

A Gamblers Clustering Based on Their Favorite Gambling Activity

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Abstract The objective of this study was to identify profiles of gamblers to explain the choice of preferred gambling activity among both problem and non-problem gamblers. 628 non-problem and problem gamblers were assessed with a structured interview including “healthy” (sociodemographic characteristics, gambling habits and personality profile assessed with the Temperament and Character Inventory-125) and “pathological” [diagnosis of pathological gambling, gambling-related cognitions (GRCs) and psychiatric comorbidity] variables. We performed a two-step cluster analysis based solely on “healthy” variables to identify gamblers’ profiles which typically reflect the choice of preferred gambling activity. The obtained classes were then described using both “healthy” and “pathological” variables, by comparing each class to the rest of the sample. Clusters were generated. Class 1 (Electronic Gaming Machines gamblers) showed high cooperativeness, a lower level of GRC about strategy and more depressive disorders. Class 2 (games with

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deferred results gamblers) were high novelty seekers and showed a higher level of GRC about strategy and more addictive disorders. Class 3 (roulette gamblers) were more often high rollers and showed a higher level of GRC about strategy and more manic or hypomanic episodes and more obsessive–compulsive disorders. Class 4 (instant lottery gamblers) showed a lower tendency to suicide attempts. Class 5 (scratch cards gamblers) were high harm avoiders and showed a lower overall level of GRC and more panic attacks and eating disorders. The preference for one particular gambling activity may concern different profiles of gamblers. This study highlights the importance of considering the pair gambler–game rather than one or the other separately, and may provide support for future research on gambling and preventive actions directed toward a particular game.

Keywords Gambling · Clustering · Personality · Gambling habits · Distorted cognitions · Continuous gambling

Introduction

Until now, international literature on gambling has mostly focused on individual or environmental factors, leaving out the development of research about the gambling activity (Raylu and Oei 2002; Toneatto and Ladouceur 2003; Toneatto and Millar 2004; Bjerg 2010; Bouju et al. 2011). Most of the studies that have attempted to focus on the gambling activity are either very general (making no distinction between gambling forms) or on the contrary ultra-specific (focusing on a specific gambling activity, like videopoker). Some authors have suggested that different types of gambling may be more or less strongly related to pathological gambling (PG) (Welte et al. 2004, 2007; Petry 2003; LaPlante et al. 2009; Sharpe 2002), while others have shown that this effect was mediated by the gambling involvement (number of games played) (Phillips et al. 2013; Laplante et al. 2013). That is why many gambling studies focus on clinical or pathological characteristics (severity of gambling, comorbid psychiatric disorders, etc.). But we can hypothesize that there are non-clinical characteristics, non-related to functional impairment, which would be relevant for establishing a gamblers' typology based on their preferred gambling activity. For example, recent studies have highlighted the importance of examining personality dimensions in addition to personality disorders in the field of PG (Odlaug et al. 2013; Miller et al. 2013). Personality dimensions are not equivalent to personality

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disorders in that they do not necessarily interfere negatively with functioning (Odlaug et al. 2013; Miller et al. 2013). Other relevant variables would be gambling habits and sociodemographics, which are characteristics known to be associated with different form of gambling activities. For example, women are more likely to engage in bingo and slot machines, whereas men are more likely to bet on sports events, cards, blackjack and pull-tabs (Grant and Kim 2002). Moreover, most of the studies focusing on the preferred gambling activity proposed an a priori classification of gambling games (Welte et al. 2002; LaPlante et al. 2009; Petry 2003). In this case, the researcher has to make arbitrary groupings of gambling activities, based on his own clinical or research experience, or has to study each form of gambling separately, without any attempt to regroup them (Welte et al. 2007; Petry and Mallya 2004). The problem is that being based on different classifications, the various studies led to conflicting results. In an attempt to harmonize, Claude Boutin (2010) and Bjerg (2010) both have suggested almost the same classification of gambling games based on the following two structural characteristics:

The respective proportions of chance and skill in the game, which can be used to distinguish between “gambling games of pure chance”, where the player’s skills or experience cannot influence the outcome of the game, and “gambling games with an element of skill”, which have an outcome that can be influenced by the player’s own competence or knowledge, although it still depends on random events.

The expected value linked to the game, which can be used to distinguish between “bank games” (played against a gambling industry) and “social games” (played against other players). For “bank games”, the expected value is always negative, since the bank always has a statistical advantage over the players which ensures a fixed profitability in the long term. For “social games”, the expected value is variable. When it is a “game of pure chance”, the expected value is always zero. For “games with an element of skill”, there is a dynamic and relative skill gap between players, and the expected value can then vary from negative to positive.

A synthesis of Bjerg’s (2010) and Boutin’s (2010) classifications is shown in Table 1.

These two classifications of gambling games accurately match our impression of some gamblers’ profiles, differing according to their preferred gambling activity. Although these classifications seem to be satisfying from a theoretical or clinical point of view, our opinion is that the field is lacking in data-based studies. To our knowledge, no study has so far verified whether the grouping of gambling activities in such gambling classifications actually corresponds to distinct gamblers’ profiles. The present study was designed to address this gap in the literature, by performing a clustering of gamblers and discussing it on the basis of the gamblers’ preferred gambling activity, especially in relation to the theoretical classifications (Bjerg 2010; Boutin 2010). The idea is to identify profiles of gamblers based on non-clinical variables to explain the choice of preferred gambling activity among both problem and non-problem gamblers.

