

**Types of emotion regulation and their associations with gambling: A cross-sectional study with
disordered and non-problem Ecuadorian gamblers**

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Compliance with Ethical Standards

Ethical Approval

The procedure of this study complies with the ethical standards of the Helsinki Declaration of 1975, as revised in 2008, and was approved by the Ethics Committee of the Faculty of Psychology of the University of Guayaquil (Ecuador), as part of the doctoral thesis project of the first author, and by the Human Research Institutional Review Board of the University of Granada, as part of the GBrain 2 Project (Reference: PSI2017-85488-P, IRB approval number 406/CEIH/2017). All participants were informed about the study's objectives and signed a written informed consent.

Conflict of interests

The authors have no conflicts of interest to declare. The funding agencies played no role in the design, execution, analysis or interpretation of the results of the present study.

Abstract

This cross-sectional study was aimed at investigating the role of emotional regulation in regular gambling in a sample of 197 disordered and non-problem gamblers from Ecuador. Two proxies were used as measures of behavioral signs of *generalized emotion dysregulation* (UPPS-P emotion-driven impulsivity) and *intentional emotion regulation strategies* (ERQ), and their associations with gambling cognitions (as measured by the GRCS questionnaire), gambling behavior (SOGS), and comorbid alcohol and drug misuse (Multi-CAGE), were explored.

For analyses, impulsivity traits, including emotion-driven impulsivity scores, were used as inputs to predict dispositional variables (ERQ strategies and GRCS cognitions), and clinically relevant behavioral outputs, while controlling for gambling severity. Hypotheses were based on previously published work, although the analysis has been improved (using hierarchical linear mixed-effects modelling), and homogenized in covariate control, and decision threshold stringency.

Results were as follows: (1) After controlling for relevant covariates, UPPS-P sensation seeking was positively associated with gambling cognitions, whereas positive urgency was positively associated with cognitive biases (interpretative bias, control illusion, and predictive control) but not with other gambling cognitions. (2) Among emotion regulation strategies, reappraisal, but not suppression, was associated with gambling cognitions. (3) Negative urgency was distinctively associated with suppression, but not with reappraisal. And (4), no impulsivity dimensions significantly predicted drug or alcohol misuse, although negative urgency fell just below the decision threshold.

These results reinforce the importance of emotion regulation processes in the cognitive and behavioral manifestations of gambling. Most importantly, they suggest a dissociation between the role of model-free dysregulation of negative emotions (as measured by UPPS-P negative urgency), as a key contributor to gambling complication and general psychopathology; and the one of strategic emotion regulation, in fueling gambling-related cognitive distortions.

Introduction

Gambling Disorder (GD) is characterized by lack of control over gambling behavior in spite of negative, persistent and severe personal consequences. Recently, it has been re-conceptualized as a behavioral addiction, within the category of *substance-related and addictive disorders* (American Psychiatric Association, 2013), which has somewhat contributed to reorient and unify its diagnosis and treatment (Stinchfield et al., 2016).

Estimated prevalence of GD across studies in different countries approximates 3%, although figures can largely vary, depending on the methods and tools used (Stucki & Rihs-Middel, 2007). Prevalence, however, is probably increasing in some areas and population sectors, due to targeted exposure to gambling-related stimuli, and the variety and availability of new gambling options in the market (Hodgins, Stea, & Grant, 2011; Calado, Alexandre & Griffiths, 2017). Besides, data are particularly limited in some areas and domains (Nature, 2018). Studies in Latin-America, for instance, are scarce and unsystematic (Gowing et al., 2015), and, they are virtually inexistent in Ecuador, which is partly due to the prohibition of most forms of gambling in 2011. This particularity limits access to information about potentially problematic gamblers, as well as the availability of psychoeducation, counseling and treatment resources for potentially risky or pathological gamblers. At the same time, Ecuador has become an interesting context to study gambling in very idiosyncratic social and legal conditions. Hence, our main interest in the present study will be to explore individual differences in a sample of Ecuadorian disordered and non-disordered gamblers, and to test whether associations between personality traits, cognitive distortions, and clinically significant features mirror the ones previously described in countries where gambling is a legal and generalized leisure activity.

A model to account for gamblers' individual differences

The DSM5 provides a unique diagnosis for GD, with three degrees of severity based on the number of diagnostic criteria met. Many authors have nonetheless stressed the importance of considering individual differences in its understanding (Blaszczynski & Nower, 2002; MacLaren, Fugelsang, Harrigan, & Dixon, 2011), in view of the fact that individual traits are strong predictors of preference for different gambling modalities (e.g. Navas et al., 2017b; Jiménez-Murcia et al., 2011), GD vulnerability and severity (e.g. Lussier, Derevensky, Gupta, Vitaro, 2014; Nower, Martins, Lin, & Blanco, 2013), and prognosis and response to treatment (Jara-Rizzo et al., 2018; Ramos-Grille, Gomà-i-Freixanet, Aragay, Valero, & Vallès, 2015). The individual differences models from which these predictive traits are extracted are varied, with personality models (Ramos-Grille et al., 2015; Carlotta et al., 2015), impulsivity models (Maccallum, Blaszczynski, Ladouceur, & Nower, 2007; Savvidou et al., 2017), cognitive models (Toneatto, Blitz-Miller, Calderwood, Dragonetti, & Tsanos, 1997; van Holts, van den Brink, Veltman, & Goudriaan, 2010), and neurobiological models (Clark et al., 2012, 2017; Potenza et al., 2013) being the most pervasive in literature.

