	0.805	2.23	0.068	<0.001	***
Gambling-pattern index ($k_{s,20}$)	0.384	1.46	0.056	<0.001	***
Dependent variable: SOGS-RA; AIC: 3767.27					

Table 3: Weighted Ordered Logit models -*Significance level:* * 5% ; ** 1% ; *** 0.1%

All the variables are significant and the results of both models and odds ratios are consistent with the existing literature. In the first model being female is associated with a decrease in the likelihood of being at-risk or problematic by about twice. In the same direction, having parents who know where their children are in the evening are associated with a decrease in the probability of being at risk or problematic by 47%[9]. Having at least one parent with gambling experience is positively associated with an increased likelihood of being at risk or problematic by 36%. Being involved in cyberbullying is associated with an increase in the probability by 33%, while getting drunk at least once or smoking at least one cigarette in the last year is positively associated with an increase of probabilities by 23% and 33% respectively. Spending too much time on the internet is positively associated with an increase of 76% in probability; at the same time a unitary increase in risk propensity is associated with with an increase probability of 38% and for gambling differentiation[10] this probability is roughly equal to 54%. The mean popularity of played games is negatively associated with problematic behaviour, in

[9]For odds ratios smaller than one, percentages have been calculated as their inverse. In particular: sex 1/0.45 = 2.22; parents knowledge 1/0.68 = 1.47; mean popularity 1/0.74 = 1.35.

[10]The values of $k_{s,0}$ and $k_{s,1}$ have been standardized for a better interpretation of the coefficients.

particular an unitary increase is associated with a decreasing likelihood of being at risk or problematic of 35%. In the second regression, as expected, the signs and the coefficients remain approximately equal to the first regression; therefore the reading of the latter model is practically the same. In this second case, as was anticipated, we can observe that the gambling-pattern index has a positive impact on at risk or problematic gambling and it is positively associated with an increased likelihood of being at risk or problematic by 46%.

Both models shed light on the role of risk propensity and gambling pattern in being not-at-risk, risk-taking and problem gambler, including the family status of each student and their risk-taking behaviors. As already shown in the literature, having a present and attentive family reduces the probability of being a risky or problematic gambler, while having a parent with gambling experience increases that probability. The two risk behaviors (having smoked and being drunk at least once in the last 12 months) are positively associated with at-risk or problem gambling. Same conclusions with spending more time than needed on the internet and having experiences related to cyberbullying.

In order to evaluate the gambling pattern in a more comprehensive way, a bipartite network as described by Hidalgo and Hausmann (2009) was used. In particular, two different configurations were defined to describe the gambling habits for each student. The first configuration consists in using the differentiation and the average popularity of the games used by each player (i.e. the first two stages of the k_s index); in the second configuration only the gambling-pattern index ($k_{s,20}$) is used. As we noticed, differentiation pushes toward problematic play, the use of popular games does not. Further, also the gambling-pattern index refers, at the same time and for each student, to both students' game differentiation (i.e. how many games he or she uses) and games' popularity (i.e. how widespread the games used are among all the players). This indicator is positively associated with at-risk or problematic gambling, in fact using many gambling products, especially unpopular games, increases the degree of gambling-pattern index. The validity of this indicator lies in the fact that unpopular games are mainly represented by online games (see Figure 6), which - according to the literature - are more associated with a problematic status.

Also a complexity measure for gambling products was defined ($k_{g,19}$). The more a game is unpopular, and - at the same time - the more the players who use it are differentiated, the more the game complexity index increases. In light of the results obtained, this indicator can be interpreted as game "dangerousness", since the gambling products that are rare and used by differentiated players, are games associated with problem behavior[11]. With this technique we created a "dangerousness" ranking, showed in Figure 3 and it is not surprising that the most complex (i.e., dangerous) games are online games. Our risk propensity indicator measures how much each student decides to play despite being aware of the economic risks associated with gambling. The results lead to the conclusion that students with at-risk or problematic gambling are aware of the financial risks they take when gambling, in fact an increase in the risk propensity indicator is positively associated with an at-risk or problematic status.

