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Paul Brunault, Sasha Mathieu, Cathie Faussat, Servane Barrault, Isabelle Varescon

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TITLE PAGE

Title: Impulsivity facets and cognitive distortions associated with problem gambling: differences between ADHD and non-ADHD gamblers

Titre : Dimensions d'impulsivité et distorsions cognitives associées au jeu problématique : différences entre joueurs avec et sans TDAH

Author names and affiliations: Dr Paul Brunault ^{1,2,3*}, Dr Sasha Mathieu⁴, Cathie Faussat⁵, Dr Servane Barrault^{2,6}, Pr Isabelle Varescon ⁴

Email addresses and ORCID numbers of each author:

Dr Paul Brunault :
<https://orcid.org/0000-0001-9317-228X>
paul.brunault@univ-tours.fr

Dr Sasha Mathieu:
<https://orcid.org/0000-0002-4663-3087>
sasha.mathieu@etu.parisdescartes.fr

Dr Servane Barrault
<https://orcid.org/0000-0002-4743-3087>
servane.barrault@univ-tours.fr

Cathie Faussat
cfaussat.spublique@gmail.com

Dr Servane Barrault
<https://orcid.org/0000-0002-4743-3087>
servane.barrault@univ-tours.fr

Pr Isabelle Varescon (Head of the research lab):
<https://orcid.org/0000-0002-1122-4662>
isabelle.varescon@parisdescartes.fr

*Corresponding author (and also author designed to review potential proofs):

Paul Brunault, University of Tours – INSERM U1253 iBrain & University Hospital of Tours, Department of Psychiatry and Addiction, 2 boulevard Tonnellé, 37042 Tours Cedex 9, France.

E-mail address: paul.brunault@univ-tours.fr

¹ CHRU de Tours, Équipe de Liaison et de Soins en Addictologie & Clinique Psychiatrique Universitaire, 2 boulevard Tonnellé, 37042 Tours Cedex 9, France.

² Department of Psychology, Qualipsy EE 1901, Université de Tours, 3 rue des Tanneurs BP 4103, 37041 Tours Cedex 1, France.

³ UMR 1253, iBrain, Université de Tours, Inserm, 2 boulevard Tonnellé, 37044 Tours Cedex, France.

⁴ Université Paris Descartes, Sorbonne Paris Cité, Laboratoire de Psychopathologie et Processus de Santé, 71 avenue Édouard Vaillant, 92100 Boulogne Billancourt, France.

⁵ CHRU de Tours, Centre d'Investigation Clinique Plurithématique, CIC-P INSERM 1415, Tours, France

⁶ CHRU de Tours, Centre de Soins d'Accompagnement et de Prévention en Addictologie - Port Bretagne (CSAPA-37), 26 rue Richelieu, 37000 Tours, France.

Telephone number: +33-247-47478043

Fax number: +33-247-478402

Running head: Impulsivity, cognitive distortions and problem gambling in ADHD vs. non-ADHD

Compliance with ethical standards:

- **Conflict of interest:** P.B. reports personal fees (honoraria for speaking at symposia) and non-financial support (travel for participating in continuing medical education sessions) from Lundbeck, personal fees (honoraria for speaking at symposia) from Astra-Zeneca, and personal fees (co-investigator of a clinical trial) from DNA Pharma, outside the submitted work. All other authors declare that they have no conflict of interest.
- **Ethical approval:** All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.
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MANUSCRIPT

Abstract

Objective: To compare the association between (1) impulsivity facets or cognitive distortions, and (2) problem gambling between male gamblers with versus without self-reported Attention-Deficit/Hyperactivity Disorder (ADHD). **Method:** In 287 male gamblers recruited online, we assessed problem gambling (South Oaks Gambling Screen; cut-off ≥ 3), ADHD (Adult ADHD Self-report Scale V1.1), impulsivity facets (UPPS Impulsive Behavior Scale-short version) and gambling-related cognitions (Gambling-Related Cognitions Scale). **Results:** The prevalence of self-reported ADHD was 21.6%. In both ADHD and non-ADHD groups, problem gambling was associated with negative urgency, positive urgency and the same cognitive distortions. Sensation seeking and lack of premeditation were associated with problem gambling, but only in non-ADHD gamblers (significant interaction effect). **Conclusion:** Different impulsivity facets, but not different cognitive distortions, are associated with problem gambling in male gamblers with or without ADHD. Emotion dysregulation (positive and negative urgency) and cognitive distortions are involved in both groups, but sensation seeking and lack of premeditation may be specific to non-ADHD problem gamblers.

Keywords: Attention-deficit/hyperactivity disorder; gambling disorder; behavioral addictions; personality traits; emotion regulation.

Résumé

Objectif : Comparer l'association entre (1) dimensions d'impulsivité ou distorsions cognitives et (2) jeu problématique entre des joueurs avec et sans Trouble Déficit de l'Attention avec ou sans Hyperactivité (TDAH).

Méthode : Nous avons recruté 287 joueurs en ligne, et évalué le jeu problématique (South Oaks Gambling Screen ; score seuil ≥ 3), le ADHD (Adult ADHD Self-report Scale V1.1), l'impulsivité (UPPS Impulsive Behavior Scale-short version) et les distorsions cognitives (Gambling-Related Cognitions Scale). **Résultats :** La prévalence auto-rapportée du TDAH était de 21,6%. Chez les joueurs avec ou sans TDAH, le jeu problématique était associé aux dimensions d'urgence négative, d'urgence positive et à des distorsions cognitives similaires. Les dimensions de recherche de sensations et de manque de préméditation étaient associées au jeu problématique, mais uniquement chez les joueurs avec TDAH (effet d'interaction). **Conclusion :** Différentes dimensions d'impulsivité, mais pas différentes distorsions cognitives, sont associées au jeu problématique selon le statut TDAH des joueurs. La dysrégulation émotionnelle (i.e., urgence positive et négative) et les distorsions cognitives sont impliquées dans les deux groupes, mais la recherche de sensations et le manque de préméditation semblent plus spécifiques des joueurs sans TDAH.

Mots-clés: Trouble Déficit de l'Attention avec ou sans Hyperactivité; jeu d'argent pathologique; addictions comportementales; traits de personnalité; regulation émotionnelle.

Introduction

Gambling disorder is a clinical disorder characterized by a persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress, as indicated in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) by the existence of at least four out of the nine DSM-5 diagnostic criteria over a 12-month period (American Psychiatric Association, 2013). Prevalence rate for adult problem gambling (last 12 months) in the overall population can be estimated between .5% and 3%, with three to four times as many people having subclinical problems or harms (Abbott, 2020), and with a higher prevalence in male than female (American Psychiatric Association, 2013). There is also some variations in prevalence rates across countries, because greater gambling availability is associated with increased prevalence rates of gambling disorder, and commercial gambling has been a major growth industry for the last three decades (Abbott, 2020). Gambling disorder, which is now recognized in the DSM-5 as a behavioral addiction (i.e., a non-substance-related addictive disorder), typically involves the combination of biological (e.g., genetic factors such as dopamine D2A1 allele receptor gene, biologically based traits of impulsivity), psychological (e.g., psychiatric disorders such as mood, anxiety and other addictive disorders, stressful life events, personality traits such as impulsivity, risk taking or proneness to boredom, or cognitive distortions), and ecological (e.g., increased availability and increased accessibility of gambling) risk factors (Blaszczynski & Nower, 2002).