The Gambling Space Model (GSM) has been recently proposed to integrate these approaches to heterogeneity in gambling disorder (Navas, Billieux, Verdejo-García, & Perales, 2018). Inspired by the *Pathways Model* (Blaszczynski & Nower, 2002), gambling addiction is modelled as mostly driven by instrumental and Pavlovian conditioning processes, linked to the reinforcement schedules present in gambling scenarios (Delfabbro, 2014). Beyond these, however, different psychobiology-informed,

affect/emotion-driven constructs play different roles in shaping GD vulnerability and development (see also Williams, Grisham, Erskine, & Cassedy, 2012; Maniacci, Picone, van Holst, Bolloni, Scardina, & Cannizaro, 2017).

In the GSM, gamblers are predicted to differ in four dimensions: (1) *sensitivity to positive reinforcement*, (2) and *negative reinforcement components of gambling*, (3) *generalized emotion dysregulation*, and (4) *motivated cognitive elaboration and self-deception*. The first dimension has been shown to play an important role in gambling preferences, motivation for change and a dropout risk during therapy (Aragay et al., 2015; Jara-Rizzo et al., 2018; Navas et al., 2017a), and the second one in transition from risky to pathological gambling, telescoping, and gambling severity (Ledgerwood & Petry, 2010; Ciccarelli, Griffiths, Nigro & Cosenza, 2017; Zakiniaez, Cosgrove, Mazure, & Potenza 2017). These two dimensions are related to gambling motives, and thus to gambling as an overt coping/enhancing strategy. The third and fourth dimensions, however, have more to do with covert emotion regulation (Braunstein, Gross, & Oschner, 2017). Given that gambling motives can largely vary across contexts, this work focuses on the latter.

Gambling and emotion regulation

Generalized emotion dysregulation is regarded here as the failure to inhibit or control the intrusion of thoughts and expression of behaviors driven by strong emotions, and, particularly, negative ones (e.g. aggression). The GSM borrows the concept of *negative urgency* from the UPPS-P model of impulsivity (Lynam, Smith, Whiteside, & Cyders, 2007; Whiteside & Lynam, 2001), and uses it as a proxy to measure the behavioral manifestation of a failure to effectively regulate intense negative emotions. Negative urgency has been reported to be one of the strongest indices of pathological status and complications among gamblers (Billieux et al., 2012). Converging studies have explored the neurobiological roots of negative urgency in basic emotion regulation processes (Chester et al., 2016; Ruiz de Lara, Navas, Soriano-Mas, Sescousse & Perales, 2018), and have shown that negative urgency plays a major role in an array of externalizing psychopathologies, including other addictions (Johnson, Carver, & Joorman, 2013; Johnson, Tharp, Peckham, Carver, & Haase, 2017).

Motivated cognitive elaboration and self-deception includes cognitive biases by mean of which the gambler attempts to reduce the impact of negative consequences derived from gambling, or to justify and maintain their desire and motives for gambling. The Gambling-Related Cognitions Scale (GRCS; Raylu & Oei, 2004), for example, evaluates five gambling-related cognitive domains. *Inability to stop* (e.g. “I’m not strong enough to stop gambling”) and *gambling expectations* (e.g. “Gambling makes things seem better”), refer to personal 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* (e.g. “Praying helps me win”), *predictive control* (e.g. “When I have a win once, I will definitely win again”), and *interpretative biases* (e.g. “Relating my losses to bad luck and bad circumstances makes me continue gambling”) are distortions of reality involving causal attribution processes, and are categorized together, in a narrower sense, as gambling-related cognitive biases.

Several models identify cognitive biases as a target of therapeutic approaches (Chrétien, Giroux, Goulet, Jacques, & Bouchard, 2017), and their biological bases are now subject to intense scrutiny (Clark, 2017). The particularity of the GSM model regarding these cognitive distortions is formulating them as

resulting from elaborated emotion regulation mechanisms, in line with the motivated reasoning hypothesis (Kunda, 1990). At difference with model-free emotion dysregulation, these mechanisms are strategic, and their effective use requires some preservation of high-order cognition

Aims and hypotheses

The GSM provides a multidimensional space to characterize different gamblers' profiles in the risky-disordered range, and makes a number of specific, and sometimes counterintuitive predictions. The first one states that gambling-related cognitive biases (namely, illusion of control, predictive control, and interpretative biases) are more tightly related to emotion and motivation-driven aspects of impulsivity than to its cognitive facets. This prediction arises from conceptualizing cognitive biases themselves as resulting from strategies to enhance or to deal with the same positive and negative emotions that trigger impulsive behavior. This pattern of correlations was found in a large British sample (Michalczuk, Bowden-Jones, Verdejo-Garcia, & Clark, 2011), and closely replicated in a Spanish one (Del Prete et al., 2017).