Methods

Participants

The participants were 628 problem and non-problem gamblers who took part in the *JEU* cohort study that is currently taking place. The *JEU* cohort study is a 5-year longitudinal case–control cohort performed at a national level. Its aims are (1) to explore and describe the gambling population, (2) to compare gamblers at baseline, especially depending on whether they are problem or non-problem gamblers, and included or not in a treatment

Table 1 Synthesis of the theoretical classification of gambling games, based on Bjerg's (2010) and Boutin's (2010) classifications

	Bank games (played against an operator)	Social games (played against other players)
Pure chance	Roulette Slot machines Video lottery terminal (including videopoker) Lotteries Bingo Keno Baccarat Sic Bo Battle Wheel of fortune Some poker variants (Caribbean, 3 cards, Pai Gow and Grand Prix)* Craps** Expected value < 0	Coin tossing Rock-paper-scissors Expected value = 0
Skill and chance	Blackjack Sports betting Horserace betting Expected value < 0	Poker (<i>Texas Hold'em</i> , <i>Omaha</i>) Backgammon Bridge Rummy Expected value variable depending on the skill gap between players

The structure of the classification was borrowed from Bjerg "Problem gambling in poker: money, rationality and control in a skilled-based social game" *International Gambling Studies* (2010—p. 241) with the kind permission of Olé Bjerg. Additional games and nuances, especially related to the dynamic and relative skill gap between players of games with an element of skill, were derived from Boutin "Le jeu: chance ou stratégie. Choisir librement la place du jeu dans votre vie" *Les éditions de l'homme* (2010—p. 22) with the kind permission of Claude Boutin

The 1st class of Boutin's classification (games without skill or potential profit) exactly matches the category of bank games of pure chance in Bjerg's classification, except for craps (included within games without skill or potential profit in Boutin's classification but within bank games of skill and chance in the Bjerg's one). The 2nd class of Boutin (games of quasi-skill without potential profit) exactly matches the category of bank games of skill and chance in Bjerg's classification. Finally, the 3rd class of Boutin (games with skill and potential profit) exactly matches the category of social games of skill and chance in Bjerg's classification. Boutin did not include social games of pure chance in his classification

* Boutin argued that these four poker games require players to be familiar with basic strategy, but beyond that, no player can acquire any supplementary skill

** In the opinion of the author, craps has more reasons to be in category of pure chance games, because the dice roll is subjected to the most complete random. Craps has thus been classified in this category in the proposed synthesis

program and (3) to identify longitudinal predictors of the key state changes of the gambling practice evolution (for more information, please refer to the study protocol of the JEU cohort: Challet-Bouju et al. 2014). The present study represents a secondary objective of the cohort (to describe and compare gamblers depending on their preferred gambling activity), and was performed on the baseline data of the JEU cohort.

The sample was constituted based on an approximate equality of size between problem and non-problem gamblers, because of the low prevalence of gambling problems in the general population. Participants were recruited in various gambling places (casinos, cafés, smoke shops, etc.) and via the press, in order to cover the broadest possible range of gambling activities. In gambling places, all the present gamblers were solicited outside of a gambling time, because gamblers are particularly irritable when gambling and in order to avoid disturbing the gambling venue activity. We had no information about non-responders, because there was a deal with the gambling places which accepted to help us. This deal consisted of seeking no information from gamblers who have refused to participate in the first instance. Problem gamblers were also recruited in seven care centers, where they started treatment less than 6 months before. Only participants who reported gambling on at least one occasion in the previous year and who were between 18 and 65 years old were included in the study. Participants were given a compensation of 15 €, except problem gamblers from care centers for whom the interview would have been done for care purpose anyway.

Measures

Sociodemographic Characteristics

A short questionnaire included a few questions about gender, age, marital status, professional activity, educational level and level of income.

Gambling Habits

Participants were asked about participation in various forms of gambling over the past year, monthly gambling expenditure especially in relation to income, maximum wagering in a single day, age at which they were initiated into gambling and family history of problem gambling. They were also invited to determine their preferred gambling activity, i.e. the one which they preferred among all the gambling activities they have experimented in their lives (gamblers with a multi-game profile were restricted to defining a single preferred gambling activity).

Temperament and Character Inventory-125 (TCI-125) (Cloninger et al. 1993; Chakroun-Vinciguerra et al. 2005)

The shorter 125-item version of the TCI is a self-report questionnaire used to rapidly explore the seven dimensions of personality defined by Cloninger's psychobiological model (Cloninger et al. 1993). The TCI-125 assesses four temperament traits (Novelty Seeking, Harm Avoidance, Reward Dependence and Persistence) and three character traits (Self-Directedness, Cooperation and Self-Transcendence). The internal consistencies of the French version appeared acceptable for each dimension (Cronbach's alpha between 0.63 and 0.87) (Chakroun-Vinciguerra et al. 2005).

Pathological Gambling Section on the DSM-IV (APA 2000)

The number of positive DSM IV criteria for PG was used as a dimensional score of gambling problem severity, and the responses to each criteria of the DSM IV was also taken into account to study the various symptoms of PG.

Gambling Attitudes and Beliefs Survey: Revised Version (GABS-23) (Breen and Zuckerman 1999; Bouju et al. 2014)

The GABS is a self-report questionnaire which assesses irrational beliefs and attitudes about gambling. The GABS-23 is a revised version of the original GABS which consists of 23 items divided into 5 dimensions: Strategies, Chasing, Attitudes, Luck and Emotions. The internal consistencies were acceptable for each dimension (Cronbach's alpha between 0.65 and 0.80) and good for the overall score (Cronbach's alpha = 0.89) of the French version (Bouju et al. 2014).

Mini International Neuropsychiatric Interview: Fifth Version (MINI) (Lecrubier et al. 1997)

This short diagnostic structured interview explores the main axis-I psychiatric disorders (plus current risk of suicide and antisocial personality disorder) of the DSM. It includes assessment of the major anxiety disorders, mood disorders, addictive disorders and to a lesser extent psychotic disorders.

