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Impulsivity traits and gambling cognitions associated with gambling preferences and clinical status

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ABSTRACT

Impulsivity (and related traits reward/punishment sensitivity and tolerance to delayed rewards) and gambling cognitions have been linked to gambling. However, their independent associations with gambling preferences and clinical status have never been dissociated. The current study applied a data-driven strategy to identify gambling preferences, based on gambling frequency in several modalities. The two resulting factors were used to classify gambling disorder patients (GDPs) and non-problem recreational gamblers (RGs) into Type I (preferring cards, casino games and skill-based bets) and Type II (preferring slot machines, lotteries/pools and bingo). Participants were assessed in impulsivity, delay discounting, reward/punishment sensitivity, gambling-related cognitions, gambling severity, gambling frequency and average amount gambled per episode. GDPs scored higher than RGs in *positive* and *negative urgency*, *delay discounting*, *reward sensitivity* and intensity of *gambling-related cognitions*, but less in *lack of perseverance*. Additionally, Type II gamblers had greater difficulties delaying gratification, whereas Type I gamblers showed higher cognitive distortion and reward sensitivity levels. In practical terms, the finding that some characteristics are equally pervasive in disordered gamblers independently of their preferences (affect-driven impulsivity), whereas others (distorted cognitions, reward sensitivity, delay discounting) are more prominent in one type or the other, provides a basis to establish targets' priority in therapy.

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Introduction

Gambling disorder (GD) shares behavioural and psychobiological features with substance use disorders (American Psychiatric Association, 2013; Frascella, Potenza, Brown, & Childress,

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2010). However, research has also shown that GD is characterized by unique psychological and neurobiological components, such as distinctly altered dopamine release (Boileau et al., 2014; Joutsa et al., 2012), gambling-related cognitive distortions (Cunningham, Hodgins, & Toneatto, 2014; Raylu & Oei, 2004) and loss-chasing behaviours (Campbell-Meiklejohn, Woolrich, Passingham, & Rogers, 2008).

Substantial efforts have been made to explore individual differences in gambling disorder patients (GDPs; MacLaren, Fugelsang, Harrigan, & Dixon, 2011). Existing studies have revealed a number of traits as clinically relevant to characterize gamblers. Among these, impulsive personality traits, sensitivity to reward and punishment, and tolerance to delayed rewards are likely to be the most relevant (e.g. Billieux et al., 2012a; Blain, Gill, & Teese, 2015; Cyders & Smith, 2008; MacLaren et al., 2011; Michalczuk, Bowden-Jones, Verdejo-García, & Clark, 2011). The relationship between these variables and problematic gambling is consistent with their influence on self-regulation-related processes (Bickel, Koffarnus, Moody, & Wilson, 2014; Goodwin, Browne, Rockloff, & Loxton, 2016).

With regard to specific gambling-related traits, a parallel line of research has demonstrated that gambling-related cognitions (beliefs about gambling settings, behaviours and outcomes) are important predictors of disordered gambling and are related to prognosis (Goodie & Fortune, 2013).

An alternative approach to the study of individual differences among gamblers has been to subtype non-problem recreational gamblers (RGs) or GDPs on the basis of their preference for different gambling modalities (Milosevic & Ledgerwood, 2010). However, only a few studies (Fang & Mowen, 2009; Moragas et al., 2015; Myrseth, Brunborg, & Eidem, 2010; Toneatto, Blitz-Miller, Calderwood, Dragonetti, & Tsanos, 1997) have combined both approaches; namely, testing whether traits with prognostic or diagnostic clinical value are also related to gambling preferences. Moreover, none of these studies have simultaneously examined GDPs and RGs.

Trait-based individual differences in gamblers

Impulsivity

Recent multimodal factor analyses have identified at least three separable impulsivity dimensions: one resulting from the more or less successful operation of the deliberative/executive system; a second reflecting the activity levels of reward-sensitive motivational systems and a third reflecting the level of effectiveness of strategies used to deal with negative affect (Sharma, Markon, & Clark, 2014).

Although no single psychometric instrument has been yet developed to assess impulsivity following this factoring, the most frequently referenced questionnaire (the UPPS-P; an acronym for *negative urgency*, *premeditation*, *perseverance* and *sensation seeking*, with the later addition of *positive urgency*; Whiteside & Lynam, 2001) is mostly consistent with it (Cyders & Smith, 2007). *Positive* and *negative urgency* measure proneness to rash action under the influence of intense negative and positive affect, respectively; *sensation seeking* measures the tendency to engage in novel and arousing activities; *lack of premeditation* involves making decisions without consideration of their potential consequences; and *lack of perseverance* assesses the difficulty to stick with long, boring or cognitively demanding tasks.

In the realm of gambling research, positive urgency, negative urgency and lack of premeditation have repeatedly been associated with problematic gambling, with some evidence that negative urgency may have the strongest effect size when comparing GDPs against controls (Billieux et al., 2012a; Blain et al., 2015; MacLaren et al., 2011; Michalczuk et al., 2011). Differences in lack of perseverance seem to be less prominent (Bagby et al., 2007; Bergen, Newby-Clark, & Brown, 2012). And, although only inconsistently linked to problem gambling, sensation seeking has been reported to be associated with gambling frequency and game preferences (Bonnaire, Bungener, & Varescon, 2006; Smith et al., 2007).

Reward and punishment sensitivity

Reward and punishment sensitivity measures were developed to assess the level of activity of the two components of Gray's psychobiological model of personality: the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS). BAS hyperactivity has been linked to impulsivity and extraversion, whereas BIS hyperactivity has been linked to neuroticism and introversion (Aluja & Blanch, 2011; Gray, 1994). As noted earlier, impulsive behaviour can result from over-activated affective systems, so there is some overlap between punishment and reward sensitivity and certain aspects of impulsivity (Lannoy, Billieux, & Maurage, 2014). Still, the importance of these systems goes beyond their role in impulsivity, constituting one of the main foundations of personality (Carver & White, 1994; Corr, 2016). Indeed, evidence shows that punishment and reward sensitivity have a significant impact on a number of externalizing behaviours, above and beyond impulsive personality traits (Carlson, Pritchard, & Dominelli, 2013).

With regard to gambling, reward sensitivity predicts gambling onset and signals problematic gambling (see MacLaren et al., 2011 for a review). But, complementarily, the possibility that gambling might compensate reduced effectiveness of natural rewards has also been suggested, on the basis of reports of diminished reward sensitivity in GDPs (Reuter et al., 2005; Sescousse, Barbalat, Domenech, & Dreher, 2013).