The second prediction is more specific: if cognitive biases reflect a reinterpretation of gambling-related events, or justifications of feelings and motives, they should be associated with the dispositional use of reappraisal-related strategies. However, reappraisal and related cognitive emotion regulation strategies have been customarily considered adaptive, wellbeing enhancing strategies (and thus related to better psychological health), in contrast with other less effective, costlier strategies (e.g. suppression), that have been related to poor psychological health (Gross & John, 2003; Potthoff et al., 2016). In line with this prediction, a recent study, by Navas et al. (2016) showed that a cluster of gambling disorder patients with stronger cognitive distortions were more prone to use the strategy *putting in perspective* (from the Cognitive Emotion Regulation Questionnaire, CERQ, Garnefski & Kraaij, 2006) in daily life. Additionally, not only higher scores in GRCS, but also *putting in perspective*, and *refocusing on planning* (both of which are customarily considered adaptive strategies) were positively related to gambling severity.

A third specific prediction arises from the GSM model and a related work by Navas et al. (2017b). As described above, negative urgency is considered a marker of malfunctioning of model-free emotion regulation mechanisms. Navas et al. found that GD patients with higher negative urgency scores show more intense activation of control-related prefrontal areas during a lab-based negative emotion regulation task, revealing that such patients experienced more cognitive load and needed to invest more executive resources to solve the task (see also Chester et al., 2016). In parallel, negative urgency correlated with more frequent use of emotion suppression (from the *Emotion Regulation Questionnaire*, ERQ, Gross & John, 2003). This was interpreted as evidence that malfunctioning of basic emotion regulation mechanism generates some degree of overload upwards, and thus interferes the balanced use of strategic emotion regulation. Here, we intend to replicate such an association between negative urgency and dispositional use of suppression to regulate negative emotions.

The fourth and last prediction also regards the overlapping between negative urgency and basic emotion dysregulation. In accordance with the abovementioned proposal that negative urgency underlies, not only GD, but also other disordered externalizing behaviors, we expect negative urgency to emerge as a complication marker, including an elevated risk of comorbidity with misuse of alcohol and other drugs. To our knowledge, this prediction remains untested.

In summary, the GSM and previous evidence support the following associations regarding the role of emotion regulation in gambling: (1) Gambling-related cognitive biases are more tightly linked to affect and motivation-driven impulsivity than to cognitive impulsivity dimensions. (2) Gambling-related cognitive biases show associations with the use of elaborate emotion regulation strategies customarily regarded as adaptive and wellbeing-promoting. (3) Negative urgency reflects malfunctioning of basic regulation mechanisms, which breaks the balance between these and strategic emotion-regulation mechanism, thus altering the normal use of such strategies (and increasing the use of emotion suppression). And (4) negative urgency is associated with an elevated risk of GD comorbidity with other externalizing behaviors, including misuse of alcohol and other drugs.

So far, these associations have been observed in gamblers from countries where gambling is a legal leisure activity. The aims of the present study were, first, to directly replicate them, and thus test the soundness of the GSM, and second, to test them in a context in which sociocultural specificities plausibly have a large impact on the features and composition of gamblers' population. The GSM is a psychobiology-informed model. Social factors are expected to interact with the proposed neurocognitive mechanisms (particularly positive and negative reinforcement mechanisms), and thus to exploit some or other vulnerability paths, and increasing or decreasing the frequency of certain gambler profiles, but are not expected to change the basic set of relationships between constructs, or between those constructs and main clinical features.

Methods

Participants and procedure

Community regular gamblers and patients undergoing treatment for gambling disorder and/or other addictions (mostly alcohol use disorder) at *Centro de Recuperación Nueva Luz*, and *Centro de Recuperación Integral de Alcoholismo y Drogadicción (CRIAD)*, from Guayaquil, Ecuador, were contacted as potential participants. Non-patients were recruited by posting bills at the University of Guayaquil premises. All patients were receiving treatment for at least one addictive disorder, diagnosed by a clinical psychologist, on the basis of DSM-IV criteria. All potential participants were also briefly interviewed to check for inclusion criteria, namely being between 18 and 65 years old, not having suffered a head injury or neurologic problem, and not having been ever diagnosed with any psychiatric or psychological disorder (apart from addictive disorders in the patient subgroup). Additionally, (a) patients were fully assessed only if they reported a previous history of significant problems as a consequence of gambling [as corroborated by a score larger than ≥ 4 in the South Oaks Gambling Screen questionnaire (SOGS, Spanish version; Echeburúa, Báez, Fernández-Montalvo, & Páez, 1994)], and (b) non-patients were fully assessed if they reported gambling at least twice a week. The final sample consisted of 27 patients from the rehabilitation centers and 170 community regular gamblers.