Among the psychiatric disorders associated with gambling disorder, adult attention-deficit/hyperactivity disorder (ADHD) is one of the most prevalent and important risk factor (Fatséas et al., 2016; Grall-Bronnec et al., 2011). ADHD is a neurodevelopmental disorder that is defined by a persistent pattern of inattention and / or hyperactivity-impulsivity that interferes with functioning or development beginning in childhood (before the age of 12). Although initially defined in childhood, with an estimated prevalence of approximately five percent of children (Polanczyk et al., 2007), it is now demonstrated that ADHD persists during adulthood in approximately one out of two patients, with an estimated prevalence ranging from 2.1% to 2.8% in adults (Fayyad et al., 2017; Vitola et al., 2017). It is important to screen for and treat as appropriate adult ADHD in patients with addictive disorders, and especially in patients with gambling disorder, because adult ADHD affects from 20% to 25% of adult patients seeking treatment for gambling disorder (Fatséas et al., 2016; Grall-Bronnec et al., 2011; Waluk, Youssef, & Dowling, 2016) and, when present, is associated with poorer outcomes (Romo et al., 2015).

Although the positive association between ADHD and problem gambling is now well established (Fatséas et al., 2016; Grall-Bronnec et al., 2011; Romo et al., 2015; Waluk et al., 2016), we currently lack an understanding of the mechanisms underlying this association. In line with individual difference theory, which

postulates that individual differences are essential to understanding behavior and disorders, we may assume that the factors contributing to gambling disorder might be different in people with ADHD than in those without it (i.e., categorical view of ADHD), as well as between people depending on their level of ADHD symptoms (i.e., dimensional view of ADHD: ADHD symptoms rather than ADHD diagnosis). Interestingly, such a differential contribution might be helpful in proposing different management strategies based on the patient's personality profile (Roberts et al., 2014).

In this study, we chose to focus on impulsivity and cognitive distortions as two measures that could contribute differently to problem gambling in patients with or without ADHD. We chose these two factors because they are among the most established risk factors for gambling disorder and predictors for gambling treatment (Blaszczynski & Nower, 2002; Chamberlain et al., 2017; Johansson et al., 2009), and, most importantly, they are psychological factors that are important treatment targets and susceptible to change (e.g., through psychotherapeutic strategies such as cognitive-behavioral therapy or emotion-regulation therapy). First, impulsivity is both a core feature of ADHD (Kooij et al., 2010) and a robust risk factor for gambling disorder (Fatséas et al., 2016). One interesting comprehensive model of impulsivity that is useful to disentangle the contribution of different impulsivity traits to addictive disorders was proposed by Whiteside & Lynam (2001). According to these authors, five distinct personality traits may be associated with impulsive behavior: negative urgency (i.e., the tendency to act rashly when faced with distress), positive urgency (i.e., the tendency to act rashly when faced with a very positive mood), lack of premeditation (i.e., the tendency to act without thinking), lack of perseverance (i.e., the inability to remain focused on a task) and sensation seeking (i.e., the tendency to seek out novel and thrilling experiences) (Cyders et al., 2014). On the other hand, cognitive distortions (i.e., irrational beliefs and erroneous perceptions about gambling and luck) are another integral component of the development, maintenance, and treatment of pathological gambling/gambling disorder (Challet-Bouju et al., 2017; Fortune & Goodie, 2012). Examples of cognitive distortions include illusion of control (i.e., expectancy of a personal success probability inappropriately higher than the objective probability would warrant), superstition (i.e., thought that the gambler has a reliable means of manipulating the outcome in his or her favour), interpretative control (i.e., magnification of gambling skill that does result in the gambler having exaggerated self-confidence and that leads to ignoring the severity of the losses) or predictive control (i.e., belief that the gambler has the skill to make accurate predictions, for example when he or she thinks that a series of losses is expected to be compensated for by chasing behavior, which is defined as a more frequent involvement, an

increased persistence and an elevated monetary risk in an effort to recoup money that has been lost) (Fortune & Goodie, 2012; Raylu & Oei, 2004).

Recent research has revealed several important facts about the relationship between ADHD, impulsivity traits, cognitive distortions and problem gambling (Lopez, Dauvilliers, Jaussent, Billieux, & Bayard, 2015; Miller, Derefinko, Lynam, Milich, & Fillmore, 2010; Romo et al., 2015). First, patients with ADHD reported higher scores than the overall population in negative urgency, lack of premeditation, lack of perseverance, and sometimes in sensation seeking (Lopez et al., 2015; Miller et al., 2010). Secondly, gambling disorder was independently predicted by ADHD symptoms, negative urgency, and lack of perseverance (Romo et al., 2015). Finally, problem gambling was also linked to cognitive distortions; these irrational beliefs about gambling and their role in the onset and maintenance of problem gambling are now well-documented in the literature (Clark, 2014; Mathieu et al., 2017). Another recent study showed that the presence of ADHD was linked to higher levels of cognitive distortions among problem gamblers (Romo et al., 2016).

Examination of the relative contribution of impulsivity facets and cognitive distortions to gambling disorder in patients with ADHD diagnosis/symptoms may lead to interesting therapeutic advances, for example customized addiction treatments for a given patient depending on his/her ADHD profile. Such an approach has already been successfully taken in patients with ADHD and substance use disorders (Pedersen et al., 2016; Roberts et al., 2014): Roberts et al. (2014) tested the hypothesis that different impulsivity facets may contribute to the increased levels of substance abuse in people with ADHD symptoms. They found that negative urgency, sensation seeking and lack of premeditation predicted alcohol use and alcohol abuse, while only negative urgency predicted tobacco and cannabis use (Roberts et al., 2014). Moreover, it was found that emotional impulsivity (i.e., high positive urgency and/or high negative urgency) may place children with ADHD at increased risk of alcohol problems in adulthood (Pedersen et al., 2016). To our knowledge, no study compared the impulsivity facets associated with problem gambling between gamblers with versus without ADHD, and no studies compared the cognitive distortions associated with problem gambling between gamblers with versus without ADHD. Given that, to the best of our knowledge, no previous studies have investigated this hypothesis, we have taken here an exploratory approach to the topic.

This study's main objective was to compare the impulsivity facets associated with problem gambling between male gamblers with versus without self-reported ADHD (i.e., to test whether there was an interaction effect between ADHD and each of these five impulsivity facets). We hypothesized that the negative urgency and positive urgency dimensions would be associated with problem gambling in both ADHD and non-ADHD male

gamblers, while the other impulsivity facets (i.e., lack of premeditation, sensation seeking, lack of perseverance) would be associated with problem gambling only in the non-ADHD group. Our secondary objective was to compare the gambling-related cognitions associated with problem gambling between male gamblers with versus without self-reported ADHD (i.e., to test whether there was an interaction effect between ADHD and each of these five gambling-related cognitions). We hypothesized that gambling-related cognitions would be equally associated with problem gambling in both ADHD and non-ADHD gamblers (no interaction effect). Finally, we also tested our hypotheses using a dimensional approach to ADHD, by considering ADHD as a continuous variable (ADHD symptom score) in addition to the categorical approach.

Material and methods

Participants

Participants were recruited through online gambling forums (e.g., Bet Clever, Club Poker, which are sports betting and poker sites) between June and October 2016, with the help of an advertisement posted on gambling forums with the permission of the website's administrators. We included gamblers who were over 18 years old, spoke fluent French, and were involved in a regular gambling activity (i.e., at least once a week; for more details, see Barrault & Varescon, 2013). Interested gamblers had to click on a LimeSurvey® link that led them to the online questionnaires (including an information notice and consent form in advance of the questionnaires). This population has already been described in a previous published study as focusing on gambling motives and cognitive distortions in gamblers (Mathieu et al., 2017). Two hundred and ninety-eight ($n = 298$) gamblers answered the whole questionnaire; of these, 97.4% were men ($n = 290$). Due to the very small sub-sample of women ($n = 8$), only men were included in this study. Of the initial sample ($n = 298$), eleven gamblers were withdrawn from the study (eight were excluded because they were female, and three were excluded because they had missing data for at least one of the self-administered questionnaires used in this study). Our final population was thus based on 287 male gamblers.

Materials

Socio-demographic characteristics

Age, gender, marital status (married or in a relationship versus single), level of education (completion of the baccalaureate or beyond versus educational level below the baccalaureate), and the types of games played (i.e.,

strategic or mixed strategic-chance gambling activity; offline and/or online gambling) were assessed using a self-administered questionnaire.

