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ORIGINAL PAPER

Cognitive Distortions in Gamblers and Non-gamblers of a Representative Spanish Sample

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Abstract

Cognitive biases or distortions related to gambling, present in all people, are considered a relevant factor in the development of gambling-related problems. Objective: to establish whether the presence of these biases or cognitive distortions, in gamblers and non-gamblers, is related to the presence of gambling problems. Method: 3000 people aged 18–81 years, representative of the Spanish adult population, underwent a structured survey. Results: the presence of distortions was relevant to distinguish gamblers according to their level of gambling engagement and problems. There is a constant and significant tendency to have more cognitive distortions as gambling problems increase. But not all distortions have the same ability to distinguish between the different groups of gamblers. The results seem to group gamblers into three groups according to the presence of cognitive distortions, from less to more: (1) non-gamblers, (2) low-risk and at-risk gamblers, and (3) problem and pathological gamblers. The relevance of this research and its practical implications for both treatment and prevention work is discussed.

Keywords Pathological gambling · Cognitive distortions · Cognitive bias · Gambling · Type of gamblers

This work has been approved by the deontological committee of Faculty of Psychology of the Complutense University of Madrid.

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Introduction

Participation in games of chance facilitates the appearance of gambling problems or disorders. The DSM-5 (APA 2013) includes the *Pathological Gambling* among the addictive disorders, establishing nine criteria to evaluate the presence of this problem. For the diagnosis of pathological gambling at least four of these criteria are required for 12 months. Less demanding criteria allow identifying *Problem gamblers* or *At-risk gamblers*. The impact of gambling disorders in Spain is relevant, having identified in adults a 1.1% as the vital prevalence of Pathological gamblers and a 1% of Problem gamblers (Labrador et al. 2014).

Therefore, it is pertinent to ask: Why does a pathological gambler gamble? Probably, like everyone else, to win prizes. But, as the odds of winning at gambling are very low, and the more one gambles, the lower they are, why do people gamble repeatedly? The most plausible explanation is that people gamble because they have irrational thoughts (cognitive distortions) about gambling and their odds of winning (Labrador and Labrador 2016).

The development of cognitive biases or distortions is usual in people when they have to face complex tasks, whose results are uncertain or difficult to predict, such as gambling. Instead of considering all the real probabilities, which is an arduous or even impossible task, they try to simplify all this unmanageable information, considering only a small part of it (they "bias" or "distort" reality). This information reduction (bias) facilitates the task, but the biased information may not adequately represent reality and lead to inadequate conclusions. In gambling, these cognitive biases can lead to irrational conclusions about the probabilities of predicting or controlling the results of an activity controlled by chance, that is, unpredictable and uncontrollable. Only if a person considers that he/she can predict or control the results of the game does it seem logical that he/she gambles repeatedly, trusting that he/she will finally get the prize. But the reality is that games of chance, by definition, are not controllable or predictable.

The presence of cognitive biases or distortions related to gambling has been repeatedly reported. There is evidence that whether or not they are gamblers and have gambling problems, when considering gambling, most people present cognitive distortions. These distortions seem to be an important ingredient, along with the prizes, in the development of gambling problems (Clark et al. 2014; Mathieu et al. 2018).

Cognitive Distortions in Gambling in Analogous Samples

The work of Gilovich (1983) with sports betting, or those of Gilovich and Douglas (1986) with computer bingo already emphasized the biased evaluation of the game, and Wagenaar (1988) established a first classification of these distortions. The work of the group of Ladouceur (2004; Ladouceur et al. 1996) with different types of gambling (flipping a coin, slot machines, roulette) indicated that the percentage of irrational thoughts in gambling surpass the rational thoughts, especially when gambling at slot machines. These authors emphasized that the main bias was not considering the independence of random events. Other works, like that of Hardoon et al. (2001), emphasized the randomness bias. Labrador (2010) found that 85% of game-related thoughts (concerning slot machines) are irrational in people without gambling problems. MacKay and Hodgins (2012) underscored that cognitive distortions in students are an important risk factor for the development of online gambling problems, which was also pointed out by Clark et al. (2009), who identified and

manipulated them successfully. In summary, even with exceptions, there is consistent support for the presence of cognitive distortions during gambling in analogous samples.