Statistical Analysis

We wanted to achieve a clustering of gamblers and to observe how they group together in terms of their preferred gambling activity. We chose to include only “non-clinical” variables in the clustering, in order to let grouping individuals according to their preferred gambling activity (since we considered that pathological characteristics, such as gambling severity or psychiatric comorbidities, would have dominated the preferred gambling activity in this sample mixing problem and non-problem gamblers). Moreover, the objective wasn't to provide a typology explaining PG status. Twenty-one variables relating to sociodemographic characteristics, gambling habits and personality profile (TCI scores) were included in the clustering. We used the SPAD software [COHERIS Group, Suresnes (France), 2014] to perform a two-step cluster analysis, which seeks to identify homogeneous subgroups in the sample. It is a particularly suitable method for working on large datasets, which both minimize within-group variances and maximize between-group variances (Álvarez-Moya et al. 2010). In the first step, two independent multivariate factorial analyses were performed: a Principal Components Analysis for continuous variables and a Multiple Correspondence Analysis for categorical variables (Husson et al. 2010). This first step allows transforming all the former variables (in particular categorical variables) in a new set of continuous variables. In the second step, only the main factorial axes obtained in the first step (these ones containing the more of information) were used to produce a mixed hierarchical clustering (Everitt et al. 2011). The minor factorial axes were dropped because these axes generally represent only noise. The best number of classes among all the possible generated partitions were determined after a visual inspection of the obtained dendrogram, in order to select a partition with less than 6 clusters (so that the nine different types of gambling could be grouped together). Each class was described in a second time using both the variables included in the clustering method and the “pathological” variables [i.e. gambling severity, gambling-related cognitions (GRCs) and psychiatric comorbidities]. Each class was compared to the rest of the sample using the more adapted statistical test depending on the nature of the variable (continuous or categorical) and on the sample size. For continuous variables, Student *t* tests were used for clusters composed of more than 30 gamblers or independent Mann–Whitney tests for fewer than

30. Categorical variables were compared using Chi squared tests, using a Yate's correction when theoretical frequencies were fewer than 5. A variable was considered characterizing a class if the corresponding test is significant at 0.05.

Ethical Considerations

Participants gave their written informed consent prior to their inclusion in the study. This study was approved by the French Research Ethics Committee.

Results

General Description of the Cohort

The sample consisted of 256 non-problem and 372 problem gamblers. The sociodemographics of the whole sample ($N = 628$) are detailed in Table 2. The participants were mainly men ($N = 418$, 66.6 %) and the mean age was 43.4 years ($SD = 12.9$). Most participants were employed, with a regular income higher than 1,100 € (i.e. approximately 1,400 US\$).

Gambling Forms

Twenty-eight participants were excluded from the clustering because they did not answer the TCI. The distribution of the gambling activities in the sample is shown in Table 3. Twelve participants could not be classified within one of the nine types, as their answer wasn't sufficiently precise. The category of social pure chance games was not represented in the cohort, as it is very unusual in France to place bets on this kind of game when playing against other players. The gambling activities mostly played in our sample were Electronic Gaming Machines (EGM) (26.0 %) and horse race betting (21.5 %). Almost all of the participants played other forms of gambling than their favorite game (97.7 %). However, the majority (81.0 %) indicated a preferred gambling activity which was coherent with the most frequently played game.

Clustering: "Healthy" Profile

Of the partitions with less than 6 clusters, the indices of homogeneity were optimal for the 3-cluster and 5-cluster solutions. We chose the 5-cluster partition because it allowed easier interpretation (since the 3-cluster partition grouped 85 % of the participants together in a single cluster, with a large mixture of types of gambling). The 3-cluster and 5-cluster solutions explained almost the same proportions of inertia (90.1 and 85.8 % respectively). Table 4 shows the distribution of gamblers within the 5 classes, focusing on their favorite gambling activity. Apart from Black Jack, between 95 and 100 % of the gamblers preferentially playing the same type of gambling game were actually present in the same class. Blackjack players were a small minority in our sample ($N = 3$). We therefore chose not to take them into account in our future interpretations.

Table 4 shows that the clustering of gamblers obtained was not equivalent to the theoretical game classifications (Bjerg 2010; Boutin 2010). Some gambling activities, which belong to different categories in the theoretical classifications (poker, horseracing/sports

Table 2 Sociodemographics of the whole sample (n = 628)

	N	%
Gender		
Male	418	66.6
Female	210	33.4
Marital status		
Single	313	49.9
As a couple	314	50.1
Educational level		
Below high school graduation	306	48.9
Higher than or equal to high school graduation	320	51.1
Professional activity		
Working	398	63.5
Non-working	229	36.5
Level of income		
Regular income and higher than the French minimum wage (approximately 1,100 € or 1,400 \$)	440	70.1
Others	188	29.9
	M	SD
Age	43.4	12.9

Table 3 Distribution of the different forms of gambling within the whole sample (n = 600)

Forms of gambling activity	N	%
Electronic gaming machines (EGM)—Slots, videopoker lotteries	156	26.0
Horse race betting	129	21.5
Poker	75	12.5
Scratch cards	74	12.3
Deferred lotteries—Loto [®] , Euromillions [®] , Kéno [®]	70	11.7
Sports betting	44	7.3
Roulette	22	3.7
Instant lotteries—Rapido [®] , online Bingo	15	2.5
Black Jack	3	0.5
Non classified	12	2.0

Rapido[®] is a French game available in bars. The goal is to find 8 out of 20 numbers in a first grid (grid A) and simultaneously one number out of 4 in a second grid (grid B). The draw frequency of the Rapido[®] is very high, with one draw every two and a half minutes

betting and deferred lotteries) were grouped together in the proposed gamblers' clustering, and on the contrary gambling activities which are in the same category in the theoretical classifications (EGM, scratch cards, roulette and instant lotteries) were separated into several clusters.

Table 5 shows the specific “healthy” profile of each class, resulting from the clustering method.