The assessment consisted of a two-hour session. Some of the instruments were not relevant for the present purposes and will be reported elsewhere. All the assessments were carried out by an Ecuadorian Clinical Psychologist with a Master's degree in neuroscience. The assessment protocol was divided in four blocks (cognitive tests, computer tests, emotion and personality tests, and a clinical interview). Block order, and task order within each block were counterbalanced.

Sociodemographic data and main measures' scores for both subsamples are reported in Table 1.

Instruments

Gambling severity and other problematic behaviors

The *South Oaks gambling Screen* (SOGS, Lesieur & Blume, 1987) is customarily used to assess gambling severity, dependence, and debt accrual, and is the most common tool in international gambling research. Only the total severity score will be used in the present study. The Spanish version used in this study has shown good psychometric properties (Echeburúa et al., 1994)

The *MultiCAGE CAD-4* (Pedrero Pérez et al., 2007) is a screening tool used to detect self-regulation problems in several behavioral domains (problem gambling, excessive spending/shopping, alcohol misuse, drug misuse, hypersexuality, excessive internet use, excessive videogaming, and dysregulated eating behavior). Each subscale consists of four yes/no items, checking for current cravings, others' complaints about the potential problematic behavior, guilt or shame feelings and/or lack of self-acknowledgment, and self-reported compensatory behaviors. Only the alcohol and illegal drug misuse subscales will be used here. Both have shown appropriate psychometric properties and predictive validity of alcohol and drug abuse.

Impulsivity

The Spanish version (Cándido, Orduña, Perales, Verdejo-García, & Billieux, 2012) of the *UPPS-P impulsive behavior scale* (Whiteside & Lynam, 2001) contains 20 items, and allows for a 5-dimension 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").

Gambling cognitions

The *Gambling Related Cognitions Scale* (GRCS, Raylu & Oei, 2004) assesses five gambling-related cognitive domains: gambling expectancies (GE), illusion of control (IC), predictive control (PC), inability to stop gambling (ISG), and interpretative bias (IB). Its Spanish version has been recently validated by Del Prete et al. (2017), showing Cronbach's α values of 0.741, 0.713, 0.836, 0.896, and 0.859 for the abovementioned dimensions, respectively. Patients in our sample were instructed to answer the questionnaire with regard to the time when they used to gamble (prior to therapy onset), whereas recreational gamblers were asked to answer the questionnaire in relation to the present time.

Emotion regulation strategies

The Spanish version (ERQ, Cabello, Salguero, Fernández-Berrocal, & Gross, 2013) of the *Emotion Regulation Questionnaire* (Gross & John, 2003) was used to assess the dispositional use of two emotion regulation strategies: reappraisal and emotional suppression. This questionnaire has shown adequate validity and internal consistency (Cronbach's $\alpha = 0.75, 0.71$, respectively).

Statistical analyses and results

The database and R Code for main analysis, as well as the JASP file containing complementary analyses (as described in the Appendix, Supplemental materials) are available without restriction at <http://osf.io/zy9k8>

Correlations

Correlations regarding the questionnaires involved in our main hypothesis, along with correlations of all traits with SOGS gambling severity, are displayed in Table 2. Shaded areas include correlations that were predicted to be significant according to our hypotheses, namely (a) correlations of affect and motivation-driven UPPS-P impulsivity dimensions with GRCS gambling cognitions (15-member family), (b) correlations between ERQ reappraisal and gambling cognitions (5-member family), (c) the single correlation between UPPS-P negative urgency and ERQ suppression, and (d) correlations between UPPS-P negative urgency and MultiCAGE alcohol and drugs subscales (2-member family). Correlations yielding significant two-tailed p -values, after family-wise Bonferroni correction are marked with an asterisk in the Table. All these correlations were also submitted to a network analysis; however, given this analysis is mostly redundant with main analysis, it is reported in the Appendix (Supplemental materials).

Importantly, these correlations are also likely to be explained away, not only by differences in severity among gamblers, but also by sociodemographic confounders. In the subsequent set of analyses, we test whether target relationships survive after controlling for relevant covariates.

Impulsivity (UPPS-P) – gambling cognitions (GRCS)

This analysis was aimed at testing the relationship between impulsivity scores (as measured by the five dimensions of the UPPS-P questionnaire) and gambling-related cognitions (as measured by the GRCS questionnaire), with UPPS-P scores as input variable, and GRCS scores as output variable, while controlling for potential confounders. All quantitative variables were translated into a zero-centered scale before any further analyses.