Cognitive Gambling Distortions in Gamblers

These works have a later starting date, paying more attention to identifying specific distortions. Thus, Keren and Wagenaar (1985) identified distortions in blackjack gamblers such as not considering the independence between the events, believing that results in small samples are representative of the population, trusting luck, etc. The group of Ladouceur (Savoie and Ladouceur 1995) underlined the gambler's fallacy (or self-correcting randomness) or superstitious behaviors. The work of Toneatto et al. (1997) identified 13 distortions, grouped in five categories:

1. Interpretation-based control: attributive bias, memory bias.
2. Probability Control: "hunting" losses, false contingencies, probability errors.
3. Passive control illusion: luck as a state, luck as a trait.
4. Active illusion of control: effectiveness of skills, cognitive control, behavioral control, control through lucky charms.
5. Prediction-based Control: manifest cues, contrasting hypotheses.

These categories were more recently reviewed by Hahmann (2016).

Particularly noteworthy is the presence of cognitive distortions in gamblers, especially in slot-machine gambling (Barrault and Varescon 2013; Labrador and Labrador 2016). Some authors have even indicated a precise percentage of these distortions. Thus, Delfabbro and Winefield (2000) indicated that 75% of gambling-related thoughts were irrational, whereas Labrador (2010) reported that 97% of the thoughts about the dynamics of gambling were erroneous. Specific distortions are highlighted, such as: the gambler's fallacy or self-correcting randomness (Goodie and Fortune 2013), the illusion of control (Barrault and Varescon 2013), the irrational perception of risk (Spurrier and Blaszczynski 2014), lose by little (Bowden-Jones and Sanju 2015), prediction of results (Labrador et al. 2008), luck as the accountable factor for the results (Cowie et al. 2017), or the perceived inability to stop gambling (Tani et al. 2018).

Some studies have indicated a causal relationship, as the presence of distortions is more likely to lead to gambling problems (Barrault and Varescon 2013; Bowden-Jones and Sanju 2015; Mathieu et al. 2018). However, other studies have given less relevance to this influence by pointing out that impulsivity and the search for rewards have a more important role in the etiology of pathological gambling (MacLaren et al. 2012).

There have also been contributions from psychobiological approaches. Thus, Clark et al. (2009) emphasized an anomalous recruitment of the brain's reward system when two cognitive distortions that are common in gamblers emerge: illusion of control and loose by little Holst et al. (2010), in pathological and problem gamblers, pointed to the implication of the ventral tegmental orbitofrontal area of the cortex, which is related to addictions rather than to impulse control problems.

In summary, the cognitive biases considered most relevant in gamblers are the illusion of control, prediction of results, and considering that there is a relationship between random gambling events (self-correcting randomness, illusory correlation). The relationship between self-correcting randomness and gambling problems are especially relevant (Goodie and Fortune 2013; Labrador and Labrador 2016).

Cognitive Distortions in Problem Gamblers

Most works find that, although the frequency of cognitive gambling distortions is high in all people, problem gamblers present more distortions than non-gamblers or than no-problem gamblers (Goodie and Fortune 2013; Michalczuk et al. 2011; Tang and Wu 2012). Specifying these differences, in slot machine gambling, Labrador (2010) found 97% of irrationality in sentences about gambling strategies in pathological gamblers compared to 85% in the control group.

From a qualitative point of view, problem gamblers may present cognitive distortions other than those of non-gamblers or non-problem gamblers, implying that some distortions may be more relevant to the development of gambling problems than others. In this direction, Labrador (2010) stated that pathological gamblers have more cognitive distortions about the prediction of results, the gambler's fallacy, and the personification of the machine compared to non-gamblers or non-problem gamblers, who present more illusion of control, belief in luck, and attention to absolute frequencies. Tang and Wu (2012) found more biases about perceiving a lack of ability to stop gambling and expectations of positive outcomes among pathological gamblers. Michalczuk et al. (2011) pointed out that pathological gamblers show higher levels of distortion about gambling and prefer immediate rewards compared to a control group.

In short, there is consistent evidence of a greater number of cognitive distortions in problem gamblers than in non-problem gamblers or non-gamblers. Regarding the qualitative differences, there is less agreement, partly because the type of distortions can vary depending on the game (Hahmann 2016).