Punishment sensitivity has received less attention but, again, its relationship with gambling does not seem straightforward. On the one hand, in community samples, individuals with low punishment sensitivity are more likely to gamble (Navas et al., 2015), and, in experimental tasks, pathological gamblers have been observed to be less sensitive than controls to punitive feedback (van Holst, van den Brink, Veltman, & Goudriaan, 2010). On the other hand, in some gamblers, heightened punishment sensitivity raises the risk of problem gambling, via the negative reinforcement effect that gambling activities might exert (Balodis, Thomas, & Moore, 2014; Wardell, Quilty, Hendershot, & Bagby, 2015).

Tolerance to reward delay

Impulsivity is also closely related to the ability to sacrifice immediate gratification for the sake of long-term goals (Rachlin, 2009). Gambling-related research has consistently found GDPs to temporally discount the value of rewards more rapidly than controls (Albein-Urios, Martinez-Gonzalez, Lozano-Rojas, & Verdejo-Garcia, 2014; Dixon, Marley, & Jacobs, 2003; MacKillop, Anderson, Castelda, Mattson, & Donovick, 2006; Miedl, Peters, & Büchel, 2012; Petry, 2003), and has identified delay discounting as an index of GD severity (Alessi & Petry, 2003). Complementarily, delay discounting measures are related to other decision-making tasks in which participants are asked to integrate rewards and punishments in the domain of time, and in which GDPs have also been found to perform abnormally (e.g. set-shifting tasks; Grant, Odlaug, Chamberlain, & Schreiber, 2012).

Gambling-related cognitions

Most research on gambling-related cognitions has focused on three related phenomena. First, most gamblers are prone to perceive patterns or streaks in random series of gambling outcomes (Jessup & O'Doherty, 2011; Ladouceur, Paquet, & Dubé, 1996). This happens, for instance, in the gambler's fallacy (the belief that a series of losses is bound to be followed by a win) and the hot-hand fallacy (the belief that a coincidental series of wins will extend in time; Ayton & Fischer, 2004; Wilke, Scheibehenne, Gaissmaier, McCanney, & Barrett, 2014). Second, some gamblers also tend to perceive causal connections in coincidental co-occurrences of environmental cues and gambling outcomes (e.g. Joukhador, Blaszczynski, & Maccallum, 2004). Third, some gamblers overestimate their degree of personal control over gambling outcomes (e.g. Coventry & Norman, 1998; Ladouceur, Mayrand, Dussault, Letarte, & Tremblay, 1984).

The most pervasively used tool to assess cognitive distortions and beliefs in relation to gambling is the Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004). This questionnaire assesses five gambling-related cognitive domains. *Inability to stop* (*ITS*, e.g. 'I'm not strong enough to stop gambling') and *gambling expectations* (*GE*, e.g. 'Gambling makes things seem better') are beliefs of lacking the ability or capacity to control gambling impulses, and overvaluing the joy, reward or relief that can be obtained from gambling, respectively. *Illusion of control* (*IC*, e.g. 'Praying helps me win'), *predictive control* (*PC*, e.g. 'When I win once, I will definitely win again') and *interpretative biases* (*IB*, e.g. 'Relating my losses to bad luck and bad circumstances makes me continue gambling'), on the other hand, are cognitive distortions involving causal attribution processes, and are categorized together as gambling-related cognitive biases.

Preference-based individual differences in gamblers

Most clinicians treating GDPs report differences between patients with a predilection for different gambling types, and stress the importance of such differences in treatment tailoring (Lobo et al., 2014). Additionally, some of the above-mentioned inconsistences in associations between psychological traits and clinically relevant gambling features could be due to the existence of gambler subtypes.

In spite of this, the psychological profiles associated with different gambling preferences have been the focus of limited studies to date. For example, Bonnaire et al. (2006) found pathological gamblers playing games of chance in cafés (e.g. lotteries, scratchcards, off-course betting) to have lower sensation-seeking scores than pathological horse-track betters. In a larger study with regular, mostly non-pathological gamblers, Fang and Mowen (2009) observed that escape motives positively correlated with slot-machine playing, but did negatively with playing card games, whereas self-esteem and competitiveness correlated negatively with playing slot machines, and positively with playing card games and sports betting. This study concurs with studies with homogeneous samples (casino betters, Anderson & Brown, 1984; horse ride betters, Coventry & Norman, 1997; poker machine gamblers, Sharpe, Tarrier, Schotte, & Spence, 1995; electronic gaming machine gamblers, MacLaren, Ellery, & Knoll, 2015) in highlighting the differential role of processes related to reward versus punishment sensitivity in different gambling modalities (Cocco, Sharpe, & Blaszczynski, 1995).

A second approach has been to categorize games based on an a priori criterion, and then classify gamblers accordingly. Following this rationale, Moragas et al. (2015) found higher levels of novelty seeking and lower levels of agreeableness in strategic gamblers, compared to non-strategic gamblers, and Toneatto et al. (1997) reported that cognitive distortions are considerably stronger in gamblers characterized by a predilection for skill-based games in comparison to gamblers preferring chance games. Such differences have been corroborated by Myrseth et al. (2010), who emphasized illusion of control being more pervasive in GDPs and RGs preferring skill-based games. Therefore, the possibility exists that gambling preferences and clinical status contribute not only to the intensity, but also to differential profiles in terms of cognitive distortions.

Current study

The aim of the present study is to explore whether treatment-seeking GDPs and non-problem RGs, further classified on the basis of their gambling preferences, differed in terms of impulsivity, reward/punishment sensitivity, tolerance to reward delay, and gambling cognitions. This approach is novel in two senses. First, our sample was composed of RGs and GDPs, so that the effect of clinical status can be dissociated from the differences depending on gambling preferences. Second, in order to categorize gamblers on the basis of their preferences, we adopted a data-driven method. A principal-component factor analysis (PCA) was used to identify covariations in participation patterns in several games, and participants were later classified according to their favourite activity. In line with previous literature, we expect this approach to succeed in differentiating at least between two broad categories of games. In previous studies, these two types have been labelled as *skill-based* and *chance-based*. However, to our knowledge, no previous attempts have been made to investigate whether these two categories are supported by actual gambling participation data.