Class 1: EGM Gamblers

Class 1 gamblers were characterized by playing EGM. They were more often women, were older people, gambled a larger part of their income, were introduced to gambling later and have gambled for a shorter period since the onset of gambling compared with the others. Their profile showed high cooperativeness.

Class 2: Games with Deferred Results Gamblers

Class 2 gamblers were characterized by playing deferred lotteries, horse race betting, sports betting and poker, which are all gambling forms whose results are not instant. They were distinguished from other gamblers by being usually male, younger, not living alone, being initiated into gambling earlier and gambling more often on the Internet. They were high novelty seekers and displayed lower scores on the TCI-Harm-Avoidance, TCI-Cooperativeness and TCI-Self-Transcendence scales.

Class 3: Roulette Gamblers

Class 3 gamblers were characterized by playing roulette. They were distinguished from other gamblers by being usually male and having experienced a higher maximum bet in 1 day, so that they could be defined as high rollers.

Class 4: Instant Lottery Gamblers

Class 4 gamblers were characterized by playing instant lotteries. They had no particular other characterizing specificities identified by the clustering method.

Class 5: Scratch Cards Gamblers

Class 5 gamblers were characterized by playing scratch cards. They were distinguished from other gamblers by being usually women, with a lower income and by gambling less often on the Internet. They were low novelty seekers and displayed a higher TCI-Harm-Avoidance score.

“Pathological” Profile

Table 6 shows the “pathological” profile of each class (i.e. gambling severity, GRCs and psychiatric comorbidities), resulting from the secondary description of each class.

Class 1: EGM Gamblers

Class 1 gamblers are more likely to use gambling as a way of escaping problems or relieving a dysphoric mood. They show a lower score on the GABS-Strategy dimension. Finally, they display more depressive disorders and fewer addictive disorders.

Table 4 Distribution of gamblers within the 5 classes from the 2-step clustering method, and reference to the theoretical classification (n = 600)

Theoretical classification of games [in reference to Bjerg's classification (2010)]	Types of gambling activity	Class 1 n = 155 26 %	Class 2 n = 328 55 %	Class 3 n = 24 4 %	Class 4 n = 18 3 %	Class 5 n = 75 13 %
Bank games of pure chance	Scratch cards (n = 74)					100 %
	EGM (n = 156)	95 %	5 %			
	Roulette (n = 22)			100 %		
	Instant lotteries (n = 15)				100 %	
	Deferred lotteries (n = 70)	3 %	97 %			
Bank games of skill and chance	Black Jack (n = 3)		33 %	33 %	33 %	
	Horse race betting (n = 129)	1 %	99 %			
	Sports betting (n = 44)		100 %			
Social games of skill and chance	Poker (n = 75)	1 %	99 %			

Percentages represent the proportion of gamblers playing preferentially to each type of game who were classified in each class of the clustering. The largest proportions are indicated in bold

Class 2: Games with Deferred Results Gamblers

Class 2 gamblers lie more often to others to conceal the extent of their involvement in gambling and have committed more illegal acts to finance gambling. They show a higher GABS-Strategy score. They display more addictive disorders, and suffer from fewer panic attacks and social phobia disorders. Finally, a history of suicide attempts is less common in this class.

Class 3: Roulette Gamblers

Class 3 gamblers are less likely to use gambling as a way of escaping problems or relieving a dysphoric mood. They have a higher GABS-Strategy score. They display more manic or hypomanic episodes and more obsessive–compulsive disorders.

Class 4: Instant Lottery Gamblers

A history of suicide attempts is more common in class 4 gamblers.

Class 5: Scratch Cards Gamblers

Class 5 gamblers display fewer PG diagnostic criteria (i.e. lower gambling problem severity). They have lower GABS-Strategy and GABS-Attitude scores, resulting in a lower overall GABS score. Finally, panic attacks and eating disorders are more frequent in this class.

Discussion

Our study proposes a clustering of non-problem and problem gamblers, with an emphasis on their preferred gambling activity. The idea was to form classes of gamblers who exhibit

Table 5 Description and characterization of the 5 classes generated by the two-step clustering method, based on “healthy” variables

	Class 1 (N = 155; 26 %)		Class 2 (N = 328; 55 %)		Class 3 (N = 24; 4 %)		Class 4 (N = 18; 3 %)		Class 5 (N = 75; 13 %)		Whole sample N = 600
	%-M (SD)	Test- value ^a	%-M (SD)	Test- value ^a	%-M (SD)	Test- value ^a	%-M (SD)	Test- value ^a	%-M (SD)	Test- value ^a	
Age	45.9 (13.1)	2.7***	42.5 (12.7)	-2.3*	40.0 (12.3)	-	46.4 (9.9)	-	43.8 (13.7)	-	43.5 (12.9)
Gender (male)	40.0 %	-7.8***	83.2 %	9.6***	87.5 %	2.1*	77.8 %	-	37.3 %	-5.4***	66.3 %
Marital status (alone)	54.8 %	-	44.8 %	-2.4**	62.5 %	-	33.3 %	-	58.7 %	-	49.5 %
Educational level (≥ 12 years)	44.5 %	-	53.7 %	-	70.8 %	-	55.6 %	-	45.3 %	-	51.0 %
Professional activity (active)	63.9 %	-	64.6 %	-	70.8 %	-	55.6 %	-	57.3 %	-	63.5 %
Level of income (>1,100€/1,400\$)	71.0 %	-	71.0 %	-	79.2 %	-	77.8 %	-	54.7 %	-2.8**	69.5 %
Preferred gambling activity											
Scratch cards	0.0 %	-6.5***	0.0 %	-11.1***	0.0 %	-	0.0 %	-	98.7 %	20.6***	12.3 %
EGM	95.5 %	23.3***	2.4 %	-15.3***	0.0 %	-3.2***	0.0 %	-2.6**	0.0 %	-6.6***	26.0 %
Roulette	0.0 %	-3.0**	0.0 %	-5.5***	91.7 %	12.9***	0.0 %	-	0.0 %	-	3.7 %
Instant lotteries	0.0 %	-2.3*	0.0 %	-4.4***	0.0 %	-	83.3 %	10.75***	0.0 %	-	2.5 %
Deferred lotteries	1.3 %	-5.3***	20.7 %	8.4***	0.0 %	-	0.0 %	-	0.0 %	-3.9***	11.7 %
Black Jack	0.0 %	-	0.3 %	-	4.2 %	-	5.6 %	-	0.0 %	-	0.5 %
Horse race betting	0.7 %	-8.6***	39.0 %	12.9***	0.0 %	-2.8**	0.0 %	-2.3*	0.0 %	-5.8***	21.5 %
Sports betting	0.0 %	-4.7***	13.4 %	7.1***	0.0 %	-	0.0 %	-	0.0 %	-2.8**	7.3 %
Poker	0.7 %	-6.0***	22.6 %	9.2***	0.0 %	-	0.0 %	-	0.0 %	-4.1***	12.5 %