On the other hand, the works seem to show a positive correlation between distortions and the severity of gambling problems (Cosenza et al. 2014; Marmurek 2018; Labrador and Labrador 2016; Tani et al. 2018). However, most of these studies have been carried out using small and non-Spanish samples.

The objective of this paper is to analyze the presence of the main gambling-related cognitive distortions and to establish whether they are related to the presence of gambling problems in a wide and representative sample of the Spanish population.

Method

Participants

Three thousand people living in Spain, aged between 18 and 81 years, underwent a survey about gambling in Spain. Participants were selected through random stratified sampling by Autonomous Communities (ACs) according to data from the Population and Housing Census 2011 of the National Institute of Statistics. The selection of the interviewees was carried out by means of a randomized sampling in the street at 195 points attending to the quotas established by ACs and sex and age. (sample error ± 1.83% for the total sample for a confidence level of 95.5%-2sigma-and under the assumption of maximum indetermination where $p = q = 0.5$). Data were collected through a personal interview in June 2013.

Design

Prospective epidemiological study with a representative sample of the Spanish population with one measurement time.

Variables and Instruments

For data collection, a questionnaire designed ad hoc was used that included the following instruments and variables.

Sociodemographic variables evaluated through survey. We assessed: gender, age, marital status, level of studies, employment status, profession, personal income level (monthly), household income level (monthly). In this study, only the first two variables will be taken into account.

Types of gamblers evaluated by the NODS-clip and the NODS.

The NODS-clip (Volberg et al. 2011), was used as a screening instrument with the entire sample. It is an abbreviated version of NODS that consists of three elements (loss of control, lies and concern), and that has been validated by Toce-Gerstein et al. (2009). Subsequently, the inclusion of a fourth item, "chasing the losses", has obtained better psychometric properties (Volberg et al. 2011).

The *NORC DSM-IV Screen for Gambling Problems* (NODS; Gerstein et al. 1999), Spanish adaptation of Becoña (2004), was applied to participants who answered affirmatively to some question of the NODS-clip. It consists of 17 dichotomous items that refer to problems related to gambling, throughout life and during the last year. The items are grouped according to the 10 diagnostic criteria established in the DSM-IV and DSM-IV-TR for the pathological gambling. The score range from 0 to 10 points and one point is obtained for each DSM-IV criterion that is met.

The types of gamblers were established according to the correction criteria of the NODS, considering the lifetime prevalence. We added one more type, non-gamblers. Five categories of gamblers were established:

(a) Non-gamblers: they never gamble
(b) Low-risk gamblers: they gamble and do not meet any NODS criteria
(c) At-risk gamblers: they gamble and meet 1 or 2 NODS criteria,
(d) Problem gamblers: they gamble and meet 3 or 4 NODS criteria
(e) Pathological gamblers: they gamble and meet 5 or more NODS criteria

Cognitive Distortions To assess cognitive distortions an ad hoc scale was developed. It included nine questions in which participants rated their degree of agreement with each statement on a four point Likert type scale (1 = Totally disagree; 2 = Reduced agree; 3 = Strongly agree; 4 = Totally agree). It also included the alternative *Doesn't know/Doesn't reply* (see Table 1). These questions referred to six of the most important distortions in gamblers according to the bibliographic review of the introduction: (1) Illusion of control, (2) Biased evaluation of results, (3) Illusory correlation, (4) Self-correcting randomness (gambler's fallacy), (5) Prediction of results, and (6) Luck as the accountable factor for the results. The mean score (1–4) for each distortion was computed. Moreover, we also obtained a seventh variable, called "summation", consisting

Table 1 Sentences used to assess the cognitive distortions

Skill influences gambling, the more you practice, the better you play and the more prizes you win (*Illusion of control*)
After an important prize, it is less likely to occur again (*Self-correcting randomness*)
You have to take advantage of gambling when you are on a lucky streak or you are feeling lucky (*Luck as the accountable factor for the results*)
Good gamblers end up earning money if they persist in gambling, even if they have bad streaks (*Biased evaluation of the results*)
Being about to win is a sign that you are closer to winning (*Illusory correlation*)
Believing in luck is nonsense, luck does not exist (-inverse- *Luck as the accountable factor for the results*)
If you know the games well, sometimes the prizes can be predicted (*Predicting results*)
Sometimes something "special" happens and I get the feeling that if I gamble that day, I will win (*Illusory correlation*)
If you gamble for a long enough time, the losses will be recovered (*Illusion of control*)

of an average score (1–4) of all the distortions. In all the cases higher scores mean more intense cognitive distortions. (see Table 1).