In order to avoid speculating about the reasons why participation scores for some games tend to correlate between themselves, but not with others, here we will use the neutral labels Type I (preferring card, casino-games and skill-based bets) and Type II (preferring slots, lotteries and bingo) to refer to gambler subtypes. Type I-RGs, Type I-GDPs, Type II-RGs and Type II-GDPs completed the brief UPPS-P Impulsive Behavior Scale (Billieux et al., 2012b), the Now-or-Later test for delay discounting (NoL; Kirby, Petry, & Bickel, 1999), the SPSRQ (Sensitivity to Punishment and Sensitivity to Reward Questionnaire; Aluja & Blanch, 2011) and the GRCS questionnaire (Gambling-Related Cognitions Scale; Raylu & Oei, 2004).

Our hypotheses referring to the effect of preferences are based on the available literature. As noted above, previous results come from homogeneous samples, one-to-one comparisons between different games, or comparisons between skill and chance games (not perfectly overlapping with our classification). On the whole, we expect GDPs to clearly differ from RGs in specific variables previously associated with problem gambling (UPPS-P, delay discounting and GRCS), except those related to affective feedback sensitivity (SPSRQ). Additionally, we expect Type I gamblers to score higher in sensation seeking and reward sensitivity. Punishment sensitivity, on the other hand, has been proposed to underlie problem gambling in emotionally vulnerable patients, via escape motives, mostly in slot machine gamblers (categorized here as Type II; Balodis et al., 2014).

With regard to cognitions (GRCS), as described earlier, causal attribution processes have consistently been shown to play a larger role in gamblers with a preference for skill-based games (most of which are labelled here as Type I). Gambling expectancies, however, include both the prospect that gambling will be enjoyable and the prospect that it will curb negative affect. Thus, we expect to find higher expectancy scores in GDPs than RGs, whereas no difference is expected regarding gambling preferences. Finally, no a priori hypotheses were formulated regarding potential differences between gambler types in feelings of inability to stop, as long as clinical status is controlled for. A comprehensive list of hypotheses and their origin in the available literature can be found in Table A1 (Appendix).

Methods

Participants

Seventy-one gambling disorder patients (GDPs) and 74 non-problem recreational gamblers (RGs) were enrolled in the current study. GDPs were diagnosed by the professional therapist at their treatment centre (AGRAJER – Granada Association of Rehabilitated Gambling disorder patients, APLIJER – Linares Provincial Association of Gamblers in Rehabilitation, and ALUJER – Jaén Association of Rehabilitated Gambling Disorder Patients [Andalusia, Spain]). RGs were recruited from GDPs' and researchers' acquaintances, and by posting notices on the University of Granada's social networks.

The only inclusion criterion for GDPs was being in treatment for GD (pathological gambling, diagnosed according to DSM-IV criteria). For RGs, the inclusion criteria were participating in any gambling modality at least once a week, and a severity score in the South Oaks Gambling Screen (SOGS) below the threshold to be at risk of problem gambling (< 5). Exclusion criteria, for beoth groups, were any history of neurological disease or brain trauma causing unconsciousness for 10 minutes or longer (as informed by the participant), and any current mental disorder. GD diagnosis and potential psychiatric co-morbidities were assessed by therapists in the case of GDPs, and by a psychologist with clinical experience (first author) in RGs.

Frequencies of participation in different gambling modalities were assessed with the Spanish SOGS. Participants were also allowed to freely report their favourite game. Those who reported more than one game were asked to list them in order of preference. Participants whose favourite game was not listed in SOGS (i.e. sport bets other than horse-race and traditional sports betting; $n = 11$) were excluded from further analyses.

Instruments

South Oaks gambling Screen (SOGS; Lesieur & Blume, 1987)

In order to estimate gambling severity and participation frequencies in different games, we used the Spanish SOGS. To date, this is the only validated instrument for the assessment of gambling severity in Spanish; it has been widely used and has good psychometric properties (Echeburúa, Báez, Fernández-Montalvo, & Pérez, 1994).

Gambling behaviour parameters

Participants were asked to report their gambling preferences, how many times a week they usually gambled (in the present moment, for RGs, and in the period preceding abstinence, for GDPs) and how much money they spent on gambling, on average, during a typical gambling episode.

Brief UPPS-P scale, Spanish Version (Cándido, Orduña, Perales, Verdejo-García, & Billieux, 2012)

This questionnaire is based on the brief French UPPS-P (Billieux et al., 2012b), contains 20 items and allows for a multidimensional assessment of impulsivity: positive urgency (e.g. 'I tend to lose control when I am in a great mood'), negative urgency (e.g. 'When I am upset I often act without thinking'), (lack of) premeditation (e.g. 'My thinking is usually careful and purposeful'), (lack of) perseverance (e.g. 'Once I get going on something I hate to stop') and sensation seeking (e.g. 'I quite enjoy taking risks'; see Cándido et al., 2012, for psychometric properties).

Now-or-later (NoL, Kirby et al., 1999)

This 27-item monetary-choice questionnaire asks for individual preferences between smaller, immediate rewards and larger, delayed rewards. In each item, the participant was asked to imagine being offered two rewards with different values and delays, and to indicate which one she/he would prefer to receive. No real rewards were administered. The main measure from this questionnaire was the number of items in which the participant chose the immediate reward, an atheoretical index that has been shown to highly correlate ($r = 0.97$) with the logarithm of k, the hyperbolic discounting rate parameter (Myerson, Baumann, & Green, 2014). Henceforth we will refer to this score as *delay discounting*.

Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Aluja & Blanch, 2011)

This questionnaire contains 20 yes/no items, and has been shown to have robust psychometric properties. Ten items are worded to measure reward sensitivity (RS, e.g. 'Do you often do things to be praised?') and the other 10 to measure punishment sensitivity (PS, e.g. 'Compared to the people you know, do you think you are afraid of many things?').

Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004)

As described above, this 23-item questionnaire assesses 5 gambling-related cognitive domains: *inability to stop* (ITS), *gambling expectations* (GE), *illusion of control* (IC), *predictive control* (PC) and *interpretative biases* (IB). GDPs were instructed to answer the questionnaire with regard to the time when they used to gamble (prior to therapy onset). The results of validating the Spanish GRCS (showing intra-class correlation coefficients, *ICC* =. 771 [GE], .676 [IC], .842 [PC], .916 [ITS] and .889 [IB]) have been reported in Del Prete et al. (in press).