A baseline linear mixed-effects (LME) model was built with participant as a random intercept, SOGS score and SOGS x GRCS subscale (ISG, IC, PC, GE, and IB) as fixed effects, and GRCS scores in the five subscales as dependent measures (the differences between GRCS subscales were previously eliminated by centering). Confounders (age, monthly income, education years, and gender) were simultaneously added upon the baseline model, but kept only if they significantly improved model fit. In order to do so, the baseline + all confounders model was tested against the same model without each of the confounders (*backward test*). The Akaike Information Criterion (AIC), and a likelihood ratio test were simultaneously used to make a decision on model fit. The all-confounders model lost fit only when education years was removed ($\Delta AIC = 3.704$, $L.Ratio = 5.704$, $p = 0.017$), so education years was kept, and age and gender were removed. The same logic was followed with confounders x GRCS subscale interactions (i.e. differential effects of confounders across subscales), but none of them substantially contributed to model fit. In consequence, the baseline + confounders model was composed of participant as the only random effect, and SOGS, SOGS x GRCS subscale, and education years as fixed effects.

To test the effects of UPPS-P variables on GRCS measures, a similar, yet more stringent, hierarchical method was followed. The effect of each UPPS-P dimension effect was kept if (1) removing it from a model with all UPPS-P dimensions hampered model fit (*backward test*), and (2) adding it to the

baseline + confounders model improved model fit (*forward test*). Positive urgency passed the forward ($\Delta AIC = 6.957$, $L.Ratio = 8.957$, $p < 0.028$), and the backward ($\Delta AIC = 1.936$, $L.Ratio = 3.936$, $p = 0.047$) tests, and so did sensation seeking ($\Delta AIC = 9.739$, $L.Ratio = 11.739$, $p < 0.001$; $\Delta AIC = 4.256$, $L.Ratio = 6.256$, $p < 0.012$, for the forward and the backward test, respectively). These results suggest that gamblers with higher scores in those two UPPS-P dimensions also showed higher general GRCS scores, independently of gambling severity and potential confounders.

UPPS-P x GRCS subscale interactive effects (that is, the potential differential effect of UPPS-P dimensions across GRCS domains) were tested following the same hierarchical rationale, against the model resulting from the previous step. Only the positive urgency x GRCS measure interaction passed both the forward and backward tests ($\Delta AIC = 7.708$, $L.Ratio = 15.707$, $p = 0.003$; $\Delta AIC = 7.035$, $L.Ratio = 15.035$, $p = 0.005$), indicating that the effect of positive urgency varied across GRCS domains.

In summary, the best-fitting model contained the effects of positive urgency, $R^2 = 0.018$ [CI90% 0 – 0.072; non-significant after including the interaction, $t(192) = -0.409$, $p = 0.683$], sensation seeking, $R^2 = 0.031$ [CI90% 0.02 – 0.096], and the positive urgency x GRCS subscale interaction, $R^2 = 0.020$ [CI90% 0.08 – 0.048]. The interactive effect was thus followed with GRCS subscale-by-subscale regression analyses, with UPPS-P dimensions as predictors, and SOGS severity and education as potential confounders. This set of analyses yielded significant effects of positive urgency on illusion of control [$\beta = 0.188$, $t(189) = 2.576$, $p = 0.011$], predictive control [$\beta = 0.188$, $t(189) = 2.385$, $p = 0.018$], and interpretative bias [$\beta = 0.140$, $t(189) = 2.037$, $p = 0.043$]. In other words, the positive urgency x GRCS subscale interaction seemed to originate in the fact that positive urgency was associated to cognitive biases, but not to gambling expectancies or perceived inability to stop gambling.

Emotion regulation (ERQ) – gambling cognitions (GRCS)

An identical rationale was followed to test the relationships between emotion regulation strategies (ERQ suppression and reappraisal) and GRCS gambling cognitions, starting with the same baseline + confounders model.

In this case, only the reappraisal score passed both the forward and the backward tests ($\Delta AIC = 14.208$, $L.Ratio = 16.208$, $p < 0.001$, and $\Delta AIC = 9.717$, $L.Ratio = 11.717$, $p < 0.001$, respectively), with reappraisal correlating globally and positively with the intensity of gambling cognitions. Neither the reappraisal x GRCS subscale term, nor the suppression x GRCS subscale term contributed to improving model fit, so the effect of reappraisal must be considered generalized across the five GRCS gambling cognitions, with a size $R^2 = 0.079$ [CI90% 0.022 – 0.163].

Impulsivity (UPPS-P) – Emotion regulation (ERQ)

In this case, UPPS-P scores were used to predict ERQ dispositional use of suppression and reappraisal to control negative emotions in daily life. The analysis rationale was as described in previous sections. However, in all models fitted with *nlme*, residuals remained non-independent from fitted values. In order to surpass that problem, standardized suppression and reappraisal scores were separately discretized in 7 bins with approximately the same number of observations (using the *cut2* function in the *Hmisc* R package; Farrell, 2018), and treated as ordinal variables. Discretization in 7 bins was used to keep the scoring as

informative as possible, while maintaining a sufficient number of observations per bin. Cumulative-link linear mixed-effects modeling (CLME), with a logit link function (as implemented in the *ordinal* package in R; Bojesen Christensen, 2015) was used in place of LME. In all other senses, the model construction and selection criteria remained as described above (please note that, although discretization improved the final model, it did not affect the basic pattern of results).