Data Analysis

The SPSS-19 program was used to analyze the data.

Descriptive statistics (means, typical deviations, and percentages) were calculated to identify the main characteristics of the participants and to evaluate the target variables of the study.

Chi square (χ^2) tests were applied for nominal variables to compare the participants as a function of the type of gambler. For the quantitative variables, we applied Student's *t*-tests, taking into account the homogeneity of the variances by means of the Levene test, or the analysis of variance (ANOVAs), applying the Scheffé test as a post hoc test. In those cases in which the analysis involved multiple comparisons, we applied the Bonferroni correction of the level of significance. In all analyses, the "Doesn't know/doesn't reply" response option was considered a missing value.

Results

Sample Description

The sample included 50.5% women and 49.5% men, aged between 18 and 80 years: 9% aged 18–24 years, 17.8% 25–34 years, 20.3% 35–44 years, 24.8% 45–59 years and 28% 60–80 years. Most of the participants lived with a partner (54.5%) and were active workers (49.6%), though 16.2% were unemployed, 17.8% retired, 7.2% were students and 7.5% were housewives. Participants were, for the most part, Spanish (95.8%) and had finished secondary studies (56.4%); 17.4% had only completed primary studies, while 19.9% had finished university studies.

With regard to their gambling situation (see Table 2), most were non-problem gamblers (84.5%) or Non-gamblers (10,5%), with the 1% problem gamblers and the 1.1% pathological gamblers.

Table 2 Number and percentage of people in the different categories of gamblers

	Total frequency	% Of total sample ($n = 3000$)
Non-gambler	315	10.5
Low-risk gambler	2.536	84.5
At-risk gambler	86	2.9
Problem gambler	29	1.0
Pathological gambler	34	1.1

Table 3 Mean scores of cognitive distortions in the total sample

	Distortions (range 1–4)	*n*	*M*	SD
1	Illusion of control	2837	1.80	0.84
2	Biased evaluation of results	2808	1.66	0.76
3	Illusory correlation	2878	1.87	0.89
4	Self-correcting randomness	2743	1.83	0.63
5	Predicting results	2750	1.69	0.65
6	Luck as the accountable factor for the results	2772	2.34	0.69
7	Summation score	2495	1.87	0.52

To measure the agreement with each cognitive distortions, a 4-point Likert scale was used (1 = Totally disagree/4 = Totally agree). The results of the average agreement with each cognitive distortion in the total sample can be seen in Table 3. All distortions obtained at least a mean score of 1.66 (between totally disagree -1- and strongly disagree -2-), with the Belief in luck distortion obtaining the higher score, 2.34 (between reduced -2- and strongly agree -3-). The summation mean is 1.87 (close to reduced agree -2-). All the averages scores of the distortions are closer to reduced agree than to totally disagree.

Cognitive Distortions Depending on the Type of Gambler

Table 4 presents the mean values of each type of gambler for each of the six distortions considered, plus the summation score, after the analysis of variance homogeneity revealed all of them as adequate for analyses. All the ANOVA reached values that indicate significant differences ($p < 0.001$) in the scores according to the type of gambler, in the six cognitions studied plus the summation. In general, the score of agreement with the distortions ranged according to the level of involvement or gambling problems. The minor scores correspond to the non-gamblers, then those of the gamblers without problem, then the at-risk gamblers, then the problem gamblers and the highest score to the pathological gamblers. As a summary it can be highlighted that the average summation of pathological gamblers is 2.58 (SD = 0.57), that is closer to strongly agreement than to reduced agreement, while in non-players it is 1.63 (SD = 0.48), a difference of about 1 point with the standard deviations around 0.05 on this scale of 1–4. Figure 1 presents the scores of each type of gambler in each cognitive distortions plus the summation. Table 5 shows the significant differences (Scheffé test) between each type of gamblers in each of the cognitive distortions plus the summation (post hoc analysis). It is noteworthy that the differences between the scores of the pathological gamblers versus the