Procedure

For GDPs, all assessments were individual and face to face. After welcoming the participant and obtaining his/her consent, the assessment started. For GDPs, the assessments were part of a larger protocol aimed at carrying out a detailed evaluation of behavioural and neurobiological correlates of gambling. The whole protocol was divided into two sessions, and all the instruments mentioned here were administered during the first session, lasting for approximately three hours. In all cases, assessments were carried out by trained psychologists with extensive experience in clinical evaluations.

RGs were either individually assessed, or asked to provide consent and fill in the questionnaires online. As evaluations for participants filling the questionnaires online ($n = 35$) were not carried out under supervision, there was no way to ensure that participants answered every item in the questionnaires. This led to limited data missing. The assessment session lasted approximately 45 minutes.

Statistical analyses

SOGS participation frequency scores were submitted to a principal component factor analysis (Oblimin-rotated). The resulting factors were used to classify participants as Type I or Type II gamblers, in accordance with their declared preference for games more heavily loaded by one factor (including cards, skills-based games, casino games) or the other (slots, lottery/pools, bingo). The factorial combination of preference and clinical status resulted in four subgroups of Type I RGs, Type II RGs, Type I GDPs and Type II GDPs.

In order to identify potential socio-demographic confounders, clinical status group (henceforth, *group*: GDP, RG) x *preference* (Type I, Type II) analyses of variance (ANOVAs) were performed on age and years of education, and a χ^2 test on sex.

SOGS severity and gambling involvement, UPPS-P dimensions, delay discounting, sensitivity to punishment and reward, and gambling-related cognitions were submitted to four group x preference multivariate analysis of covariance (MANCOVA; one for SOGS and gambling involvement, one for impulsivity and delay discounting, another one for sensitivity to punishment and reward, and a fourth one for gambling cognitions). Potential confounders identified in preliminary analyses entered the design as continuous covariates. Omnibus MANCOVA and variable-by-variable between-group effects (but not the effects of covariates) are reported.

Additionally, the origin of main effects was explored using Bonferroni-corrected pairwise comparisons (restricted ANCOVAs) for each possible pair of subgroups. For the sake of conciseness, the results of these pairwise comparisons are reported in online supplementary materials.

Results

Gambler subtyping

Factor analysis of participation in game modalities

Figure 1 summarizes gambling frequency for GDPs and RGs in the modalities under scrutiny in the Spanish SOGS. Factor analysis was performed on the whole sample of GDPs and RGs. This strategy is congruent with the one followed by previous studies validating instruments intended to be relevant in both pathological and non-pathological samples (for example, French, Japanese and Turkish validations of the GRCS scale; Arcan & Karanci, 2015; Grall-Bronnec et al., 2012; Yokomitsu, Takahashi, Kanazawa, & Sakano, 2015). Still, as described below, extra measures were taken to ensure that factor composition was not affected by the dual origin of our sample.

Distribution of frequencies was similar across groups for all games, except slot machines, which was strongly over-represented in GDPs. In addition, some activities were very infrequent in both groups. To ensure factorizability, we took into account only those activities reaching at least a 5% occasional participation rate (at least <1/week) in the two groups. Consequently, horse-track bets (6.8 and 4.2% for RGs and GDPs, respectively), traditional

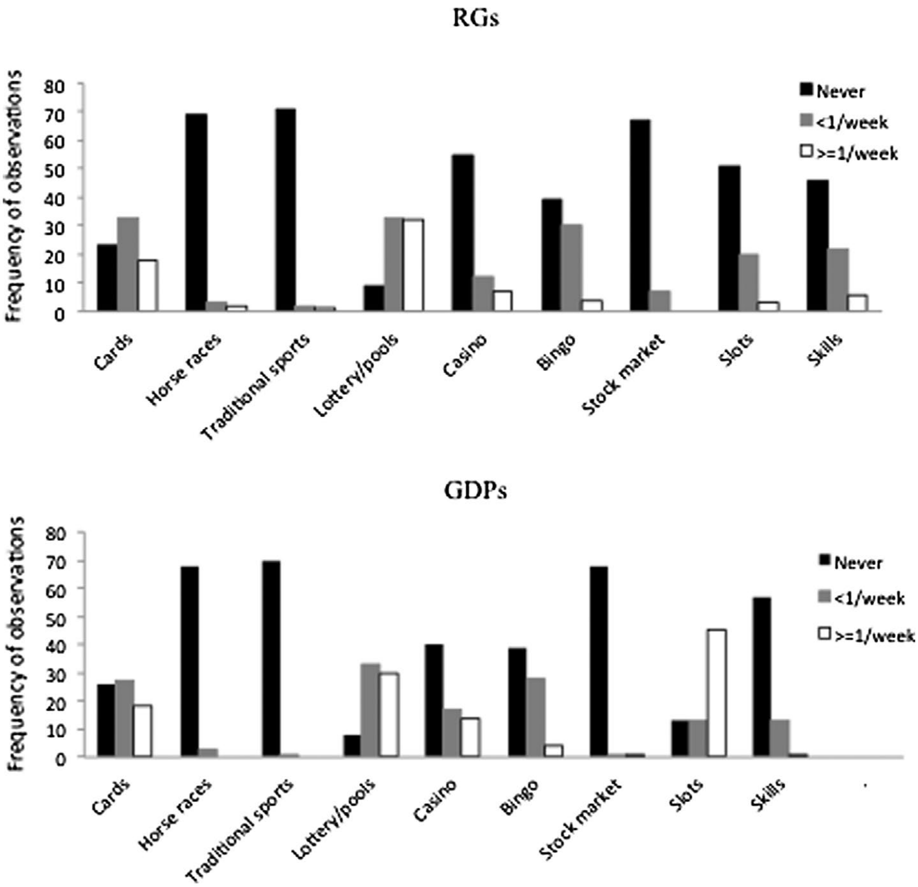

Figure 1. Frequency of observations (total number of responses) in each participation frequency category (never, less than once a week, once a week or more) for gambling modalities, as registered by the Spanish version of SOGS. Upper panel: recreational gamblers (RGs). Lower panel: gambling disorder patients (GDPs).

sports betting (4.1 and 1.4%) and investing in the stock market (2.8 and 9.5%) were not further considered.