A baseline CLME model was built with participant as random intercept, SOGS score and SOGS x ERQ subscale (reappraisal, suppression) as fixed factors, and ERQ scores in two subscales as dependent measures. The baseline + all confounders model lost fit when age ($\Delta AIC = 4.730$, $L.Ratio = 6.730$, $p = 0.009$) and education years ($\Delta AIC = 5.058$, $L.Ratio = 7.058$, $p = 0.008$) were removed, so these two factors were kept. No UPPS-P x ERQ subscale interactive effect contributed to model fit. The definitive baseline + confounders model was composed of participant as a random intercept, and SOGS, SOGS x ERQ dimension, age and education years as fixed terms. Subsequent models were tested against this one.

No UPPS-P dimensions contributed to model fit. However, the negative urgency x ERQ subscale interaction passed both the forward and the backward tests ($\Delta AIC = 4.280$, $L.Ratio = 8.280$, $p = 0.016$, and $\Delta AIC = 4.996$, $L.Ratio = 8.996$, $p = 0.011$, respectively).

This effect was thus followed with ERQ subscale-by-subscale CLM analyses, with SOGS, SOGS x ERQ dimension, age and education years as confounders, and UPPS-P scores as main predictors. In accordance with the global analysis, these analyses yielded a significant effect of negative urgency, restricted to the ERQ suppression subscale [$z = 2.132$, $p = 0.033$], with higher negative urgency scores signaling a more frequent dispositional use of suppression to control negative emotions.

Impulsivity – Drug and alcohol risk of misuse

Finally, we assessed the relationship between UPPS-P scores and risk of alcohol and illegal drugs misuse, as measured by the drug and alcohol subscales of the MultiCAGE. These scores range from 0 to 4, and were fitted as ordinal scores with the *ordinal* package (logit link).

A baseline model was built with participant as random intercept, SOGS score, MultiCAGE subscale (alcohol, drugs), and the SOGS x MultiCAGE subscale interaction as fixed terms, and MultiCAGE scores in two subscales as dependent measures. Given that raw MultiCAGE scores are ordinal in their original form, standardization was not feasible, and the MultiCAGE subscale effect was thus included in the baseline model. The baseline + all confounders model lost fit when education years ($\Delta AIC = 4.214$, $L.Ratio = 6.214$, $p = 0.013$), monthly income ($\Delta AIC = 4.835$, $L.Ratio = 6.835$, $p = 0.009$), and sex ($\Delta AIC = 7.288$, $L.Ratio = 9.288$, $p = 0.002$) were removed, so these three factors were kept. The age x MultiCAGE subdimension ($\Delta AIC = 6.561$, $L.Ratio = 10.561$, $p = 0.005$), the education years x subdimension ($\Delta AIC = 2.747$, $L.Ratio = 4.747$, $p = 0.029$), and the monthly income x subdimension ($\Delta AIC = 2.955$, $L.Ratio = 4.955$, $p = 0.026$) interactions contributed to model fit, and were also kept. Subsequent models were tested against this baseline + confounders + interactions model.

No UPPS-P dimensions simultaneously passed the forward and backward tests. Still, negative urgency passed the forward test ($\Delta AIC = 3.349$, $L.Ratio = 5.349$, $p = 0.021$), and fell close to passing the backward test ($\Delta AIC = 1.540$, $L.Ratio = 3.535$, $p = 0.060$; $z = 1.852$ in the saturated model).

Discussion

This study was aimed at testing the set of associations regarding the role of emotional regulation in gamblers' individual differences predicted by the Gambling Space Model (GSM), in the particular sociocultural context of a country where gambling is mostly illegal (i.e. Ecuador). With that aim in mind, we explored the associations between gambling cognitions (as measured by the GRCS), impulsivity (UPPS-P), emotion regulation strategies (ERQ), and comorbid alcohol and drug misuse (Multi-CAGE CAD4). For analyses, personality (impulsivity) scores were used as inputs to predict dispositional variables (ERQ and GRCS scores), and symptoms (MultiCAGE drugs and alcohol subscales). All hypotheses were based on previous works, although the analysis strategy has been improved and homogenized in terms of sample size and composition, covariate control, and decision threshold stringency.

Results can be summarized as follows: (1) after controlling for gambling severity and relevant sociodemographic covariates, sensation seeking was positively associated with gambling cognitions, whereas positive urgency was positively associated with cognitive biases, defined in a narrow sense (interpretative bias, illusion of control, and predictive control) but not with other gambling cognitions (inability to stop and gambling expectancies). On the contrary, negative urgency was far from predicting any gambling cognitions. (2) Among emotion regulation strategies, reappraisal, but not suppression, was associated with gambling cognitions. (3) Negative urgency was distinctively associated with suppression, but not with reappraisal. And (4), no impulsivity dimensions substantially predicted comorbid drug and alcohol abuse, although negative urgency fell just below the decision threshold. These links were confirmed by a network analysis, as shown in the appendix (Supplemental materials).