Table 4 Mean (and standard deviation) and ANOVAS of the cognitive distortions scores, as a function of the type of gambler

		Non-gambler (N = 315)	Low-risk gambler (N = 2536)	At-risk gambler (N = 86)	Problem gambler (29 = N)	Pathological gambler (34 = N)	ANOVAS	*P*
		M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*F* (*df*)	
1	Illusion of control *n* = 2837	1.58 (0.75)	1.81 (0.84)	1.95 (0.92)	2.41 (1.21)	2.50 (1.08)	14.68 (4. 2832)	0.001
2	Biased evaluation of results *n* = 2808	1.43 (0.68)	1.68 (0.75)	1.57 (0.81)	2.14 (0.86)	2.58 (0.95)	22.97 (4. 2803)	0.001
3	Illusory correlation n = 2878	1.47 (0.68)	1.88 (0.88)	2.33 (1.11)	2.20 (0.81)	2.78 (0.92)	31.26 (4. 2873)	0.001
4	Self-correcting randomness *n* = 2743	1.71 (0.60)	1.83 (0.62)	1.89 (0.74)	2.32 (0.74)	2.31 (0.76)	11.40 (4. 2738)	0.001
5	Predicting results *n* = 2750	1.52 (0.61)	1.69 (0.64)	1.65 (0.72)	2.36 (0.77)	2.34 (0.72)	20.56 (4. 2745)	0.001
6	Luck as the accountable factor for the results *n* = 2772	2.02 (0.68)	2.36 (0.67)	2.48 (0.77)	2.62 (0.71)	2.79 (0.77)	21.91 (4. 2767)	0.001
7	Summation score N = 2495	1.63 (0.48)	1.88 (0.51)	2.03 (0.48)	2.35 (0.55)	2.58 (0.57)	35.98 (4. 2490)	0.001

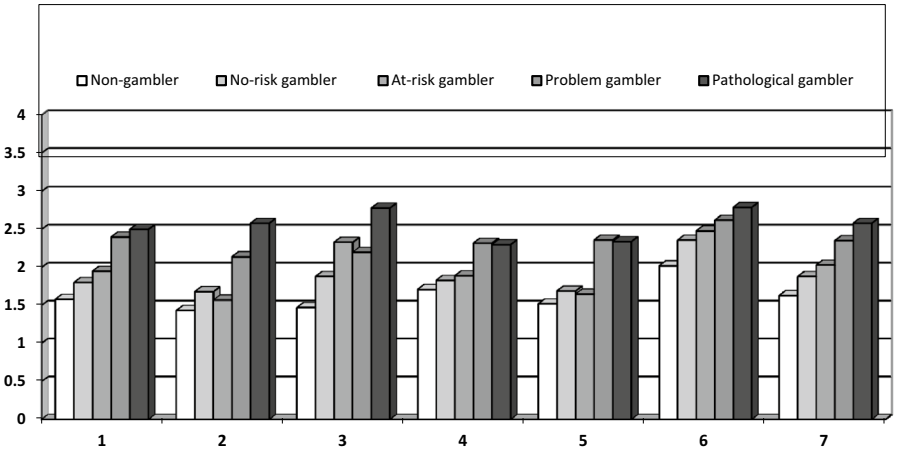

Fig. 1 Level of belief in each distortion and total sum as a function of type of gambler. 1. Illusion of control, 2. Biased evaluation of results, 3. Illusory correlation, 4. Self-correcting randomness, 5 Predicting results, 6 Luck as the accountable factor for the results, and 7. Summation score

Table 5 Significant differences (Scheffé test) in distortions as a function of type of gambler

	Does not gamble	Low-risk gambler	At-risk gambler	Problem gambler	Pathological gambler
Does not gamble	–				
Low-risk gambler	1, 2, 3, 5, 6, S	–			
At-risk gambler	1, 3, 6, S	3	–		
Problem gambler	1, 2, 3, 4, 5, 6, S	1, 2, 4, 5, S	2, 5	–	
Pathological gambler	1, 2, 3, 4, 5, 6, S	1, 2, 3, 4, 5, 6	1, 2, 4, 5, S		–

1 = illusion of control; 2 = biased evaluation of the results; 3 = illusory correlation; 4 = self-correcting randomness; 5 = prediction of results; 6 = luck as the accountable factor for the results; S = Summation

non-gamblers and the gamblers without problem are higher and significant in the six distortions and the summation ($p < 0.01$). Pretty similar results can also be noted for problems gamblers. On the opposite side, non-gamblers present lower and significant scores in almost all the distortions with respect to the other types of gamblers ($p < 0.01$). Scores fairly close to those are present in low risk gamblers.