Participation frequency scores in lottery/pools, cards, slot machines, casino games, skill-based games and bingo were submitted to a principal components factor analysis. (*Pools* here refers to *football pools*, a State-operated form of betting on football results with small amounts of money [€0.75 per 14-match bet] and delayed feedback, for which tickets are sold by licensed lottery agents). The two components resulting from this analysis (Table 1, left panel) accounted for 50.895% variance. Eigenvalues were 1.720 and 1.334 for factors 1 and 2.

In order to control for the possibility that correlations between modalities are partially explained by the clinical status of participants, participation scores were regressed over group, and standardized residuals were kept for factor analysis. This yielded almost identical results (Table 1; right panel; 1.759 and 1.356 eingenvalues, and 51.922% explained variance).

Participants' classification based on gambling preferences

As noted earlier, all gamblers were asked to freely report their preferred game. Figure 2 displays cumulated frequency of responses (please note that labels are not exactly the same as in Figure 1, given that, in this case, participants' responses are not referred to any predefined categories). Gambling preferences differed between GDPs and RGs, with slot machines favoured among the former, and lotteries/pools among the latter.

These results were used to classify gamblers in two categories. Domino, card games (including poker and blackjack) and roulette players were categorized as Type I, whereas lottery/pools, slot machine and bingo gamblers were categorized as Type II, on the basis of factor 1 and factor 2 games, as identified by the factor analysis. The final sample consisted of 31 Type I RGs, 43 Type II RGs, 24 Type I GDPs, and 47 Type II GDPs (a χ^2 test on these numbers revealed no significant association between preference and group in the total sample, $p = 0.316$).

Data in Figure 2 suggest that preferences are more discriminative than participation scores. Our decision to classify gamblers on the basis of preferences, instead of participation scores, was based partially on this, but much more strongly on methodological reasons. First, frequency of participation is only an indirect proxy to other gambling measures (there are games that can be played many times without incurring severe losses, whereas others can imply large losses with low playing frequency). In other words, the game with highest frequency is not necessarily the most personally salient or significant. Second, an alternative measure based on estimated factor values would imply dichotomizing a continuous

Table 1. Results of factoring frequency of participation scores in the different SOGS gambling modalities. Left panel: factor analysis on raw scores. Right panel: factor analysis on residuals resulting from controlling for clinical status.

	Raw scores		Residuals	
	1	*2*	*1*	*2*
Cards	0.69	−0.13	0.68	−0.08
Lottery/pools	−0.33	0.62	−0.36	0.65
Casino games	0.63	0.23	0.66	0.08
Bingo	0.43	0.64	0.39	0.68
Slot machines	−0.03	0.66	−0.01	0.68
Skill-based	0.75	−0.14	0.76	−0.01

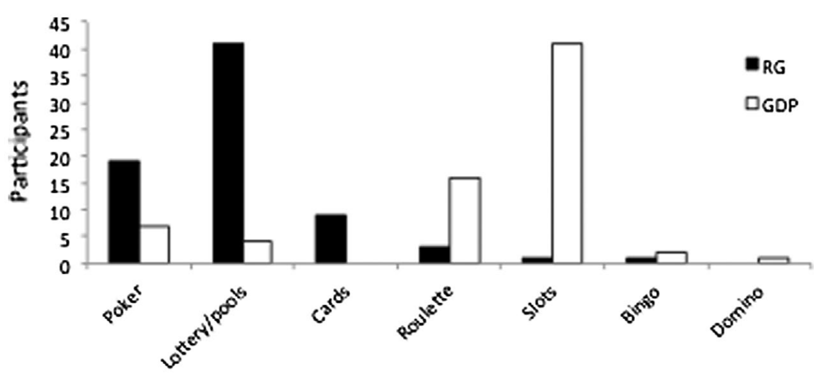

Figure 2. Number of individuals with predilections for different game types (as freely reported), in the gambling disorder patient (GDP) and recreational gambler (RG) groups.

measure (e.g. median-split of the differences between Factor 1 and Factor 2 estimates for each participant). Expressed preferences override these potential problems, although they present some problems of their own (see Limitations section). In view of that, additional analyses were performed to ensure that preferences relate to participation frequencies and portray real behavioural meaning (online supplementary materials).

Socio-demographic variables

Descriptive data for the four group x preference conditions are displayed in Table 2 (rows 1–3). Some data were missing regarding gender (n = 1), age (n = 2) and years of education (n = 4). The two-factor group x preference ANOVA on age yielded an effect of preference, $F(1, 139) = 53.690$, $MSE = 103.636$, $p<0.001$, $\eta^2_p = 0.279$. The effects of group and group x preference were not significant (min. $p = 0.358$). A similar analysis on years of education yielded a significant effect of group, $F(1, 137) = 10.377$, $MSE = 24.367$, $p = 0.002$, $\eta^2_p = 0.070$, but no effect of preference, or group x preference (min. $p = 0.207$). Finally, regarding sex, χ^2 tests revealed that the proportion of women was larger in the RG subgroups than in the GDP subgroups: $\chi^2(1) = 10.868$, $p = 0.001$. In view of these results, multivariate analyses on gambling involvement and severity, impulsivity, delay discounting, reward and punishment sensitivity, and gambling-related cognitions were performed while controlling age, sex and education level.

Gambling severity and involvement

Table 2 (rows 4–6) displays mean (SD) values for SOGS severity, weekly gambling frequency, and average amount gambled per episode across conditions.

Multivariate effects were found for group and preference, Wilks' $\lambda = 0.240$, $p < 0.001$, $\eta^2_p = 0.760$, and Wilks' $\lambda = 0.931$, $p = 0.026$, $\eta^2_p = 0.069$, respectively. Table 3 (rows 1–3) displays results of variable-by-variable between-participant effects, revealing that the multivariate effect of preference originated in frequency scores (Type I>Type II).

Impulsivity and delay discounting

Figure 3 (A, B) displays covariate-corrected mean (SE) UPPS-P and delay discounting scores for the two groups and the two gambling modalities. Some data were missing regarding impulsivity (n = 1) and delay discounting (n = 4). A multivariate significant effect of group

Table 2. Mean (SD) for age, years of education, SOGS severity, weekly gambling frequency and average spending per gambling episode, and total number of males (percentage), across the four subgroups in the study.