Problem gambling

Problem gambling was assessed using the total score of the South Oaks Gambling Screen (SOGS), which is a 20-item self-administered questionnaire for problem gambling (Lesieur & Blume, 1987; French validation: Lejoyeux, 1999). Item examples include “When you gamble, how often do you go back another day to win back money you lost”, “Did you ever gamble more than you intended to”, or “Have you ever borrowed from someone and not paid them back as a result of your gambling?”. The SOGS can be interpreted using a total score that indicates the severity of gambling, or as an ordinal variable (a score less than or equal to 2 corresponds to the absence of problem gambling, a score of 3 or 4 corresponds to problem gambling, and a score equal to or higher than 5 characterizes probable pathological gambling). In this study, as has often been done before (Mathieu et al., 2017; Stark et al., 2012), the SOGS variable was considered a binary one: no problem gambling (SOGS total score < 3) vs. problem gambling (SOGS total score ≥ 3 ; category that includes both problem gambling and potential pathological gambling). The existence of current problem gambling was assessed over the past 12 months. The SOGS shows acceptable psychometrics in problem gamblers (Stinchfield, 2002). In our sample, the internal consistency was adequate (Cronbach’s alpha = .79)

Self-reported ADHD

Self-reported ADHD was assessed using the Adult ADHD Self-Report Scale-V1.1 (ASRS-V1.1), which is a six-item self-administered questionnaire designed with the help of the World Health Organization to screen for ADHD (based on Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, Text Revised, criteria) in both community surveys and clinical settings (Kessler et al., 2005). In this study, we used the French adaptation of the ASRS that was proposed by the World Health Organization and that is presented in Supplemental Table 1. Item examples include “How often do you have problems remembering appointments or obligations?” or “How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?”. Each item is assessed using a five-point Likert scale ranging from one (“never”) to five (“very often”), with different cut-offs depending on the considered item: for items 1 to 3, an item is considered significant when the person answered at least three on the Likert scale; for items 4 to 6, an item is considered significant when the person answered at least four on the Likert scale. This allows the calculation of a total

ASRS score that ranges from zero to six. Given that the presence of at least four significant items (i.e., a total ASRS score ≥ 4) is considered to be highly consistent with ADHD diagnosis in adults (Kessler et al., 2005), we differentiated gamblers with self-reported ADHD from those without self-reported ADHD based on this cut-off. The ASRS is effective for screening adults for ADHD (Cronbach's α was in the range of .63 to .72 in the overall population) (Kessler, Adler, Gruber, Sarawate, Spencer, Van Brunt, 2007), with a good internal consistency ($\alpha = .84$) and construct validity in adult patients with addictive disorders (van de Glind et al., 2013). In our sample, the internal consistency was $\alpha = .69$. We also tested our hypotheses using a dimensional approach to ADHD (ASRS total score that ranges from zero to six).

Impulsivity

Impulsivity facets were assessed using the French version of the UPPS Impulsive Behavior Scale, short version (UPPS-P) (Billieux et al., 2012). The UPPS-P is a 20-item self-administered questionnaire that is based on the UPPS (Whiteside et al., 2005; Whiteside & Lynam, 2001) and one measure of positive urgency (Cyders et al., 2007). The UPPS-P assesses five impulsivity facets (all defined above in the Introduction): negative urgency (four items), e.g., "When I am upset, I often act without thinking" (reversed score); positive urgency (four items), e.g., "I tend to act without thinking when I am really excited" (reversed score), lack of premeditation (four items), e.g., "I like to stop and think things over before I do them", lack of perseverance (four items), e.g., "I generally like to see things through the end", and sensation seeking (four items), e.g., "I welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional" (reversed score), (Cyders et al., 2014). Each item is assessed using a four-point Likert scale ranging from one ("agree strongly") to five ("disagree strongly"). The UPPS-P enables the calculation of a sub-score for each impulsivity facet, with a higher score indicating a higher intensity of the facet under consideration (items belonging to the positive urgency, negative urgency, and sensation seeking subscales are reversely scored). In our study, internal consistencies were good for negative urgency ($\alpha = .82$), positive urgency ($\alpha = .82$), lack of premeditation ($\alpha = .82$), and lack of perseverance ($\alpha = .86$) and acceptable for sensation seeking ($\alpha = .79$).

Gambling-related cognitions

Gambling-related cognitions were measured using the French version of the Gambling-Related Cognitions Scale (GRCS), which is a 23-item self-report that records common thoughts associated with problem gambling (Raylu & Oei, 2004; French validation: Grall-Bronnec et al., 2012). This questionnaire has a seven-point Likert scale

ranging from one (strongly disagree) to seven (strongly agree). Items are grouped into five subscales: interpretative control/bias (four items), e.g., “relating my winnings to my skill and ability makes me continue gambling”; illusion of control (four items), e.g., “I have specific rituals and behaviors that increase my chances of winning”; predictive control (six items), e.g., “losses when gambling, are bound to be followed by a series of wins”; gambling-related expectancies (four items), e.g., “gambling makes things seem better”; and perceived inability to stop gambling (five items), e.g., “it is difficult to stop gambling as I am so out of control.” The higher each sub-score is, the greater the corresponding gambling-related cognition is. In our sample, internal consistencies were $\alpha = .55$ for interpretative control/bias, $\alpha = .74$ for illusion of control, $\alpha = .54$ for predictive control, $\alpha = .60$ for gambling-related expectancies and $\alpha = .84$ for perceived inability to stop gambling.

Data analyses

Analyses were conducted using SPSS version 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM Corp.) and SAS version 9.3 (SAS Institute, Cary, NC). All analyses were two-tailed; p -values $< .05$ were considered statistically significant.

Descriptive statistics included percentages for ordinal variables; means and standard deviations for continuous variables. Factors associated with problem gambling (SOGS score ≥ 3) were first identified using a series of univariate logistic regressions. Then, for each impulsivity facet and for each gambling-related cognition, to assess whether their association with problem gambling was different according to ADHD status (ASRS score ≥ 4 versus ASRS score < 4), we fitted multivariate logistic regression models considering an interaction term between the studied dimension and the ADHD status. All these latter models were adjusted on marital status but not age nor educational level, because marital status was the only variable with a p -value $< .20$ in univariate analysis. Results were reported using Forest plots. We also computed the same statistical analyses by considering the “ADHD” variable as a continuous variable (number of ADHD symptoms = ASRS total score, that ranges from zero to six) rather than ADHD status. These additional analyses were driven by the fact that there is an ongoing debate on whether ADHD should be best considered from a dimensional or from a categorical point of view. We followed here the advice from Coghill & Sonuga-Barke (2012) who proposed that when we lack data demonstrating the latent structure of a disorders, “one possible way forward is the possibility for studies to routinely include both categorical and dimensional conceptualisations and measurements of disorder” (Coghill & Sonuga-Barke, 2012).

Ethical considerations

This study was approved by the Ethics Committee of Paris Descartes University (IRB number: 20162200001072). All procedures were performed in accordance with the ethical standards of the national and/or institutional research committee as well as with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All participants took part freely and voluntarily in the study, and we obtained informed consent from all individual participants before the inclusion in the study.

Results

Descriptive data

The descriptive statistics of the whole sample ($n = 287$), as well as those of persons with and without problem gambling, are presented in Table 1. The prevalence of problem gambling was 33.4%. Self-reported ADHD was observed in 21.6% of our population. Participants had mixed gambling practices, involving both online and offline activities, as well as both strategic games and mixed (strategic and chance) games. They played offline: poker (74.6%), sports betting (22.3%), blackjack (12.9%), lottery or scratch games (8.7%) and horse-race betting (8.7%); and online: poker (89.5%), sports betting (38%), horse-race betting (4.9%), lottery or scratch games (3.5%), and black jack (1.4%). In Table 1, we also described and compared the characteristics of gamblers with problem gambling versus those with no problem gambling (univariate logistic regression analyses). Table 2 presents the correlations between gambling severity (SOGS score), ADHD symptoms (ASRS score), impulsivity facets (UPPS-P scores), gambling-related cognitions (GRCS scores), and age.