Table 5 continued

	Class 1 (N = 155; 26 %)		Class 2 (N = 328; 55 %)		Class 3 (N = 24; 4 %)		Class 4 (N = 18; 3 %)		Class 5 (N = 75; 13 %)		Whole sample N = 600
	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	
Non classified	1.9 %	—	1.5 %	—	4.2 %	—	11.1 %	—	1.3 %	—	2.0 %
Internet gambling	9.7 %	—	14.3 %	2.4**	8.3 %	—	11.1 %	—	2.7 %	—	11.3 %
Familial history of gambling problems	25.2 %	—	26.5 %	—	16.7 %	—	33.3 %	—	22.7 %	—	25.5 %
Ratio bets/income	0.5 (0.9)	2.2*	0.3 (0.5)	—	0.4 (0.8)	—	0.2 (0.2)	—	0.2 (0.6)	—	0.4 (0.6)
Max. amount of money wagered in a day (€)	1.639.2 (8.369.0)	—	1.093.7 (3.072.6)	—	4.893.3 (11.154.5)	3.4***	1.260.7 (2.307.5)	—	184.1 (444.9)	—	1.277.9 (5.370.3)
Betting back of winnings	85.8 %	—	82.9 %	—	87.5 %	—	83.3 %	—	74.7 %	—	82.8 %
Duration of gambling since the onset (years)	21.1 (10.7)	—	23.9 (11.9)	—	22.0 (13.4)	—	22.1 (12.4)	—	24.5 (11.9)	—	23.1 (11.7)
Gambling initiation age	24.9 (11.9)	7.0***	18.5 (6.7)	—	18.0 (5.9)	—	24.3 (11.3)	—	19.2 (8.1)	—	20.4 (9.2)
TCI—novelty seeking	51.2 (17.7)	—	54.1 (18.1)	2.2*	56.7 (15.4)	—	49.2 (23.6)	—	48.7 (16.5)	—	52.6 (17.9)
TCI—harm avoidance	45.4 (23.3)	—	41.5 (23.0)	—	37.7 (18.7)	—	54.2 (21.4)	—	51.0 (24.3)	2.8**	43.9 (23.3)
TCI—self-directedness	70.2 (17.9)	—	67.7 (19.9)	—	63.5 (18.3)	—	61.6 (19.9)	—	65.1 (23.6)	—	67.7 (19.9)
TCI—cooperation	77.2 (12.7)	3.2***	72.4 (15.5)	—	73.7 (14.9)	—	77.8 (15.5)	—	72.9 (16.7)	—	73.9 (15.1)
TCI—reward dependence	61.3 (17.1)	—	59.1 (18.2)	—	62.2 (15.1)	—	64.4 (14.0)	—	61.0 (17.9)	—	60.2 (17.4)
TCI—self-transcendence	34.4 (23.3)	—	29.4 (21.7)	—	32.5 (25.9)	—	33.4 (22.0)	—	33.1 (20.9)	—	31.4 (22.2)

Table 5 continued

	Class 1 (N = 155; 26 %)		Class 2 (N = 328; 55 %)		Class 3 (N = 24; 4 %)		Class 4 (N = 18; 3 %)		Class 5 (N = 75; 13 %)		Whole sample N = 600
	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	%—M (SD)	Test- value ^a	
TCI—persistence	58.0 (27.3)	—	53.5 (29.3)	—	58.3 (32.3)	—	45.6 (28.1)	—	56.9 (24.1)	—	55.1 (28.3)

In addition, the test-value is a test parameter automatically determined by the SPAD software which indicates the direction of the relationships. When the test-value is positive, then the related variable is statistically higher in the class than in the rest of the sample, and conversely. Positive test-values are indicated in bold. For ease of clarity, test-values are only given for characterizing variables (that is for significant comparisons)

%; proportions; M (SD): means and standard deviations

* *p* value <0.05; ** *p* value <0.01; *** *p* value <0.001

^a The test was selected depending on the nature of the variable (continuous or categorical) and on the sample size, from the following tests: Fisher Exact test, Chi squared test, Student test or Mann–Whitney test. A variable was considered characterizing if the test was significant at 0.05. The lower the *p* value, the higher the variable is characterizing of the class

a particular profile, and to see whether they shared a preferred gambling activity, especially in comparison with existing theoretical classifications of gambling games (Boutin 2010; Bjerg 2010).