Figure 2 presents a summary of the differences in the summation scores. All differences according to the type of gamblers are significant ($p < 0.01$) when applying the Scheffé test. Scores are sorted increasingly from the gamblers least involved to the most involved and with gambling problems. It is noteworthy that only non-gamblers and low risk gamblers have an average value in the summation of the six distortions below two (reduced agree). That is to say that the gamblers at risk, problem and pathological present at least a reduced agreement with cognitive distortions.

Finally, Table 6 shows the correlations between all the distortions studied and the summation mean value of the distortions. As it can be seen, there were significant correlations between all the distortions studied and also with the summation of the distortions,

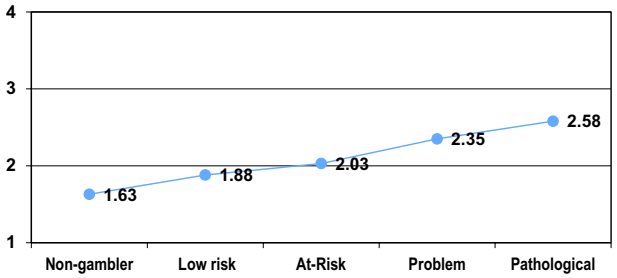

Fig. 2 Mean in the Summation score of cognitive distortions as a function of type of gambler

many of them with high values, especially the correlations related to the summation of the distortions.

Discussion

This study provides information on cognitive distortions as a function of the type of gambler with a broad and representative sample of the population in Spain. Few works have been carried out with comparable samples (Bowden-Jones and Sanju 2015; Tang and Wu 2012).

It highlights that the mean value of the scores of the global sample in all the distortions exceeds the value of one (*totally disagree*), which would be the adequate score from the logical point of view. The average score on each distortions plus the summation, from 1.66 to 2.34, indicates that people are closer to the "reduced agree" than the "totally disagree", the score that should be if they do not accept the cognitive distortions.

The distortions luck as the accountable factor for the results obtained the highest score of 2.34 (between reduced agree -2- and strongly agree -3-). It is confirmed that the Spanish population's analysis of gambling is incorrect, as it is biased, since all the distortions studied present scores above 1 in the global sample, which includes a majority (95%) of non-player gamblers or no problem gamblers. That is, the cognitive distortions about the gambling are present in all the people of our Spanish sample with or without problems of gambling, even though they do not gamble.

When considering the type of gambler, the data show a tendency towards the increase of the scores of cognitive distortions as engagement in gambling and its problems increase (i.e., from non-gamblers to pathological gamblers). In fact, in pathological gamblers, five of the seven distortions reached values higher than 2.5, and two of them (Illusory correlation and Luck) reached a score higher than 2.78 (range of scale 1–4). In other words, they are very close to the "strongly agree" showing a great deal of irrational thoughts about the gamble. In addition, scores according to irrational beliefs show a great ability to distinguish different types of gamblers. All the pathological gamblers' scores in distortions are higher than those of the other groups and all but one are higher than the scores of problem gamblers. ($p < 0.01$).

In short, "everyone" has distortions about gambling, but their magnitude is greater as gambling engagement and problems increase. These results are consistent with what we expected drawing on previous works (Cosenza et al. 2014; Tang and Wu 2012; Tani et al. 2018).