Factors associated with problem gambling in the whole sample

Table 1 presents the factors associated with problem gambling in univariate analyses. In the whole sample, problem gambling was not associated with educational level, marital status or age. Problem gambling was also associated with four out of the five UPPS-P impulsivity facet sub-scores (negative urgency, positive urgency, lack of premeditation and sensation seeking, but not lack of perseverance), and with three out of the five gambling-related cognitions (i.e., illusion of control, gambling-related expectancies, and perceived inability to stop gambling, but not interpretative control/bias nor predictive control) (Table 1). Results were the same whether ADHD was regarded a categorical (ADHD status) or as a continuous (number of ADHD symptoms) variable.

Are the factors associated with problem gambling different between ADHD and non-ADHD gamblers ?

A series of logistic regression analyses with interaction terms were used to investigate whether the association between impulsivity facets and problem gambling, as well as the association between cognitive distortions and problem gambling, might be different depending on ADHD status (Table 3). For better clarity, these results were presented graphically using Forest plots (Figure 1 and Figure 2).

PLEASE INSERT HERE FIGURE 1 AND FIGURE 2

The association between impulsivity facets and problem gambling was different between ADHD and non-ADHD gamblers for lack of premeditation and sensation seeking (i.e., lack of premeditation and sensation seeking were associated with problem gambling only in the non-ADHD group: interaction effects), but not for negative urgency or positive urgency (i.e., negative urgency and positive urgency were associated with problem gambling in both ADHD and non-ADHD gamblers: no interaction effects). Lack of perseverance was not associated with problem gambling, and there was no interaction effect.

The association between gambling-related cognitions and problem gambling was confirmed for illusion of control, predictive control, gambling-related expectancies, and perceived inability to stop gambling, but not for interpretative control/bias. There was no interaction effect: no difference in these associations between ADHD and non-ADHD gamblers (Table 3).

Are the factors associated with problem gambling different depending on the number of ADHD symptoms?

We obtained the same results when considering ADHD as a continuous variable (number of ADHD symptoms) or as a categorical one (ADHD status) (Supplemental Table 2): lack of premeditation and sensation seeking were associated with problem gambling, with significant interaction effects; negative urgency and positive urgency were associated with problem gambling in both ADHD and non-ADHD gamblers, with no interaction effects. Illusion of control, predictive control, gambling-related expectancies, and perceived inability to stop gambling, but not interpretative control/bias, were associated with problem gambling, with no interaction effect (Supplemental Table 2).

Discussion

This research aimed to compare the association between impulsivity facets and problem gambling, as well as between gambling-related cognitions and problem gambling, between male gamblers with ADHD versus

without ADHD. While negative urgency and positive urgency were associated with problem gambling in both groups, sensation seeking and lack of premeditation were associated with problem gambling only in the non-ADHD group. We found no different association between gambling-related cognitions and problem gambling between ADHD and non-ADHD gamblers: illusion of control, gambling-related expectancies, and perceived inability to stop gambling were associated with problem gambling, but there was no interaction effect. We confirmed these results using a dimensional approach to ADHD.

Our main result is that negative urgency and positive urgency were the only impulsivity facets associated with problem gambling in male ADHD gamblers. These results are in line with those obtained in alcohol use disorders: elevated levels of emotional impulsivity place children with ADHD at increased risk of alcohol problems in adulthood (Pedersen et al., 2016). Moreover, positive and negative urgency are personality traits that represent individual differences in the disposition to engage in rash action when experiencing an intense emotion, either an extreme positive or negative affect (Cyders & Smith, 2008). In this connection, our results highlight here the central role of emotion dysregulation in ADHD (cf. Shaw, Stringaris, Nigg, & Leibenluft, 2014) and its unique contribution to problem gambling in this population. Emotion regulation can be defined as “an individual’s ability to modify an emotional state so as to promote adaptive, goal-oriented behaviors; it encompasses the processes that enable an individual to select, attend to, and appraise emotionally-arousing stimuli, and to do so flexibly” (Thompson, 1994). Emotion dysregulation is assumed to arise when these adaptive processes are impaired, leading to behavior that defeats the individual’s interests. In ADHD, emotion dysregulation is reported in 34 to 70% of adults and is correlated with the severity of ADHD symptoms (Shaw et al., 2014). Because emotion dysregulation in ADHD patients may arise from deficits in orienting toward, recognizing, and/or allocating attention to emotional stimuli, the assessment of the specific underlying process(es) involved in emotion regulation for a given patient may guide therapeutic approaches that could treat and prevent problem gambling.

Although ADHD patients usually report higher scores than the overall population in sensation seeking, lack of premeditation and lack of perseverance (Lopez et al., 2015), our data support the proposition that in male ADHD gamblers, sensation seeking and lack of premeditation, although prevalent in this population, are not risk factors for problem gambling. These results are in line with studies conducted in the field of non-behavioral addictive disorders. Belin et al. (2008) demonstrated in a preclinical model that high impulsivity predicted the development of addictive-like behavior, while novelty seeking, a phenotype close to sensation seeking, predicted the propensity to initiate cocaine self-administration but not addictive-like behavior. Consistent with these

findings, Ersche et al. (2010) also showed the differential association between personality traits and drug use/addiction: impulsivity was found to be mediating the risk for stimulant dependence potentially exacerbated by chronic drug exposure, whereas abnormal sensation seeking was hypothesized to be more likely an effect of stimulant drug abuse. In ADHD patients, we may explain our results by the fact that high sensation seeking and lack of perseverance may be associated with gambling use rather than problem gambling, and high sensation seeking could thus reflect the severity of ADHD rather than a specific vulnerability risk factor for problem gambling.

In gamblers without ADHD, we found that sensation seeking and lack of premeditation were additional risk factors for problem gambling. After adjustment for marital status, we found that sensation seeking, but not lack of premeditation, was associated with problem gambling. The association between sensation seeking and gambling disorder has already been observed in previous studies with a small effect-size (Müller et al., 2016). This relatively weak association in the whole sample might be due to the confounding effect of ADHD, and such an association could increase when non-ADHD gamblers are included. Alternatively, this association might also be explained by the specificity of our sample (i.e., we included mainly gamblers playing strategic games rather than only games of chance), because sensation seeking is associated with gambling disorder in strategic gamblers, but not in non-strategic gamblers (Bonnaire et al., 2017).

Our study confirms the high prevalence of ADHD in gamblers and the strong association between ADHD and problem gambling. We found that 21.6% of our sample met criteria for self-reported ADHD, which is close to the prevalence observed in previous studies conducted in clinical samples with the same self-administered questionnaire (namely, 25% and 20.7%, respectively in Fatséas et al., 2016 and Grall-Bronnec et al., 2011), and higher than those observed in patients seeking treatment for substance-related disorders: 13% for van de Glind et al. (2013), 19.4% for Lugoboni et al. (2017). This high prevalence observed for a non-clinical sample might be explained by our exclusively male sample (the prevalence of ADHD might be higher in males than in females, although this explanation is subject to discussion because ADHD might be underdiagnosed in women ; see Polanczyk et al. 2007). , and by the fact that we considered “problem gambling” to be a category including both problem gambling and potential pathological gambling. The association between ADHD and problem gambling remained significant after adjustment for impulsivity facets, ADHD being the variable that was most strongly associated with problem gambling. This result confirms the central role of ADHD in gambling disorder. Screening for ADHD in gamblers is a challenge, partly because ADHD and gambling disorder share several neurocognitive abnormalities such as high impulsivity (Grall-Bronnec et al., 2011); hence,

ADHD symptoms may be mixed up with personality traits that are risk factors for gambling disorder or with gambling disorder symptoms themselves. ADHD in gamblers is a hidden disorder (Grall-Bronnec et al., 2011) and we have confirmed it in a population of male online gamblers. Interestingly, we obtained the same results whether ADHD was regarded as ADHD status or ADHD symptoms, indicating that the categorical and the dimensional approach to ADHD both seem relevant in this context. Future studies should not only focus on ADHD diagnosis, but also on ADHD symptoms; and we may assume that we should not limit ourselves to the treatment of ADHD diagnosis, but also take into account ADHD symptoms.