A first result of our study is that, based on non-pathological characteristics, it is possible to obtain homogeneous groups of gamblers who share a common preferred category of gambling activities. We were concerned that gamblers playing the same gambling activity would end up in different classes in the clustering, which would have meant that the choice of preferred gambling activity wasn't necessarily associated with a particular gambler profile. In our results, the vast majority (>95 %) of the gamblers playing preferentially the same gambling activity were actually present in the same class of the classification. That means that gamblers who play preferentially the same type of gambling seem to share a common profile, independently of pathological characteristics. It is thus relevant to establish classifications of gambling games to support the development of research, prevention and care.

The second important point of the study is that the grouping of gambling activities based on our results is not equivalent to the theoretical classifications (Bjerg 2010; Boutin 2010). These latter had presented a theoretical view based on the structure of the game (i.e. the amount of skill and the expected value). Our typology didn't verify the importance of the expected value of the game. Indeed, we expected that poker gamblers would form a separate class, as previous literature indicated that they have a specific profile: younger males with alcohol abuse and earlier gambling onset (Bjerg 2010; Shead et al. 2008; Bouju et al. 2013). The notion of the expected value of the game is perhaps more important for problem gamblers, because they have difficulty in accepting that they will not win money at the end. As problem and non-problem gamblers were mixed together in our sample, it may explain why the expected value appeared to be not so determining for the choice of gambling activity. Moreover, even though a large majority of gambling activities in class 2 included an element of skill (except deferred lotteries), the grouping of gambling activities seems to be more based on the time required to obtain the results. At first, we were surprised by this grouping because we expected that games with an element of skill would form a class in themselves, and in any case that they would group with a lottery game. Indeed, current literature focuses on the distinction between skillful and non-skillful games and insists on the importance of studying the skill component of the game to explain differences in gamblers (Stevens and Young 2010; Turner and Fritz 2001; Meyer et al. 2013; Kelly et al. 2007; Dreef et al. 2004; Grant et al. 2012). With a second look, we deduced that the delay in obtaining the result may be the most important feature in differentiating profiles of gamblers. This delay could be very different, but always with an event between the bet and the outcome (the race for horse race betting, the match/competition for sports betting, the rounds of betting for poker and the delayed draw for deferred lotteries). It's particularly the case in contrast with games with instant results (roulette, EGM, instant lotteries, scratching), for which the outcome immediately follows the bet, with no new betting event concluded between. This delay between the bet and the outcome was particularly studied in the early 2000's (Breen and Zimmerman 2002; Loba et al. 2001; Dowling et al. 2005) to explain the perceived dangerousness of continuous gambling forms, especially EGM (Dowling et al. 2005). At this time, studies failed to establish a causal effect of the speed of the game on gambling problems (Dowling et al. 2005). We hypothesize that the association between the speed of the game and problem gambling could be indirect. We assume that high speed games attract a particular gambler profile, which might be more likely to develop gambling problems in response to the speed of the game. Other gamblers may not have a higher risk of problems even if they are facing high-

Table 6 Comparison of the 5 classes based on “pathological” variables

	Class 1 N = 155 26 %	Class 2 N = 328 55 %	Class 3 N = 24 4 %	Class 4 N = 18 3 %	Class 5 N = 75 13 %	Whole sample N = 600 ^a
Number of positive criteria on DSM-IV PG section	3.8 (3.0)	3.9 (3.0)	4.3 (3.0)	4.6 (3.8)	2.5 (2.9)***	3.8 (3.0)
% of positive criteria (DSM-IV PG section)						
Preoccupation with gambling	42.6 %	49.7 %	58.3 %	50.0 %	34.7 %*	46.3 %
Increasing amounts of bets	38.7 %	41.2 %	50.0 %	38.9 %	18.7 %***	38.0 %
Unsuccessful efforts to control	50.3 %	45.4 %	62.5 %	55.6 %	34.7 %*	46.3 %
Withdrawal symptoms	32.3 %	30.8 %	50.0 %	44.4 %	26.7 %	31.8 %
Gambling for escapism	58.7 %***	43.9 %	20.8 %*	50.0 %	36.0 %	46.0 %
Chasing	52.3 %	56.1 %	62.5 %	66.7 %	36.0 %**	53.2 %
Lies to conceal gambling involvement	48.4 %	53.7 %*	45.8 %	61.1 %	29.3 %***	49.2 %
Illegal acts to finance gambling	9.7 %	15.9 %*	8.3 %	22.2 %	6.7 %	13.0 %
Jeopardization of job or relationship	25.8 %	28.7 %	33.3 %	33.3 %	10.7 %**	26.0 %
Borrowing money to finance gambling	25.8 %	25.9 %	37.5 %	33.3 %	18.7 %	25.7 %
GABS—23	43.1 (17.3)	43.6 (18.8)	52.2 (21.6)*	44.6 (20.8)	39.0 (19.5)*	43.3 (18.8)
Strategy	36.7 (24.2)**	43.6 (25.0)*	62.2 (32.6)***	41.6 (20.9)	35.6 (25.1)*	41.5 (25.6)
Luck	39.6 (23.6)	38.1 (25.4)	44.1 (29.0)	39.4 (25.6)	37.1 (22.2)	38.7 (24.7)
Attitude	56.7 (22.6)	56.8 (23.4)	65.6 (26.7)	58.8 (24.7)	50.6 (21.6)*	56.4 (23.3)
Chasing	40.6 (26.8)	40.6 (25.1)	46.3 (25.4)	44.8 (34.3)	37.2 (25.0)	40.6 (25.8)
Emotions	42.2 (24.9)	38.7 (24.9)	43.0 (25.3)	38.1 (26.2)	34.5 (26.6)	39.2 (25.2)
COMORBIDITIES (10)						
Depressive disorders	49.0 %*	39.6 %	33.3 %	44.4 %	41.3 %	42.2 %
Manic or hypomanic disorders	9.0 %	12.2 %	25.0 %*	11.1 %	12.0 %	11.8 %
Panic disorder	23.9 %	16.8 %*	16.7 %	16.7 %	29.3 %*	20.2 %
Social phobia	14.8 %	8.5 %*	12.5 %	16.7 %	13.3 %	11.2 %
OCD	1.3 %	3.4 %	12.5 %*	0.0 %	2.7 %	3.0 %