The review by Spurrier and Blaszczynski (2013) outlines that disordered gamblers hold both more optimistic overall perceptions of risk, and a mix of positive and negative specific expectations about outcomes. Anyway, disordered gamblers - even with negative expectations - retain gambling incentive and Spurrier and Blaszczynski (2013) conclude that this category discounts risks in some way, for example by attributing preferential importance to positive outcomes. Our result strengthen their conclusion, as the adolescents analyzed have essentially equal perceptions of economic risks (see Table 2), but at-risk and problem gamblers tend to play more intensively and in a more spe-

[11]No causal relationship can be established.

cialized manner, probably because they assign superior importance to positive returns or because of a self-control problem.

4 Discussion and Policy Advice

The analysis conducted in this paper shows that students with gambling problems do not seem to be naive. On the contrary, they are aware and conscious of the economic risks they face. It turns out that problematic gamblers are also those who play in a more intensive and specialized way, preferring less popular and more complex games. In particular, we have seen how the latter are mainly online games, making the problem even more difficult from a policy perspective. In fact, a policy aimed at reducing the problem of gambling among adolescents, should limit and contrast the use of niche games (i.e. online games) even if it is difficult to effectively regulate them, since they are not physically present on the national territory and may follow legislation from other countries. This need is even more important during the pandemic phase of COVID-19, where most students around the world are in daily contact with the internet, conducting online school instruction and socializing on the web due to mobility restrictions. Thus, teens are more exposed and encouraged to use online betting, increasing their risk of developing an addiction. Moreover, games payouts[12] suggest the same idea (see Appendix). Online games are the games that promise the highest payouts, along with card games and poker, while scratch cards and lotteries are the games with the lowest payouts. Problem gamblers, as we have seen, tend to prefer online games while scratch cards and lotteries are the most popular games. This fact is coherent with our hypothesis that problematic gamblers are informed and aware of the "gambling world", focusing on the games that "pay" the most.

More work on awareness is necessary to consolidate (or deny) our result and establish whether our result is specific to Italy or can be extended to other contexts. In the same vein more work is also necessary to identify more dangerous and damaging forms of gambling, maybe associated to other dimensions than complexity or online gaming.

Some consequences for policies can also be drawn. The proliferation and the increasing variety of games introduced in Italy in the last decade probably has not been helpful and should not set an example for any other country. A ban on niche games, that is more feasible as probably will not impact heavily on revenues, may help limiting the number of problematic gamers, though we did not establish a causal link. The risk is however that when eliminating legal games, problematic players will turn to illegal ones. While our study indicates that general campaigns to increase awareness of gambling risks may be ineffective, as more problematic gambler seem quite aware of the risks, campaigns that discourage youngsters from using niche games may be more useful. Enforcement of legality in gaming therefore remains tantamount.

Although this study allows a better understanding of gamblers behavior, there are several limitations that must be considered. Since the data came from a school-based survey, any students who dropped out of school, those who were absent, and those who did not agree to participate in such studies were not considered. Furthermore, despite the large sample of students considered, we were unable to consider some questionnaires due to inappropriate completion.

[12] Payout is defined as how much money a player expects to win per unit bet.

A Appendix

A.1 SOGS-RA questionnaire

The SOGS-RA items are referred on the last 12 months and can be answered with “Yes” or “No” (Poulin, 2002):

1. how often have you gone back another day to win back the money you lost?
2. when you were betting, have you told others you were winning money when you really weren’t winning?
3. has your betting money caused any problems for you such as arguments with family and friends, or problems at school or work?
4. have you gambled more than you had planned to?
5. has anyone criticized your betting or told you that you had a gambling problem, regardless of whether you thought it was true or not?
6. have you felt bad about the amount you bet, or about what happens when you bet money?
7. have you felt that you would like to stop betting money but didn’t think you could?
8. have you hidden from family or friends any betting slips, IOUs, lottery tickets, money that you’ve won or other signs of gambling?
9. have you had money arguments with family or friends that centred on gambling?
10. have you borrowed money to bet and not paid it back?
11. have you skipped or been absent from school or work due to betting activities?
12. have you borrowed money or stolen something in order to bet or to cover gambling debts?