Our results do not demonstrate a different association between gambling-related cognitions and problem gambling in ADHD gamblers versus non-ADHD gamblers. Although patients with ADHD may experience a higher severity of gambling-related cognitions—which is in line with the results of Romo et al. (2016)—the relative impact of each cognitive distortion did not differ between ADHD and non-ADHD gamblers. The association between cognitive distortions and problem gambling/gambling disorder is in line with previous studies, as previous research has demonstrated that irrational beliefs were a risk factor for, rather than a consequence of, gambling disorder (Barrault & Varescon, 2013; Romo et al., 2016). All of these distortions can be targeted by psychotherapy (e.g., cognitive and behavioural therapy/cognitive restructuring), on either an individual or a group basis (Chrétien et al., 2017). Such a treatment is crucial given that reduction of gambling cognitive distortions is one of the main predictors of gambling recovery (Rossini-Dib et al., 2015) and given that cognitive distortions mediate the relationship between depression symptoms and gambling severity (Schluter et al., 2019). Our results support the idea that gambling-related cognitions should be equally considered and treated appropriately in both ADHD and non-ADHD problem gamblers, and that there seems to be no specific gambling-related cognitions in ADHD problem gamblers. Adequate management of gambling-related cognitions is one of the cornerstones of problem gambling treatment, with some cognitive behavioral therapies such as cognitive restructuring/cognitive remediation being effective in improving both conditions (Challet-Bouju et al., 2017; Fortune & Goodie, 2012).

Our study has several practical implications. The demonstration that specific impulsivity pathways contribute to specific substance-related and addictive disorders/gambling disorder in patients with ADHD may aid targeted intervention efforts (Roberts et al., 2014). In our study, we underscore the specific contribution of negative urgency and positive urgency to problem gambling in ADHD patients: therapeutic approaches targeting emotional dysregulation should be systematically proposed to this population. To this end, Shaw et al. (2014) put forward the potential benefits of psychostimulants, selective serotonin reuptake inhibitors, and postsynaptic

alpha-2 adrenoceptor agonists, whose promising benefits should be confirmed in clinical populations. Other important therapeutic options (Mongia & Hechtman, 2012) include: (1) cognitive and behavioral therapy, which could help individuals with ADHD recognize and label emotions accurately, challenge emotions that are not appropriate, and cope with intense negative emotional reactions; (2) mindfulness training, which promotes a non-judgmental, present-centered focused awareness of emotions; and (3) cognitive training, which could improve executive functions such as working memory and planning abilities. In gamblers without ADHD, based on our results, we can assume that therapeutic approaches should include both treatments targeting emotion dysregulation, as mentioned above, as well as psychotherapeutic strategies targeting high sensation seeking and low premeditation (i.e., cognitive training). As pointed out by Hershberger et al. (2017), the measurement and targeting of impulsive personality traits in psychotherapy is an important step in the patient management as it has strong potential to improve clinical outcomes across substance-use disorders and a wide range of clinical problems and disorders. To implement therapeutic approaches assessing and targeting emotional dysregulation and impulsivity, ambulatory assessment could be a promising tool. Another implication is the need to assess ADHD systematically in male gamblers when determining the contribution of impulsivity facets to problem gambling: ADHD is a major risk factor for gambling disorder and a hidden disorder in this population (Grall-Bronnec et al., 2011) as well as a moderating variable of the relationships between impulsivity facets and problem gambling.

Our study's limitations include its cross-sectional design, which does not allow any causality interpretation; the use of self-administered scales based on adult symptoms to assess both ADHD (use of the ASRS may have increased the prevalence of self-reported ADHD) and problem gambling (use of the SOGS); and the specificity of our population (i.e., males with higher degrees of education than the overall population who gamble online and that play strategic games rather than both non-strategic and strategic games), which limits the generalizability of our findings. Another limitation is the lack of assessment of ADHD or gambling-related treatment. Future studies should take into account this variable as a potential confounding factor to better study the association between impulsivity facets, cognitive distortions and problem gambling in males with ADHD versus those without ADHD. Another limitation pertains to the latent structure of ADHD in adults: some authors stated that ADHD has a dimensional rather than a categorical latent structure in children and adolescents (Coghill & Sonuga-Barke, 2012), but we lack such studies in adults populations. Our main hypothesis was driven by a categorical approach, which is in line with the DSM-5, but future studies should better investigate what is

the exact latent structure of ADHD in adults. In the meantime, we may assume that future studies should use both a categorical and a dimensional approach that are two useful and complementary approaches.

Conclusion

In conclusion, our results support the hypothesis that different impulsivity facets are associated with problem gambling in male gamblers with versus without ADHD. In gamblers with ADHD, problem gambling is related to negative urgency and positive urgency, but not to sensation seeking, lack of perseverance or lack of premeditation; in gamblers without ADHD, however, problem gambling is related not only to negative urgency and positive urgency, but also to sensation seeking and lack of premeditation. Four out of the five cognitive distortions (i.e., illusion of control, gambling-related expectancies, and perceived inability to stop gambling) were associated with problem gambling, with no difference between gamblers with versus without ADHD. We obtained the same results when considering ADHD symptoms rather than ADHD status. Our study demonstrates the central role of emotion dysregulation as a potential vulnerability risk factor for problem gambling both in gamblers with and in those without ADHD, and the additional contribution of sensation seeking and lack of premeditation in problem gamblers without ADHD.

Data accessibility: all data are available on request.

References

- Abbott, M. W. (In Press). The changing epidemiology of gambling disorder and gambling-related harm : Public health implications. *Public Health*. <https://doi.org/10.1016/j.puhe.2020.04.003>
- American Psychiatric Association. (2013). *DSM-5: Diagnostic and Statistical Manual of mental disorders*. Washington, DC: American Psychiatric Press.
- Barrault, S., & Varescon, I. (2013). Cognitive distortions, anxiety, and depression among regular and pathological gambling online poker players. *Cyberpsychology, Behavior and Social Networking*, *16*(3), 183–188. <https://doi.org/10.1089/cyber.2012.0150>
- Belin, D., Mar, A. C., Dalley, J. W., Robbins, T. W., & Everitt, B. J. (2008). High Impulsivity Predicts the Switch to Compulsive Cocaine-Taking. *Science*, *320*(5881), 1352–1355. <https://doi.org/10.1126/science.1158136>
- Billieux, J., Rochat, L., Ceschi, G., Carré, A., Offerlin-Meyer, I., Defeldre, A.-C., ... Van der Linden, M. (2012). Validation of a short French version of the UPPS-P Impulsive Behavior Scale. *Comprehensive Psychiatry*, *53*(5), 609–615.
- Blaszczynski, A., & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction*, *97*(5), 487–499.
- Bonnaire, C., Bungener, C., & Varescon, I. (2017). Sensation seeking in a community sample of French gamblers: Comparison between strategic and non-strategic gamblers. *Psychiatry Research*, *250*, 1–9. <https://doi.org/10.1016/j.psychres.2017.01.057>
- Challet-Bouju, G., Bruneau, M., IGNACE Group, Victorri-Vigneau, C., & Grall-Bronnec, M. (2017). Cognitive Remediation Interventions for Gambling Disorder: A Systematic Review. *Frontiers in Psychology*, *8*, 1961. <https://doi.org/10.3389/fpsyg.2017.01961>
- Chamberlain, S. R., Stochl, J., Redden, S. A., Odlaug, B. L., & Grant, J. E. (2017). Latent class analysis of gambling subtypes and impulsive/compulsive associations: Time to rethink diagnostic boundaries for gambling disorder? *Addictive Behaviors*, *72*, 79–85. <https://doi.org/10.1016/j.addbeh.2017.03.020>
- Chrétien, M., Giroux, I., Goulet, A., Jacques, C., & Bouchard, S. (2017). Cognitive restructuring of gambling-related thoughts: A systematic review. *Addictive Behaviors*, *75*, 108–121. <https://doi.org/10.1016/j.addbeh.2017.07.001>
- Clark, L. (2014). Disordered gambling: the evolving concept of behavioral addiction. *Annals of the New York Academy of Sciences*, *1327*, 46–61. <https://doi.org/10.1111/nyas.12558>
- Coghill, D., & Sonuga-Barke, E. J. S. (2012). Annual Research Review : Categories versus dimensions in the classification and conceptualisation of child and adolescent mental disorders – implications of recent empirical study. *Journal of Child Psychology and Psychiatry*, *53*(5), 469–489. <https://doi.org/10.1111/j.1469-7610.2011.02511.x>
- Cyders, M. A., Littlefield, A. K., Coffey, S., & Karyadi, K. A. (2014). Examination of a short English version of the UPPS-P Impulsive Behavior Scale. *Addictive Behaviors*, *39*(9), 1372–1376. <https://doi.org/10.1016/j.addbeh.2014.02.013>