	Subgroup (preference/group)			
	Type I RG	Type II RG	Type I GDP	Type II GDP
Age	28.677 (9.590)	39.951 (11.079)	27.542 (8.309)	42.064 (10.580)
Years of education	16.233 (3.070)	14.275 (4.878)	12.375 (2.961)	12.596 (6.486)
Sex (male)	26 (83%)	32 (74%)	24 (100%)	45 (96%)
SOGS severity	1.926 (1.385)	0.949 (1.025)	10.542 (2.359)	10.021 (3.267)
Frequency	4.556 (4.598)	1.705 (1.757)	4.917 (2.823)	4.447 (3.477)
€/episode	54. 11 (121.939)	6.910 (11.579)	152. 415 (202.356)	151.415 (157.225)

Abbreviations: RG = recreational gamblers group; GDP = gambling disorder patients group.

Table 3. Results for group, preference and group x preference effects on SOGS clinical measures, impulsivity, delay discounting, reward and punishment sensitivity and intensity of gambling-related cognitions with age, gender and education years as covariates.

	IV								
	Group			Preference			Interaction		
DV	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p
SOGS severity	405.355	**<0.001**	0.757	0.390	0.534	0.003	0.475	0.492	0.004
Frequency	4.374	**0.038**	0.033	8.854	**0.003**	0.064	5.442	**0.021**	0.040
€/episode	17.256	**<0.001**	0.117	0.918	0.340	0.007	0.839	0.361	0.006
Negative urgency	43.115	**<0.001**	0.248	0.039	0.843	0.000	0.231	0.632	0.002
Positive urgency	7.295	**0.008**	0.053	0.869	0.353	0.007	1.372	0.244	0.010
Sensation seeking	1.11	0.294	0.008	2.302	0.132	0.017	1.253	0.265	0.009
Lack of premeditation	1.756	0.187	0.013	2.731	0.101	0.020	0.729	0.395	0.006
Lack of perseverance	4.029	**0.047**	0.030	0.676	0.412	0.005	2.979	0.087	0.022
NoL choices	6.769	**0.010**	0.049	4.946	**0.028**	0.036	0.066	0.797	0.001
RS	8.642	**0.004**	0.062	6.386	**0.013**	0.046	3.269	0.073	0.024
PS	2.710	0.102	0.020	0.001	0.971	0.000	0.243	0.623	0.002
Expectations	36.416	**<0.001**	0.214	4.522	**0.035**	0.033	1.656	0.200	0.012
Illusion of control	34.065	**<0.001**	0.203	4.454	**0.037**	0.032	0.616	0.434	0.005
Predictive control	67.636	**<0.001**	0.335	8.184	**0.005**	0.058	0.038	0.845	0.000
Inability to stop	144.114	**<0.001**	0.518	7.129	**0.009**	0.051	0.459	0.499	0.003
Interpretative bias	93.661	**<0.001**	0.411	10.598	**0.001**	0.073	0.658	0.419	0.005

Note: DV = Dependent variable; IV = Independent variable; NoL = Now-or-later; RS = Reward sensitivity; PS = Punishment sensitivity.

was found in both variables, Wilks' λ = 0.689, p<0.001, η^2_p = 0.311. Neither the effect of preference (p = 0.109) nor the interaction were significant (p = 0.619).

Table 3 (rows 4–9) displays variable-by-variable between-participants effects. Positive and negative urgency, and delay discounting scores were higher for GDPs than for RGs. Lack of perseverance, on the contrary, was slightly higher for RGs. Despite the fact that preference did not reach significance in the general MANCOVA, the test on delay discounting revealed more impulsive choices in Type II gamblers.

Sensitivity to punishment and reward

Figure 3 (C) shows covariate-corrected mean (SE) sensitivity to reward (RS) and sensitivity to punishment (PS) scores in the SPSRQ questionnaire. SPSRQ data were missing for 3 participants. Significant multivariate effects of group, Wilks' λ = 0.928, p = 0.008, η^2_p = 0.072, and preference, Wilks' λ = 0.952, p = 0.042, η^2_p = 0.048, were found. The interaction between the two was not significant (p = 0.197).

Table 3 (rows 10–11) displays between-participants effects. RS reflected the effects of group and preference, whereas PS did not reveal any significant influence of either group or preference.

Gambling cognitions

Figure 3 (D) shows covariate-corrected mean (SE) GRCS scores. Multivariate significant effects were found for group, Wilks' λ = 0.426, p<0.001, η^2_p = 0.574, and preference, Wilks' λ = 0.915, p = 0.040, η^2_p = 0.085. The group x preference interaction did not reach significance, Wilks' λ = 0.935, p = 0.116, η^2_p = 0.065.

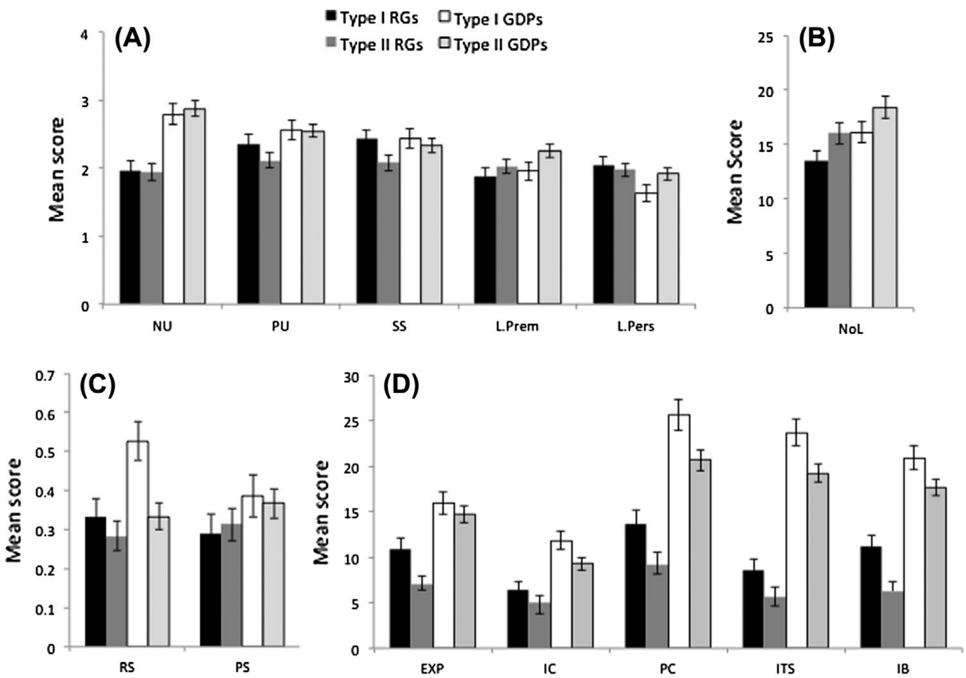

Figure 3. Corrected mean impulsivity, delay discounting, reward and punishment sensitivity and intensity of gambling-related cognitions scores across Type I/Type II Preference conditions and Group (gambling disorder patients [GDPs] vs. recreational gamblers [RGs]).
Note: NU = Negative urgency; PU = Positive urgency; SS = Sensation seeking; LPrem = Lack of premeditation: LPers = Lack of perseverance; NoL = Now-or-later; RS = Reward sensitivity; PS = Punishment sensitivity; EXP = Expectations; IC = Illusion of control; PC = Predictive control; ITS = Inability to stop; IB = Interpretative bias.