Table 6 Correlations between cognitive distortions

	2. Biased evaluation of results	3. Illusory correlation	4. Self-correcting randomness	5. Predicting results	6. Luck as responsible for the results	7 Summation score
1. Illusion of control	0.448**	0.290**	0.387**	0.510**	0.310**	0.716**
2. Biased evaluation of results		0.350**	0.428**	0.601**	0.357**	0.755**
3. Illusory correlation			0.341**	0.444**	0.348**	0.686**
4. Self-correcting randomness				0.479**	0.209**	0.666**
5. Predicting results					0.327**	0.786**
6. Luck as the accountable factor for the results						0.595**

**$p < 0.01$ (bilateral)

However, within this general trend there are differences for each distortion:

- *Illusion of Control* non-gamblers differ significantly from all other groups of gamblers ($p < 0.01$). In addition, problem and pathological gamblers present scores around 2.5 (rank 1–4), indicating a high belief in this distortion, differing significantly from the other groups of gamblers. It seems like a relevant distortion to distinguish the types of gamblers, which is consistent with most of the previous works (Barrault and Varescon 2013; Clark 2014; Myrseth et al. 2010).
- *Biased evaluation of results* Three differentiated levels appear: (a) non-gamblers, low-risk and at-risk gamblers; (b) problem gamblers; and (c) pathological gamblers. Significant differences appeared between problem and pathological gamblers and the rest of the groups ($p < 0.01$). The differences in the scores are high, about 0.5 points (rank 1–4), compared to the other groups in the case of problem gamblers, and more than one point in pathological gamblers. Although less importance has been given to this distortion in the literature, it was relevant to distinguish problem gamblers.
- *Illusory correlation* Three levels of differentiated gamblers appear, but grouped in another way: (a) non-gamblers; (b) low-risk, at-risk, and problem gamblers; and (c) pathological gamblers. The score of pathological gamblers is very high (2.79; rank 1–4), with differences of 0.45 to 1.32 points with regard to the other groups. It is noteworthy that, although with little difference, problem gamblers' scores are lower than those of the at-risk gamblers. It seems to stand out as a particularly differentiating distortion of pathological gamblers.
- *Randomness as a self-correcting process* (*gamblers' fallacy*) two levels are differentiated: on the one hand, problem and pathological gamblers, and on the other, the rest of the groups. The differences between groups are not as high as in the previous distortions; with the maximum being 0.62 (rank 1–4). The scores are not so high, reaching the maximum (2.33) in the problem gamblers, not the pathological gamblers. It seems that, despite the relevance granted in prior works (Donati et al. 2018; Goodie and Fortune 2013; Ladouceur et al. 1996), it shows a lower capacity to differentiate between the types of gamblers, except for those who already have problems.
- *Prediction of results* the results obtained in this distortion are very similar to those of the Self-correcting randomness, identifying two groups, although the differences in the scores are higher, reaching 0.84 (rank 1–4). The relationship of these two distortions seems logical, as, in both cases, they imply a prediction of results. Therefore, although the scores are not very high in the groups of problem and pathological gamblers (2.36), they do have a greater ability to distinguish people with gambling problems from those who do not have them.
- *Luck as the accountable factor for the results* this is the distortion with the highest scores in all the groups, perhaps indicating the mistake of thinking that luck and randomness is the same thing. There are differences between non-gamblers and the other groups ($p < 0.01$), but it does not seem to be a very relevant distortion to distinguish between gamblers with and without problems. The fact that some previous works reported higher scores in the belief in luck in non-problem gamblers than in pathological gamblers points in the same direction (Labrador 2010).
- *Summation score*, a gradual increase was observed, with significant differences between all the levels or types of gamblers, especially high in the progress towards the groups of problem gamblers and pathological gamblers. Also noteworthy is the fact that the mean score in pathological gamblers' cognitive distortions is 2.58 (rank 1–4), which implies a high level of belief in the distortions. Also, as noted in previous works, all participants,

including the non-gamblers (1.63), present some level of belief in the cognitive distortions (Hardoon et al. 2001; Labrador and Labrador 2016; Ladouceur et al. 1996).

Therefore, in general, there is a growing increase in the scores of the distortions as the level of engagement in gambling and gambling problems progress. We also highlight the magnitude of the differences in scores, in many cases significant, between the groups of gamblers. The most obvious is that the distortions of non-gamblers differ significantly from those of gamblers, regardless of their level of engagement in gambling. Also noteworthy is the fact that the distortions of low-risk gamblers are lower than those of the rest of the gamblers. The distortions of at-risk gamblers are usually lower than those of problem gamblers, some with significant differences, and they are always lower than those of pathological gamblers. Finally, problem gamblers usually have lower scores than pathological gamblers, although the differences are no significant.