- Cyders, M. A., & Smith, G. T. (2008). Emotion-based Dispositions to Rash Action: Positive and Negative Urgency. *Psychological Bulletin*, *134*(6), 807–828. <https://doi.org/10.1037/a0013341>
- Cyders, M. A., Smith, G. T., Spillane, N. S., Fischer, S., Annus, A. M., & Peterson, C. (2007). Integration of impulsivity and positive mood to predict risky behavior: development and validation of a measure of positive urgency. *Psychological Assessment*, *19*(1), 107–118. <https://doi.org/10.1037/1040-3590.19.1.107>
- Ersche, K. D., Turton, A. J., Pradhan, S., Bullmore, E. T., & Robbins, T. W. (2010). Drug addiction endophenotypes: impulsive versus sensation-seeking personality traits. *Biological Psychiatry*, *68*(8), 770–773. <https://doi.org/10.1016/j.biopsych.2010.06.015>
- Fatséas, M., Alexandre, J.-M., Vénisse, J.-L., Romo, L., Valleur, M., Magalon, D., ... Grall-Bronnec, M. (2016). Gambling behaviors and psychopathology related to Attention-Deficit/Hyperactivity Disorder (ADHD) in problem and non-problem adult gamblers. *Psychiatry Research*, *239*, 232–238. <https://doi.org/10.1016/j.psychres.2016.03.028>
- Fayyad, J., Sampson, N. A., Hwang, I., Adamowski, T., Aguilar-Gaxiola, S., Al-Hamzawi, A., ... Collaborators, on behalf of the W. W. M. H. S. (2017). The descriptive epidemiology of DSM-IV Adult ADHD in the World Health Organization World Mental Health Surveys. *ADHD Attention Deficit and Hyperactivity Disorders*, *9*(1), 47–65. <https://doi.org/10.1007/s12402-016-0208-3>
- Fortune, E. E., & Goodie, A. S. (2012). Cognitive distortions as a component and treatment focus of pathological gambling: a review. *Psychology of Addictive Behaviors*, *26*(2), 298.
- Grall-Bronnec, M., Bouju, G., Sébille-Rivain, V., Gorwood, P., Boutin, C., Vénisse, J.-L., & Hardouin, J.-B. (2012). A French adaptation of the Gambling-Related Cognitions Scale (GRCS): A useful tool for assessment of irrational thoughts among gamblers. *Journal of Gambling Issues*, *(27)*, 1–21.
- Grall-Bronnec, M., Wainstein, L., Augy, J., Bouju, G., Feuillet, F., Vénisse, J.-L., & Sébille-Rivain, V. (2011). Attention deficit hyperactivity disorder among pathological and at-risk gamblers seeking treatment: a hidden disorder. *European Addiction Research*, *17*(5), 231–240. <https://doi.org/10.1159/000328628>
- Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Publications.
- Hershberger, A. R., Um, M., & Cyders, M. A. (2017). The relationship between the UPPS-P impulsive personality traits and substance use psychotherapy outcomes: A meta-analysis. *Drug and Alcohol Dependence*, *178*, 408–416.
- Kessler, R. C. A., Lenard A. Gruber. Michael J. Sarawate. Chaitanya A. Spencer. Thomas Van Brunt, David L. (2007). Validity of the World Health Organization Adult ADHD Self-Report Scale (ASRS) Screener in a representative sample of health plan members. *International Journal of Methods in Psychiatric Research*, *16*(2), 52–65.
- Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E., ... Spencer, T. (2005). The World Health Organization Adult ADHD Self-Report Scale (ASRS): a short screening scale for use in the general population. *Psychological Medicine*, *35*(2), 245–256.
- Kooij, S. J. J., Bejerot, S., Blackwell, A., Caci, H., Casas-Brugué, M., Carpentier, P. J., ... Fitzgerald, M. (2010). European consensus statement on diagnosis and treatment of adult ADHD: The European Network Adult ADHD. *BMC Psychiatry*, *10*(1), 67.

- Lejoyeux, M. (1999). Échelles de dépistage du jeu pathologique : Jeu pathologique [Screening scales of pathological gambling: Pathological gambling]. *Neuropsychologie*, *14*(2), 67–71.
- Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): a new instrument for the identification of pathological gamblers. *The American Journal of Psychiatry*, *144*(9), 1184–1188. <https://doi.org/10.1176/ajp.144.9.1184>
- Lopez, R., Dauvilliers, Y., Jaussent, I., Billieux, J., & Bayard, S. (2015). A multidimensional approach of impulsivity in adult attention deficit hyperactivity disorder. *Psychiatry Research*, *227*(2–3), 290.
- Lugoboni, F., Levin, F. R., Pieri, M. C., Manfredini, M., Zamboni, L., Somaini, L., ... Gruppo InterSert Collaborazione Scientifica Gics (2017). Co-occurring Attention Deficit Hyperactivity Disorder symptoms in adults affected by heroin dependence: Patients characteristics and treatment needs. *Psychiatry Research*, *250*, 210–216. <https://doi.org/10.1016/j.psychres.2017.01.052>
- Luo, S. X., & Levin, F. R. (2017). Towards Precision Addiction Treatment: New Findings in Co-morbid Substance Use and Attention-Deficit Hyperactivity Disorders. *Current Psychiatry Reports*, *19*(3), 14. <https://doi.org/10.1007/s11920-017-0769-7>
- Mathieu, S., Barrault, S., Brunault, P., & Varescon, I. (2017). Gambling Motives: Do They Explain Cognitive Distortions in Male Poker Gamblers? *Journal of Gambling Studies*. <https://doi.org/10.1007/s10899-017-9700-8>
- Miller, D. J., Derefinko, K. J., Lynam, D. R., Milich, R., & Fillmore, M. T. (2010). Impulsivity and Attention Deficit-Hyperactivity Disorder: Subtype Classification Using the UPPS Impulsive Behavior Scale. *Journal of Psychopathology and Behavioral Assessment*, *32*(3), 323–332. <https://doi.org/10.1007/s10862-009-9155-z>
- Mongia, M., & Hechtman, L. (2012). Cognitive behavior therapy for adults with attention-deficit/hyperactivity disorder: a review of recent randomized controlled trials. *Current Psychiatry Reports*, *14*(5), 561–567.
- Müller, K. W., Dreier, M., Beutel, M. E., & Wölfling, K. (2016). Is Sensation Seeking a correlate of excessive behaviors and behavioral addictions? A detailed examination of patients with Gambling Disorder and Internet Addiction. *Psychiatry Research*, *242*, 319–325. <https://doi.org/10.1016/j.psychres.2016.06.004>
- Pedersen, S. L., Walther, C. A. P., Harty, S. C., Gnagy, E. M., Pelham, W. E., & Molina, B. S. G. (2016). The indirect effects of childhood attention deficit hyperactivity disorder on alcohol problems in adulthood through unique facets of impulsivity. *Addiction*, *111*(9), 1582–1589. <https://doi.org/10.1111/add.13398>
- Polanczyk, G., de Lima, M. S., Horta, B. L., Biederman, J., & Rohde, L. A. (2007). The worldwide prevalence of ADHD: a systematic review and meta-regression analysis. *The American Journal of Psychiatry*, *164*(6), 942–948. <https://doi.org/10.1176/ajp.2007.164.6.942>
- Raylu, N., & Oei, T. P. (2004). The Gambling Related Cognitions Scale (GRCS): Development, confirmatory factor validation and psychometric properties. *Addiction*, *99*(6), 757–769.
- Roberts, W., Peters, J. R., Adams, Z. W., Lynam, D. R., & Milich, R. (2014). Identifying the facets of impulsivity that explain the relation between ADHD symptoms and substance use in a nonclinical sample. *Addictive Behaviors*, *39*(8), 1272–1277. <https://doi.org/10.1016/j.addbeh.2014.04.005>
- Romo, L., Rémond, J. J., Coeffec, A., Kotbagi, G., Plantey, S., Boz, F., & Kern, L. (2015). Gambling and Attention Deficit Hyperactivity Disorders (ADHD) in a Population of French Students. *Journal of Gambling Studies*, *31*(4), 1261–1272. <https://doi.org/10.1007/s10899-014-9515-9>