A.2 Testing the Logistic regression's assumptions

Since the VIF cannot be applied with categorical variables, it has been applied using the SOGS-RA results without grouping them in the three categories, thus obtaining an OLS with the same regressors.

Variable	**VIF**
First model	
Sex	1.104
Parents know where I am in the evening	1.051
At least one parent gambled	1.034
Involved in cyberbullying	1.050
Drunk at least once in the last 12 months	1.280
At least one cigarette in the last 12 months	1.269
Too much time on the internet	1.058
Risk propensity	3.002
Gambling differentiation ($k_{s,0}$)	3.462
Mean popularity of played games ($k_{s,1}$)	1.629
Second model	
Sex	1.139
Parents know where I am in the evening	1.049
At least one parent gambled	1.034
Involved in cyberbullying	1.050
Drunk at least once in the last 12 months	1.278
At least one cigarette in the last 12 months	1.268
Too much time on the internet	1.058
Risk propensity	1.324
Gambling-pattern index ($k_{s,20}$)	1.355

Table 4: VIF analysis results

All VIF values are close to 1, indicating an absence of multicollinearity. However, in the first regression, risk propensity and gambling differentiation ($k_{s,0}$) have a VIF of 3.002 and 3.462, respectively. This slight multicollinearity is likely due to the fact that both variables were calculated using the total number of games used in the past 12 months; in any case, the thumb rule considers a VIF of less than 5 to be acceptable.

As far as the parallel assumption is concerned, Brant's test is not significant overall and therefore the assumption holds in both models.

	Chi2	**df**	**P-value**
First model	8.61	10	0.569
Second model	7.24	9	0.611

Table 5: Brant test results

A.3 Model comparison

It may be interesting to compare the two models, in particular the explanatory goodness has been evaluated with the LR test:

Regression	**Df**	**LogLik**	**AIC**	**Chi2**	**Sign.**
First model	12	-1852.6	3729.1	40.16	***
Second model	11	-1872.6	3767.2		

Table 6: LR test - *Significance level:* * 5% ; ** 1% ; *** 0.1%

The LR test result shows that the model with $k_{s,0}$ and $k_{s,1}$ is significantly better in terms of Likelihood than the model with $k_{s,20}$.

A.4 Estimated payout

Payout refers to how much money a player expects to win per unit bet. Obviously, since by definition gambling is not a fair game, the payout will always be less than one. Each game has a different payout, however, it is possible to give an estimate for categories of games using the information made available by the Italian State Monopoly. In particular, the "Libro Blu" [13] contains all the information about italian gambling, including total expenditure and total winnings.

The following table shows this information and the "Payout" column has been calculated as the ratio of total winnings to total expenditure.

Game	**Total expenditure**	**Total winnings**	**Payout**
Totalizator games (e.g. superenalotto)	1545	940	0,61
Bingo	1647	1157	0,70
Lotto	8017	5645	0,70
Lotteries	9242	6815	0,74
Horse racing betting	536	398	0,74
Scommesse virtuali	1744	1478	0,85
Sport betting	10903	9414	0,86
Slotmachine	24535	21517	0,88
Online games	31442	29817	0,95
Card games	19759	19049	0,96
Poker	2274	2209	0,97

Table 7: Estimated payout of the different games

[13] https://www.adm.gov.it/portale/documents/20182/536133/LibroBlu_2018_Web.pdf/71883245-0320-4a6a-9c1f-be196ed4439f - pages 96 and 106.

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