Table 6 continued

	Class 1 N = 155 26 %	Class 2 N = 328 55 %	Class 3 N = 24 4 %	Class 4 N = 18 3 %	Class 5 N = 75 13 %	Whole sample N = 600 ^a
PTSD	10.3 %	6.1 %	4.2 %	11.1 %	8.0 %	7.5 %
Substances/alcohol-related disorders	24.5 %**	39.0 %***	25.0 %	33.3 %	28.0 %	33.2 %
Psychotic syndrome	10.3 %	6.4 %	12.5 %	22.2 %	5.3 %	8.0 %
Eating disorders	2.6 %	2.1 %	0.0 %	5.6 %	9.3 %***	3.2 %
Generalized anxiety disorder	14.2 %	14.0 %	12.5 %	16.7 %	18.7 %	14.7 %
Antisocial personality disorder	1.9 %	4.6 %	8.3 %	0.0 %	4.0 %	3.8 %
Suicide attempts antecedents	18.7 %	11.9 %*	12.5 %	38.9 %**	18.7 %	15.3 %

%, proportions; M (SD): means and standard deviations

In bold = significant differences

* *p* value <0.05; ** *p* value <0.01; *** *p* value <0.001

^a “Pathological” variables were compared between the relevant class and the rest of the sample (which corresponds to the whole sample without the gamblers included in the studied class—the remaining sample is then variable depending on comparisons). For ease of clarity and to avoid presenting too many tables, only descriptive results of the total sample were presented as a comparison point with each class. However, the indications of significance are based on the results of comparisons between a class and the related remaining sample

speed features. Thus, in the future, experimental studies that focus on the speed of the game as a risk factor for problem gambling should be carried out on sub-populations of players with and without continuous games as their preferred games.

Furthermore, it seems that class 2 gamblers would seek games involving reflection or games with high earning potential that allow them to dream. Since the novelty seeking (NS) trait is a bias in the initiation or activation of the appetitive approach to reward signals and in response to novelty, two hypotheses can be made: (1) the skill component would be a way of searching for novelty through the constant search to master the game—the perpetual confrontation with other players and the “conquest” of the game’s secrets may help maintain a level of arousal beyond the typical high threshold of high novelty seekers; (2) the thrill provided by the expectation of results, especially when it comes to a high potential gain, would give the player a feeling of excitement that would help him maintain a high level of arousal. Assuming that different gambling activities attract different gamblers who would not have the same level of NS, it’s easy to understand the varying results in the literature about the level of NS in gambling (Grall-Bronnec et al. 2010; Inserm 2008). High NS would be characteristic of choosing this kind of game. Thus, it is not surprising that the gamblers in this class are men with an early onset of gambling, which are two characteristics known to be associated with high NS (Jiménez-Murcia et al. 2010; Echeburúa et al. 2011). Moreover, a recent study showed that gamblers who felt highly skillful chose the high prize lottery excessively (Dorfman et al. 2013), which can also explain why games with an element of skill and deferred lottery are grouped in the same class.

Another important finding was that pure chance games did not cluster together in terms of gambler typology, and appeared to involve many different gambler profiles. Again, it seems that the skill component and the expected value of a game are not so important when one wishes to identify different gambler profiles. When looking at the distribution of games in the non-retained 3-class partition, we can see that EGM and roulette are clustering together (and with class 2), and that instant lotteries and scratch cards are clustering separately together. Consequently, we can propose two characteristics that could be used to distinguish between different types of pure chance games. The first characteristic would be the place where these games are available. In France, EGM and roulette are allowed exclusively in casinos, while scratch cards and instant lotteries are proposed in cafés. Thus, we can hypothesize that casino gamblers (EGM and roulette) look for a particular atmosphere and for a community to belong to. This is supported by the cooperativeness profile of EGM gamblers, indicating that they thought of themselves as an integral part of a community. At the opposite, café gamblers (scratch cards and instant lotteries) would prefer solitary games. Given that availability of EGM is very different from one country to the other (some countries have liberal gambling laws, allowing EGMs outside of a casino environment, whereas others, like France, have more regulated gambling laws which restrict EGM in casinos only), future research is needed to corroborate this hypothesis, especially transcultural studies. The second characteristic distinguishing games of pure chance would be the active or passive modality of the game. Indeed, some games of pure chance allow the gambler to experience a kind of control over the game, by selecting a modality (numbers, colors, etc.) on which to place the bet (roulette and instant lotteries). Conversely, scratching and EGM are rather passive games, in which the gambler places a bet and gets the result almost immediately. According to our results, passive games would particularly attract women. The passivity or activity of the game could also explain why roulette gamblers scored higher and EGM gamblers lower on the GABS-Strategy dimension, which explores the conviction in illusory gambling strategies which are

supposed to increase the probability of winning. This result is reminiscent of the numerous studies on the illusion of control (Langer and Roth 1975; Walker 1992; Ladouceur et al. 1988; Griffiths 1994). Thus, the importance of GRCs would be variable from one game to the other, regardless of the amount of skill in the game.