- Romo, L., Legauffre, C., Guilleux, A., Valleur, M., Magalon, D., Fatséas, M., ... Grall-Bronnec, M. (2016). Cognitive distortions and ADHD in pathological gambling: A national longitudinal case-control cohort study. *Journal of Behavioral Addictions*, 5(4), 649.
- Rossini-Dib, D., Fuentes, D., & Tavares, H. (2015). A naturalistic study of recovering gamblers: What gets better and when they get better. *Psychiatry Research*, 227(1), 17–26. <https://doi.org/10.1016/j.psychres.2015.03.003>
- Schluter, M. G., Kim, H. S., Poole, J. C., Hodgins, D. C., McGrath, D. S., Dobson, K. S., & Taveres, H. (2019). Gambling-related cognitive distortions mediate the relationship between depression and disordered gambling severity. *Addictive Behaviors*, 90, 318–323. <https://doi.org/10.1016/j.addbeh.2018.11.038>
- Shaw, P., Stringaris, A., Nigg, J., & Leibenluft, E. (2014). Emotional dysregulation and Attention-Deficit/Hyperactivity Disorder. *The American Journal of Psychiatry*, 171(3), 276.
- Stark, S., Zahlan, N., Albanese, P., & Tepperman, L. (2012). Beyond description: Understanding gender differences in problem gambling. *Journal of Behavioral Addictions*, 1(3), 123–134. <https://doi.org/10.1556/JBA.1.2012.3.5>
- Stinchfield, R. (2002). Reliability, validity, and classification accuracy of the South Oaks Gambling Screen (SOGS). *Addictive Behaviors*, 27(1), 1–19.
- Thompson, R. A. (1994). Emotion regulation: A theme in search of definition. *Monographs of the Society for Research in Child Development*, 59(2–3), 25–52.
- van de Glind, G., van den Brink, W., Koeter, M. W. J., Carpentier, P.-J., van Emmerik-van Oortmerssen, K., Kaye, S., ... Levin, F. R. (2013). Validity of the Adult ADHD Self-Report Scale (ASRS) as a screener for adult ADHD in treatment seeking substance use disorder patients. *Drug and Alcohol Dependence*, 132(3), 587–596. <https://doi.org/10.1016/j.drugalcdep.2013.04.010>
- Vitola, E. S., Bau, C. H. D., Salum, G. A., Horta, B. L., Quevedo, L., Barros, F. C., ... Grevet, E. H. (2017). Exploring DSM-5 ADHD criteria beyond young adulthood: phenomenology, psychometric properties and prevalence in a large three-decade birth cohort. *Psychological Medicine*, 47(4), 744–754. <https://doi.org/10.1017/S0033291716002853>
- Waluk, O. R., Youssef, G. J., & Dowling, N. A. (2016). The Relationship Between Problem Gambling and Attention Deficit Hyperactivity Disorder. *Journal of Gambling Studies*, 32(2), 591–604. <https://doi.org/10.1007/s10899-015-9564-8>
- Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, 30(4), 669–689.
- Whiteside, S. P., Lynam, D. R., Miller, J. D., & Reynolds, S. K. (2005). Validation of the UPPS impulsive behaviour scale: a four-factor model of impulsivity. *European Journal of Personality*, 19(7), 559–574.

TABLES

Table 1. Descriptive data of the whole sample (n = 287), and comparison between persons with versus without problem gambling

	Total sample (n=287)	Problem gambling (n=96)	No problem gambling (n=191)	OR [95% CI]
<i>Sociodemographic characteristics</i>				
Age (years)	34.1 ± 10.2	33.3 ± 10.0	34.5 ± 10.3	.99 [.96-1.01]
Educational level (completion of the baccalaureate or beyond)	88.9% (255)	88.5% (85)	89% (170)	1.05 [.48-2.27]
Marital status (married or in a relationship)	47% (135)	53.1% (51)	44% (84)	1.44 [.88-2.37]
<i>ADHD status (ASRS score ≥4)</i>				
“Trouble wrapping up the final details of a project, once the challenging parts have been done” (criteria met)	21.6% (62)	34.4% (33)	15.2% (29)	1.40[1.19-1.65]
“Difficulty getting things in order when having to do a task that requires organization” (criteria met)	57.8% (166)	63.5% (61)	55% (105)	1.43 [0.86-2.36]
“Problems remembering appointments or obligations” (criteria met)	48.8% (140)	59.4% (57)	43.5% (83)	1.90 [1.16-3.13]
“Avoiding or delaying getting started when a task requires a lot of thought” (criteria met)	36.2% (104)	46.9% (45)	30.9% (59)	1.97 [1.19-3.27]
“Fidgeting or squirming with hands or feet when having to sit down for a long time” (criteria met)	27.9% (80)	39.6% (38)	22% (42)	2.32 [1.36-3.96]
“Feeling overly active and compelled to do things” (criteria met)	33.8% (97)	42.7% (41)	29.3% (56)	1.80 [1.08-2.99]
ADHD symptoms (ASRS score)	15% (43)	21.9% (21)	11.5% (22)	2.15 [1.12-4.15]
<i>Gambling disorder</i>				
Gambling severity (SOGS score)	2.2 ± 1.6	2.7 ± 1.6	1.9 ± 1.5	1.40[1.19-1.65]
Prevalence of problem gambling	2.4 ± 2.7	5.3 ± 2.6	.9 ± .7	-
<i>Impulsivity facets (UPPS-P)</i>				
Negative urgency	33.4% (96)	-	-	-
Positive urgency	8.2 ± 3.0	9.5 ± 3.1	7.5 ± 2.7	1.26 [1.15-1.38]
Lack of premeditation	9.3 ± 2.9	10.5 ± 8.7	8.7 ± 2.7	1.26 [1.15-1.39]
Lack of perseverance	6.8 ± 2.2	7.5 ± 2.4	6.5 ± 2.1	1.23[1.10-1.38]
Sensation seeking	8.2 ± 2.7	8.6 ± 2.7	8.0 ± 2.7	1.08 [0.99-1.19]
<i>Gambling-related cognitions (GRCS)</i>				
Interpretative control/bias	9.6 ± 2.4	10.4 ± 2.1	9.2 ± 2.5	1.25 [1.12-1.40]
Illusion of control	15.5 ± 5.0	15.8 ± 5.5	15.3 ± 4.7	1.02 [0.97-1.07]
Predictive control	5.9 ± 3.5	7.1 ± 4.6	5.3 ± 2.6	1.16 [1.07-1.25]
Gambling-related expectancies	15.8 ± 5.7	16.9 ± 6.3	15.3 ± 5.3	1.05 [1.01-1.10]
Perceived inability to stop gambling	14.1 ± 4.6	15.6 ± 4.9	13.4 ± 4.4	1.11 [1.05-1.18]
	12.9 ± 7.0	17.4 ± 7.6	10.6 ± 5.4	1.17 [1.12-1.22]

Note. Descriptive data are presented as mean \pm standard deviation (SD) or percentage (number). ADHD: attention-deficit/hyperactivity disorder; ASRS: Adult ADHD Self-Report Scale; GRCS: Gambling-Related Cognitions Scale; SOGS: South Oaks Gambling Screen; UPPS-P: UPPS Impulsive Behavior Scale, short version.