In this progression of scores according to gambler types, the most important change is observed when going from non-gamblers to low-risk gamblers. Low-risk and at-risk gamblers' scores are the closest among the groups, and important jumps emerge when going on to problem gamblers and pathological gamblers. In this way, three groups of gamblers can be established according to their scores on the distortions: (1) non-gamblers; (2) Low-risk gamblers and at-risk gamblers; and (3) problem and pathological gamblers.

Not all distortions show the same ability to distinguish between the groups of gamblers considered in this study. By comparing low-risk gamblers with problem and pathological gamblers, the distortions that indicate the major differences between those who gamble and have no problems and those who gamble and do have problems are: illusory correlation, biased evaluation of the results, illusion of control, and prediction of results. On another hand, when comparing problem and pathological gamblers, the especially relevant distortions to differentiate these groups are biased evaluation and illusory correlation. As in previous works, the gambler's fallacy (with its different distortions) and the illusion of control seem to be of particular relevance (Goodie and Fortune 2013; Labrador and Labrador 2016). We highlight that the illusion of control is not relevant when distinguishing between problem and pathological gamblers. We also underline the lower relevance of self-correcting randomness and, in particular, luck, at least in comparison with previous works (Cowie et al. 2017).

Data from the correlational analysis present significant correlations between all the distortions. Moreover, most correlations are high. Thus, six of them exceed the value of 0.60, and three of them are even higher than 0.70. Only two are below 0.31. The highest correlations in virtually every case are between each distortion and the summation of the six distortions. It seems that the distortions are not independent, that is "they are not isolated", but instead having one gambling distortion indicates that it is more likely to be accompanied by others. This indicates that, with a view to prevention and intervention in gambling, all gambling distortions should be investigated, not just some.

In summary, the analysis of cognitive distortions has shown an important ability to distinguish gamblers according to their level of gambling involvement and gambling problems, indicating a constant and significant tendency to present more cognitive distortions as gambling problems increase. The results seem to group gamblers into three groups: (1) non-gamblers; (2) low-risk and at-risk gamblers; (3) problem and pathological gamblers. In addition to the relevance of each individual distortion, we highlight the importance of the total amount of a person's distortions, given the high correlations between them.

Regarding limitations, although the sample is broad and representative, the data collection method, self-report by street survey, always implies some distrust in the data obtained.

Secondly, the allocation of the gamblers to the different types depends on a double evaluation (i.e., first step of screening with the NODS-Clip and second step, application of the NODS only to those who screened positive). This ensures that those identified as at-risk or problem gamblers are correctly classified, but there is a chance of some false negatives. Finally, the categories of problem or pathological gambler were established through only one questionnaire.

Lastly, the relevance of this research is regarding practical implications both for prevention work and for treatment interventions. At a prevention level, if, according to this study, greater gambling problems are related to more cognitive distortions, selective prevention programs should be established aimed at adolescents with some problematic behaviors (high sensation seeking, impulsivity, mood deregulation, antisocial behaviors, substance misuse, etc.) who do not still gamble and at- risk adult gamblers. With these groups it would be necessary to focus on unrealistic expectations about their chances of winning easy money and to replace them by a rational thinking on gambling, as well as to suggest alternative ways of socialization and leisure (Leonard and Williams 2016). The use of a harm reduction/minimization approach toward alcohol and substance abuse may be a useful strategy in preventing gambling problems for both youth and adults (Derevensky and Gupta 2007).

And, at a therapeutic level, there is a strong link between problem gambling behaviors and cognitive distortions. Distorted cognitions about gambling are reinforced by gambling because wins are regarded as evidence of skill, while losses are regarded as random, uncontrollable events. For clinicians an interesting therapeutic approach involves eliciting problematic thoughts guiding the patient to question the validity of those thoughts and providing corrective information. Such cognitive approach is expected to lead to improve control over gambling and to aid in coping with urges to gamble and managing negative emotions (Echeburúa et al. 2017; Hodgins and Holuv 2007; Toneatto 2002).

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