Table 3 (rows 12–16) shows variable-by-variable between-participant effects. GRCS cognitions were stronger in GDPs than in RGs. Cognitions were also stronger in Type I gamblers than in Type II gamblers, with the strongest effect size observed for interpretative bias.

Discussion

The current study classified gambling disorder patients (GDPs) and non-problem recreational gamblers (RGs) according to the modality of their preferred gambling activity. Participants were then assessed in impulsivity, delay discounting, punishment and reward sensitivity, and gambling-related cognitions, with the aim of disentangling the impact of clinical status and gambling preferences on these variables. To our knowledge, this is the first time GDPs and RGs have been examined in a single study, using the same set of variables.

The PCA on gambling activities successfully identified two factors contributing to participation scores. These two factors were subsequently used to classify participants' reported preferences in Type I (card games, casino games and skill-based bets) and Type II (lotteries/pools, slot machines and bingo). This distinction shows partial overlapping but not full correspondence with the one between strategic and non-strategic games (Grant et al., 2012; Odlaug, Marsh, Kim, & Grant, 2011). Actually, complementary analyses showed that a game customarily classified as chance-based (i.e. roulette) behaviourally and subjectively aligns not only with other casino games, but also with card games and skill-based bets, but diverge from slot machine gambling. This preliminary result, made possible by letting participants freely report their preferred game, somewhat questions the strategic/non-strategic dichotomy.

As expected, there were group differences in urgencies and delay discounting (with higher scores in GDPs). Neither sensation seeking nor lack of premeditation yielded significant differences between RGs and GDPs. Finally, GDPs presented lower scores in lack of perseverance. This counter-intuitive difference, and the lack of differences in lack of premeditation, contradicts our hypotheses. On the other hand, Type II gamblers discounted rewards more rapidly than Type I gamblers, but the two did not differ between them in any UPPS-P dimension, including sensation seeking (for which higher scores were expected in Type I gamblers) and lack of premeditation (for which higher scores were expected in Type II gamblers).

In a recent report, urgency has been observed to influence GD symptoms via altered decision-making (Canale, Vieno, Griffiths, Rubaltelli, & Santinello, 2015), and more specifically via diminished reward delay tolerance. Our results, however, seem to show that negative urgency relates to clinical status in a less restricted way. Confirming previous reports, among impulsivity-related dimensions, negative urgency emerges as the clearest marker of gambling disorder (Billieux et al., 2012a; Blain et al., 2015; Cyders & Smith, 2008). Elevated negative urgency stands out as a hallmark of addictive and self-control disorders (Dir, Karyadi, & Cyders, 2013) and seems to be connected with addictive behaviours via abnormal emotion regulation and dysfunctional coping skills (Adams, Kaiser, Lynam, Charnigo, & Milich, 2012). Importantly, negative urgency seems to be particularly relevant in gambling disorder (Torres et al., 2013), and, following the observed results, arises as a common feature associated with clinical status, regardless of gambling preferences. Accordingly, negative urgency stands as a core treatment target. This is potentially addressable by incorporating emotion regulation strategies into cognitive-behavioural packages designed to manage negative emotions that are not necessarily triggered by gambling stimuli.

Gambling preferences were found to be unrelated to lack of premeditation, but were associated with delay discounting. This result suggests the specific vulnerability of Type II gamblers (most of whom are slot machine gamblers in the GDP sample) to executive function-based decision-making anomalies, which replicates the results previously reported by Goudriaan, Oosterlaan, de Beurs, and van den Brink (2005). Importantly, that effect seems independent of socio-demographic factors.

Regarding affective feedback-driven motivation, results did not replicate any of the previous (inconsistent) results regarding gambling severity on punishment sensitivity, in any direction. GDPs were not more sensitive to punishment than RGs (in contrast to the findings by Álvarez-Moya et al., 2007, and related results by Forbush et al., 2008; Loxton, Nguyen, Casey, & Dawe, 2008; and Nordin & Nylander, 2007). Contrary to our hypothesis, Type II gamblers did not display higher punishment sensitivity than Type I gamblers. In combination with previous results, that lack of effect in all likelihood indicates that GDP samples consist of mixtures of individuals with more or less avoidant/escapist tendencies, but such variability is not necessarily connected to the modality of games they prefer. Neither GDPs nor RGs showed the difference between Type I and Type II gamblers that would be expected on the basis of Fang and Mowen's (2009) and Balodis et al.'s (2014) results (see online supplementary materials for detailed analyses). That opens the hypothesis that Type II gamblers do not necessarily present higher levels of anxiety or neuroticism, but are instead more sensitive to the 'anxiolytic' properties of gambling. The existence of a specific path to addiction vulnerability attributable to the sedative effect of the potentially addictive agent, rather than to previous neuroticism per se, has also been proposed for alcohol abuse (Hendler, Ramchandani, Gilman, & Hommer, 2013).

On the other hand, results were consistent with the hypotheses formulated regarding reward sensitivity. As expected (on the basis of Balodis et al., 2014; Barrault & Varescon, 2013; and Sharpe et al., 1995), collapsing GDPs and RGs, Type I gamblers were more reward-sensitive than Type II gamblers (in online supplementary materials, we briefly discuss how well this global preference effect replicates across clinical status levels). Complementarily, gambling expectancies, as measured by the GRCS, were also elevated in Type I gamblers, which suggests that gambling expectancies substantiate gambling behaviour reinforcement, and such reinforcement processes seem to play a more important role in Type I than in Type II gamblers.