Jointly considered, these results reinforce the importance of emotion regulation processes in the cognitive and behavioral manifestations of gambling (Williams et al., 2012). Beyond that overarching corroboration, the first set of specific relationships confirms the affective nature of cognitive biases predicted by the *cognitive elaboration and self-deception* construct in the GSM model, and also partially replicates previous findings by Michalczuk et al. (2011) and Del Prete et al. (2017). However, these studies did not segregate the effect of impulsivity from gambling severity and sociodemographic factors. In line with that, unconditional correlations between negative urgency and gambling cognitions were explained away by covariate control in further analyses. This negative finding thus qualifies our initial prediction about the potential link between gambling cognitions and motivation/affect driven impulsivity (which did not include any reference to possible differential influences of positive and negative affect/motives).

As noted in the introduction, the hypothesis that affect/motivation driven impulsivity is associated with cognitive biases was founded on the assumption that problem gamblers distort reality in an attempt to reduce the impact of negative consequences derived from gambling, or to justify and maintain their desire and positive motives for gambling. In other words, we assumed that cognitive biases would be equally fueled by *enhancement* regulation and *coping* regulation. Our data support the former possibility but certainly not the latter.

Results are more consistent with predictions regarding the linkage between emotion regulation strategies and cognitive biases. Extending Navas et al.'s (2016) findings, reappraisal was positively associated with gambling cognitions. This association not only corroborates the emotional roots of gambling cognitions, but also their overlap with high-order, model-based emotion regulation strategies.

These strategies are customarily regarded as adaptive and have been linked to psychological adjustment and wellbeing (Aldao et al., 2010; Gross & John, 2003). Somewhat counterintuitively, these strategies seem to help gamblers deceive themselves, get an imaginary sense of mastery and justify their desire for gambling. Tentatively, enhancement of positive emotional states elicited by gambling episodes could bias the processing of gambling outcomes, altering associative and causal attribution learning, and thereby increasing the strength of gambling distorted beliefs (Navas, 2016).

The last two sets of hypothesized associations have implications beyond gambling symptomatology. The fact that negative urgency signals the dispositional use of suppression to regulate negative emotions (and, actually, seem to alter the balance between reappraisal and suppression) suggests that negative urgency is a marker of gambling ‘over-pathologization’, that is, a clue that psychopathology extends beyond gambling, to other potentially problematic behaviors. This possibility emerges from the extensive available evidence of a link between suppression use and a variety of mental disorders (Wegner & Zanakos, 1994). However, our attempt to further corroborate this idea by finding an association between negative urgency and comorbid alcohol and drug misuse found only a suggestive and partial corroboration.

Limitations and strengths

These results must be interpreted in light of at least two limitations. First, effects are mostly subtle (mostly falling in the high end of the small size range [$R^2 = 0.01 - R^2 = 0.10$], or the low end of the medium size range [$R^2 = 0.1 - R^2 = 0.25$], according to customary conventions. This is partially attributable to the measurement error consubstantial to the scales used here, and also to the fact that some of them (e.g. *negative urgency*) were used as proxies to the key construct of interest (e.g. generalized emotion regulation failure). Further research is needed to find more direct ways to measure such constructs. Second, associations do not allow to establish causal directionality. Input and output variables in analyses were established on the basis of which of them were more basic traits (with personality traits considered more fundamental than dispositional or behavioral traits). Results reinforce the GSM because hypotheses emerged from it, but, definitely, other underlying structures are viable.

At the same time, this work also presents three remarkable strengths. First, its large sample size compared with studies of the same sort. Second, the sensitivity of statistical analyses, combined with a stringent criterion on model fit, designed to avoid false positives. And finally, its purely confirmatory nature, with all hypotheses emerging from previous works and GSM predictions.

Final remarks

Emotion regulation has a key role in many mental disorders. Very powerful models describing the different components of emotion regulation are also available in the recent literature. The proposal that different emotion regulation mechanisms differ in the degree of involvement of model-free vs. model-based processes (Etkin, Büchel & Gross, 2015) is particularly appealing, and seems to fit well with the different ways and levels of severity in which gambling disorder manifests in different patient profiles. Our results suggest different roles for the generalized emotion regulation failure (as measured by negative urgency), and the motivated use of reappraisal (customarily regarded as adaptive). The former seems to be characteristic of a complicated profile (probably overlapping with the impulsive-antisocial gambler subtype described by the pathways model, Blaszczynski & Nower, 2002), with heightened psychopathology and

worse prognosis. The latter seems however characteristic of overconfident, sophisticated gamblers, probably with well-preserved cognitive and intellectual abilities, but with complex networks of beliefs that help them maintain gambling motivation. We suspect this profile is associated with new gambling modalities, and more pervasive in young gamblers, and will probably be on the rise in the years to come (Gainsbury, Russell, Hing, Wood, Lubman, & Blaszczynski, 2015; Griffiths, Wardle, Orford, Sproston, & Erens, 2009).