Limitations

This study has several limitations. (1) Even if we tried to cover the whole range of gambling activities, it is certain that other types of gambling exist in addition to the nine mentioned. Moreover, the sample size for each type of gambling is very unbalanced. However, the overall sample size was largely sufficient for this classification method, and this sample size is rarely achieved for studies with semi-structured interviews. Therefore, even with small sample sizes for certain gambling activities, they succeeded in being isolated in a single class and were not drowned in a larger, more heterogeneous, class as might have been expected. (2) Given that recruitment was done on a voluntary basis and that a compensation was offered, this study is subjected to typical participation biases associated with voluntary participation. (3) Participation in the study was restricted to gamblers aged under 65. Casino gambling (especially EGM) is known to attract people over 65 years old, and thus the results of the present study may have been affected by this restriction. However, this threshold was part of the design of the JEU cohort study for three reasons: first, to avoid cognitive biases for filling questionnaires; second, because the tools used were not validated in this age group; and third, the prospect of long-term study (5 years) of gambling practices in the JEU cohort made that we had to restrict the maximum age at inclusion. (4) Some data which may have had an influence on the classification were not collected (locus of control, emotional regulation, impulsivity, motivations to gambling, etc.). (5) We forced our participants to choose one preferred gambling activity out of all of those they had tried during their life. Consequently, gamblers with a multi-game profile were restricted to defining a single preferred gambling activity, and their particular profile was not considered separately. (6) From a methodological point of view, the fact that this analysis has been realized using a specific software (SPAD) can be considered as a limit. Nevertheless, all the realized statistical procedures are classical ones (Principal Components Analysis, Multiple Correspondence Analysis, Mixed Hierarchical Clustering, etc.) and are available with other major statistical software.

Conclusions

Figure 1 shows a proposed classification algorithm, based on the previous hypotheses and discussion. This algorithm is an attempt to explain how gamblers could group together in relation to their preferred gambling activity. Regarding our results, three characteristics could explain this grouping: the search for a thrill, the search for control over the game and the atmosphere of the game. Future research should take into account the preference for one particular gambling activity, which may concern different profiles of gamblers. They especially should clarify the real importance of the skill component and the expected value of a game with respect to gambling behaviors or gambler profiles. Especially, the role of GRCs would not be as important, depending on the preferred gambling activity. The distinction would not necessarily be based solely on the proportion of skill present in the game. Future studies about the link between the speed of the game and problem gambling

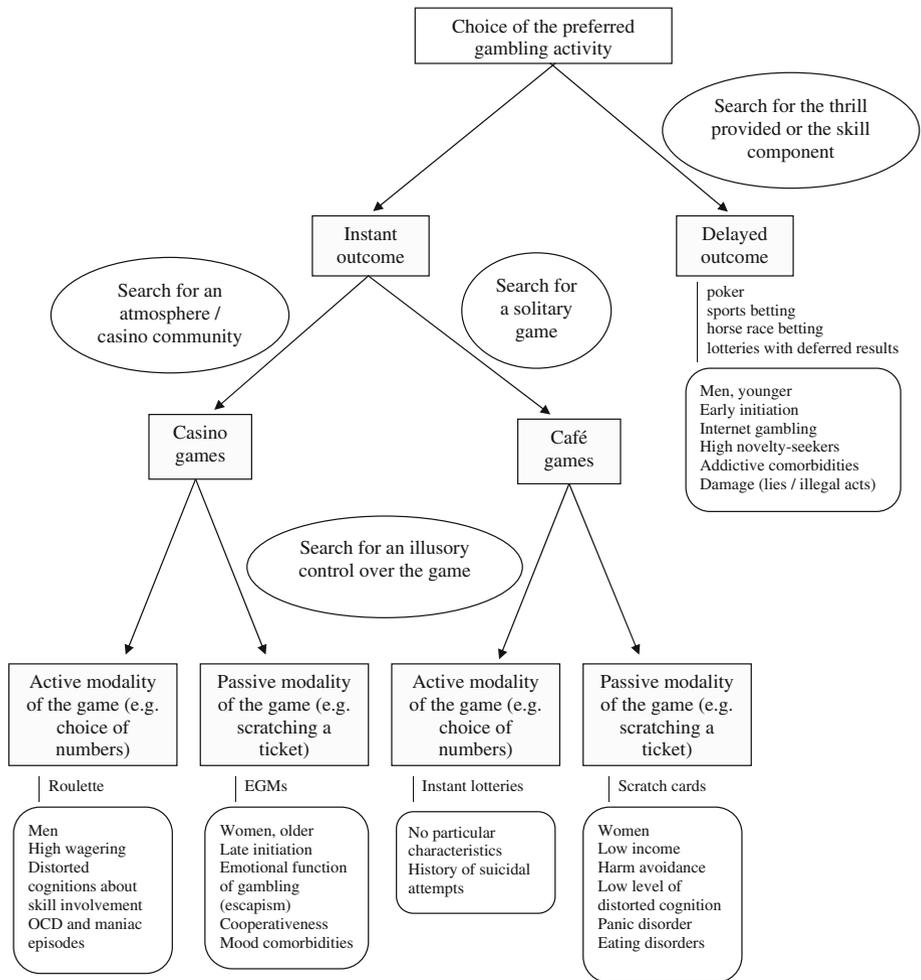


Fig. 1 Algorithm for a gamblers’ classification based on their preferred gambling activity

should also be carried out on sub-populations of players with and without continuous games as their preferred games, in order to take their specific profiles into account. This study highlights the importance of considering the pair gambler-game rather than one or the other separately.

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Conflict of interest M.G.B., J.L.V. and G.C.B. declare that the University Hospital of Nantes has received funding from gambling industry (Française Des Jeux and Pari Mutuel Urbain) in the form of a sponsorship which supports the gambling section of the *BALANCED* Unit (the Reference Centre for Excessive Gambling). Scientific independence towards gambling industry operators is warranted. C.L. declares that the University of Paris Ouest Nanterre La Défense has received funding directly from gambling industry (Française Des Jeux and Pari Mutuel Urbain) as part of other research contracts—this funding has never had any influence on the present work. J.B.H., N.R., M.V., D.M., M.F., J.C.B. and M.A.G. declare that they have no conflicts of interest. There were no constraints on publishing.

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