Finally, with regard to gambling cognitions, our results mostly confirmed previous reports of stronger cognitive biases in GDPs than in non-problem gamblers or healthy controls (Goodie & Fortune, 2013; Jacobsen, Knudsen, Krogh, Pallesen, & Molde, 2007), and are consistent with the higher pervasiveness of biases in strategic gamblers (Myrseth et al., 2010; Toneatto et al., 1997). Among the cognitions under scrutiny, interpretative bias – the tendency to attribute losses to external factors and wins to internal ones, once a gambling episode has finished – showed the strongest difference between preference groups. This effect suggests that cognitive differences appear not only in GDPs, but also in non-problem recreational gamblers. In other words, preference for certain games seems to have an intrinsic link to gambling-related cognitions. Still, the possibility exists that a stronger perception of one's skills is not necessarily distorted. Poker, for example, has an objective skill element, and some other games, though not having a skill element, contain probabilistic or frequency information that can quite accurately be captured by players. Supporting this, some recent evidence (Perales, Navas, Ruiz de Lara, Maldonado, & Catena, in press) shows that GDPs with higher GRCS scores are better at discriminating null from positive contingencies in an instrumental learning task. These results resonate with evidence showing that some GDPs are very accurate at capturing statistical information from gambling devices, and that accuracy could contribute to a false sense of mastery (King, Delfabbro, & Griffiths, 2010). In other words, it could be that although both RGs and GDPs Type I gamblers have an elevated concept of their skills, in GDPs, such beliefs – distorted or not in terms of statistical accuracy – are useless to avoid loss accrual and could contribute to the maintenance or aggravation of the disorder.

This is a significant advance in the direction signalled by Fortune and Goodie (2012), according to whom 'there is little consensus on whether distortions might be fruitfully considered separately for the various gambling modalities that lead to pathology, or whether it is more useful to collapse across modalities' (p. 307). According to our results, cognitive distortions influence both clinical status and gambling preference. So, engaging the right distortions could help prevent and treat problem gambling in general (Ladouceur et al., 2001, 2003; Spurrier & Blaszczynski, 2014), although such interventions will probably have a larger effect in Type I gamblers.

Limitations and strengths

In the present study we found GDPs to differ from RGs in a number of traits that had previously been identified as contributing to gambling disorder. Among these, delay discounting, reward sensitivity and gambling-related cognitive distortions also discriminated between gambler subtypes.

The interpretation of results from this study is, however, affected by several limitations. First, its cross-sectional nature precludes causal statements about the correlations found, so that gambling preferences and clinical status could be either causes or consequences of other individual differences. Second, participant selection methods do not ensure representativeness. Gambling disorder patients were selected from a small set of treatment facilities, all of which are federated and have common recruitment and therapy resources, so that we could be targeting a socially distinctive subgroup of GDPs. Similarly, RGs were recruited via social networks, and again the risk exists that our sample is more socially homogeneous than the whole population. Third, although the sample is large enough to make cross-modality and cross-group comparisons, power is reduced for the analysis of group x modality interactions. Although the direction of modality effects for main dependent variables was the same across GDPs and RGs, the possibility exists that differences in effects size could emerge with larger samples. Eventually, assessments are limited by the availability of only one validated instrument in Spanish that allows for measurement of frequency of participation in different game types.

To conclude, the main strength of this study is the fact that, to our knowledge, it is the first to simultaneously consider carefully characterized GDPs and RGs, while exploring individual differences in risk factors for disordered gambling associated with gambling preferences. Future research should explore other variables and, particularly, those yielding the most promising ways to tailor treatments to individual features.

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Conflicts of interest

Competing interests

The authors declared no competing interests.

Constraints on publishing

The authors declared no constraints on publishing.

Ethical approval

The procedure performed in this study involving human participants was approved by the Ethics Committee of the University of Granada as part of the PSI2013-45055-P research project, and was in accordance with the 1964 Helsinki declaration and its later amendments.

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Appendix

Table A1. Hypotheses regarding relationships of gambler subtypes' preferences and gamblers' clinical status with self-regulation and gambling cognitions.

Variables	Hypotheses	Rationale for hypotheses
UPPS Positive urgency *UPPS Negative urgency*	GDP>RG	Failure of top-down emotion regulation, common to gambler subtypes and other addictive disorders (Clark et al., 2012; MacLaren et al., 2011; Michalczuk et al., 2011)
UPPS Lack of Premeditation	GDP>RG Type II>Type I	Deterioration of executive functions involved in decision-making (shortsightedness) found in slot machine gamblers but not in strategic gamblers (Goudriaan et al., 2005; Grant et al., 2012)
UPPS Sensation Seeking	Type I>Type II	Search for stimulation through skill-based and exciting games (Barrault & Varescon, 2013; Moragas et al., 2015; Sharpe et al., 1995).
UPPS Lack of Perseverance	GDP>RG	Less availability of general cognitive resources, less conscientiousness and more sensitivity to ego depletion in GDP and other addictions (Bagby et al., 2007; Bergen & Newby-Clark, 2012).
Delay discounting	GDP>RG Type I>Type II	Deterioration of executive functions involved in decision-making (shortsightedness) found in slot machine gamblers but not in strategic gamblers (Goudriaan et al., 2005; Grant et al., 2012).
SPSRQ Reward Sensitivity	Type I>Type II	Positive reinforcement, not necessarily problematic, and previous associations with skill-based and exciting games (Balodis et al., 2014; Sharpe et al., 1995).
SPSRQ Punishment Sensitivity	Type I<Type II	Negative reinforcement/coping-based gambling previously associated with non-strategic games (Balodis et al., 2014).
GRCS Predictive Control *GRCS Interpretative Bias* *GRCS Illusion of Control*	GDP>RG Type I>Type II	Illusions linked to beliefs in a hidden causal structure underlying gambling outcomes, either related to one's instrumental or pattern-detection skills (more related to skills-based games; Myrseth et al., 2010; Toneatto et al., 1997).
GRCS Expectations	GDP>RG	Related to both positive and negative reinforcement processes. Unlikely to reflect gambling preferences.
GRCS Perceived inability to stop	GDP>RG	Perceived failure of self-control that can be related to various factors, independent of game preferences.

Note: References regarding rationale for hypotheses are illustrative, not exhaustive. GDP = gambling disorder patients group; RG = recreational gamblers group.