Importantly, the context of the sample from which these data have been collected is very different to the British and Spanish samples of the studies from which hypotheses generated. In spite of the differences, results seem mostly analogue. Similarities are compatible with a cross-culturally valid and unique definition of gambling disorder, and also with the commonality of its basic neurocognitive mechanisms. The GSM is however sensitive to the interactions between those basic mechanisms and gambling exposure, which make us suspect that the same mechanisms could give rise to quite different proportions of the different gambler profiles across different cultural contexts, depending on factors like available gambling modalities, gambling exposure, spread of Internet access, or regulation of gambling advertising.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Table 1 Sociodemographic data and scores in target measures from community gamblers and patients

	Community gamblers	Patients
<i>Sociodemographic variables</i>		
<i>Sex</i>	39% females	26% females
<i>Age</i>	34.36 (13.73)	25.74 (8.34)
<i>Years of education</i>	13.20 (4.02)	12.52 (2.33)
<i>ERQ</i>		
<i>Reap</i>	30.41 (7.65)	29.81 (9.06)
<i>Supp</i>	17.47 (6.58)	15.89 (7.08)
<i>SOGS</i>		
<i>Severity</i>	3.60 (3.55)	7.78 (4.54)
<i>MC</i>		
<i>Alcohol</i>	0.35 (0.35)	0.64 (0.33)
<i>Drugs</i>	0.08 (0.20)	0.77 (0.25)
<i>UPPS-P</i>		
<i>NegUrg</i>	2.49 (0.78)	2.73 (0.84)
<i>PosUrg</i>	2.51 (0.71)	2.79 (0.58)
<i>SensSeek</i>	2.66 (0.89)	2.97 (0.76)
<i>Lprem</i>	1.75 (0.63)	1.89 (0.64)
<i>Lpers</i>	1.76 (0.62)	1.92 (0.63)
<i>GRCS</i>		
<i>GE</i>	3.83 (1.60)	3.56 (1.95)
<i>CI</i>	2.36 (1.47)	3.09 (1.69)
<i>PC</i>	3.17 (1.50)	3.90 (1.75)
<i>ISG</i>	2.13 (1.34)	2.93 (1.68)
<i>IB</i>	3.04 (1.80)	3.83 (2.08)

Note: ERQ: emotion regulation questionnaire (Reap: reappraisal; Supp: suppression); SOGS: South Oaks gambling screen; MC: MultiCAGE CAD-4; UPPS-P: NegUrg: negative urgency; PosUrg: positive urgency; SensSeek: sensation seeking, Lprem: Lack of premeditation; Lpers: Lack of perseverance; GRCS: gambling-related cognitive scale (GE: gambling expectancies; CI: control illusion; PC: predictive control; ISG: inability to stop gambling; IB: interpretative bias).

Table 2 Correlations between variables

	<i>GRCS</i>					<i>ERQ</i>		<i>MC</i>		<i>SOGS</i>
	GE	CI	PC	ISG	IB	Reap.	Sup.	Alcohol	Drugs	Severity
<i>UPPS-P</i>										
Neg. U	0.10	0.21*	0.18	0.09	0.15	-0.05	0.16*	0.22*	0.12	0.23*
Pos. U	0.04	0.26*	0.23*	0.16	0.20	-0.06	0.00	0.15	0.05	0.12
SS	0.21*	0.24*	0.21*	0.23*	0.24*	-0.02	0.05	0.07	0.01	0.16
Lprem	-0.06	0.04	-0.05	0.03	0.01	-0.09	-0.05	0.15	0.05	0.20*
Lpers	-0.01	0.08	-0.04	0.02	0.02	-0.05	-0.04	0.22	0.12	0.23*
<i>GRCS</i>										
GE						0.30*	0.23			0.30*
CI						0.27*	0.23			0.37*
PC						0.23*	0.21			0.39*
ISG						0.22*	0.12			0.51*
IB						0.24*	0.18			0.47*
<i>MC</i>										
Alcohol										0.48*
Drugs										0.37*

Note: GRCS: gambling-related cognitive scale (GE: gambling expectancies; CI: control illusion; PC: predictive control; ISG: inability to stop gambling; IB: interpretative bias); ERQ: emotion regulation questionnaire (Reap.: reappraisal; Sup.: suppression); MC: MultiCAGE CAD-4; SOGS: South Oaks gambling screen; Neg.U: negative urgency; Pos.U: positive urgency; SS: sensation seeking, Lprem: Lack of premeditation; Lpers: Lack of perseverance.

* Correlations yielding significant two-tailed *p*-values, after family-wise Bonferroni correction.