Table 2. Correlation matrix between gambling severity, ADHD symptoms, impulsivity facets, gambling-related cognitions, and age in the whole sample

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Gambling severity (SOGS total)	-												
2. ADHD symptoms (ASRS)	.26***	-											
3. Negative urgency (UPPS-P)	.38***	.20***	-										
4. Positive urgency (UPPS-P)	.38**	.30***	.66***	-									
5. Lack of premeditation (UPPS-P)	.24***	.15*	.41***	.43***	-								
6. Lack of perseverance (UPPS-P)	.16**	.32***	.26***	.26***	.39***	-							
7. Sensation seeking (UPPS-P)	.27***	.18**	.34***	.47***	.40***	.09	-						
8. Interpretative control/bias (GRCS)	.15*	.27***	.14*	.08	-.05	.12*	.09	-					
9. Illusion of control (GRCS)	.18**	.24***	.18**	.27***	.18**	.05	.15*	.11	-				
10. Predictive control (GRCS)	.11	.19**	-.04	.08	-.04	-.02	.13*	.44***	.31***	-			
11. Gambling-related expectancies (GRCS)	.24***	.19**	.01	.19**	.01	.08	.14*	.38***	.22***	.36***	-		
12. Perceived inability to stop gambling (GRCS)	.47***	.24***	.23***	.46***	.23***	.20***	.22***	.27***	.24***	.24***	.53***	-	
13. Age	-.14*	-.19**	.11	-.04	.11	.01	-.10	-.22***	.06	-.07	-.04	.04	-

Note. We used Spearman's correlation tests because some variables did not meet normality assumptions. Gambling severity was assessed using the South Oaks Gambling Screen (SOGS) total score. ADHD symptoms were assessed using the Adult ADHD Self-Report Scale (ASRS). Impulsivity facets were assessed using the UPPS Impulsive Behavior Scale, short version (UPPS-P). Gambling-related cognitions (i.e., interpretative control/bias, illusion of control, predictive control, gambling-related expectancies, perceived inability to stop gambling) were assessed using the Gambling Related Cognition Scale (GRCS).

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3. Predictors of problem gambling in multivariate logistic regressions, with a comparison between persons with versus without ADHD

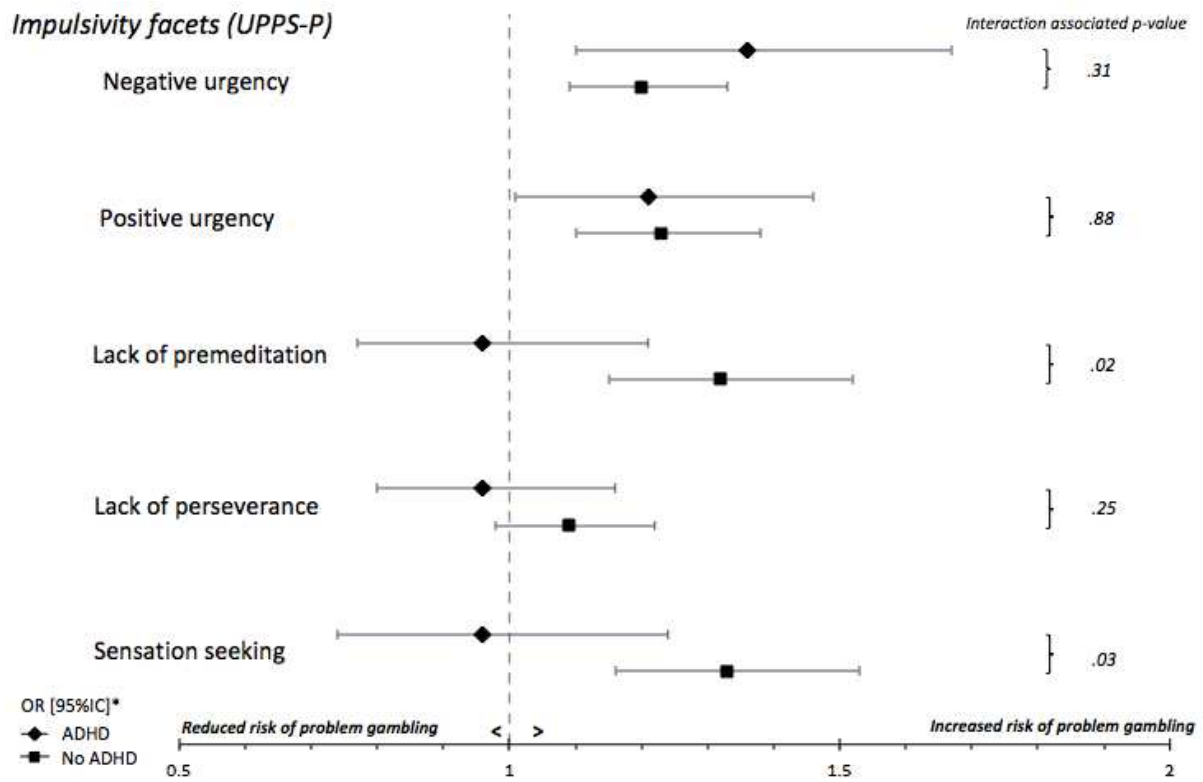
	Multivariate logistic regressions*		
	ADHD	No ADHD	Interaction
	OR [95% CI]	OR [95% CI]	<i>p-value</i>
<i>Marital status</i>	-	-	-
<i>ASRS status</i>	-	-	-
<i>ASRS score</i>	-	-	-
<i>Impulsivity facets (UPPS-P)</i>			
Negative urgency	1.36 [1.10-1.67]	1.20 [1.09-1.33]	.31
Positive urgency	1.21 [1.01-1.46]	1.23 [1.10-1.38]	.88
Lack of premeditation	0.96 [0.77- 1.21]	1.32 [1.15-1.52]	.02
Lack of perseverance	0.96 [0.80-1.16]	1.09 [0.98-1.22]	.25
Sensation seeking	0.96 [0.75- 1.24]	1.33 [1.16- 1.53]	.03
<i>Gambling-related cognitions (GRCS)</i>			
Interpretative control/bias	0.99 [0.89-1.10]	1.01 [0.95-1.08]	.71
Illusion of control	1.09 [0.98-1.22]	1.18 [1.06-1.32]	.32
Predictive control	1.05 [0.96-1.15]	1.04 [1.00-1.10]	.92
Gambling-related expectancies	1.06 [0.95-1.18]	1.13 [1.05-1.21]	.35
Perceived inability to stop gambling	1.24 [1.11-1.38]	1.14 [1.08-1.19]	.16

*adjusted for marital status and ADHD status (ADHD considered as a dichotomous variable).

Note. We present here the Odds ratio of the association between a given impulsivity facet and problem gambling in each group (gamblers with or without ADHD), as well as the association between a given gambling-related cognition and problem gambling in each group (gamblers with or without ADHD), and we compared the odds-ratio between these two groups (test for interaction effect). ADHD: Attention-deficit/hyperactivity disorder; ASRS: Adult ADHD Self-Report Scale; GRCS: Gambling-Related Cognitions Scale; UPPS-P: UPPS Impulsive Behavior Scale, short version.

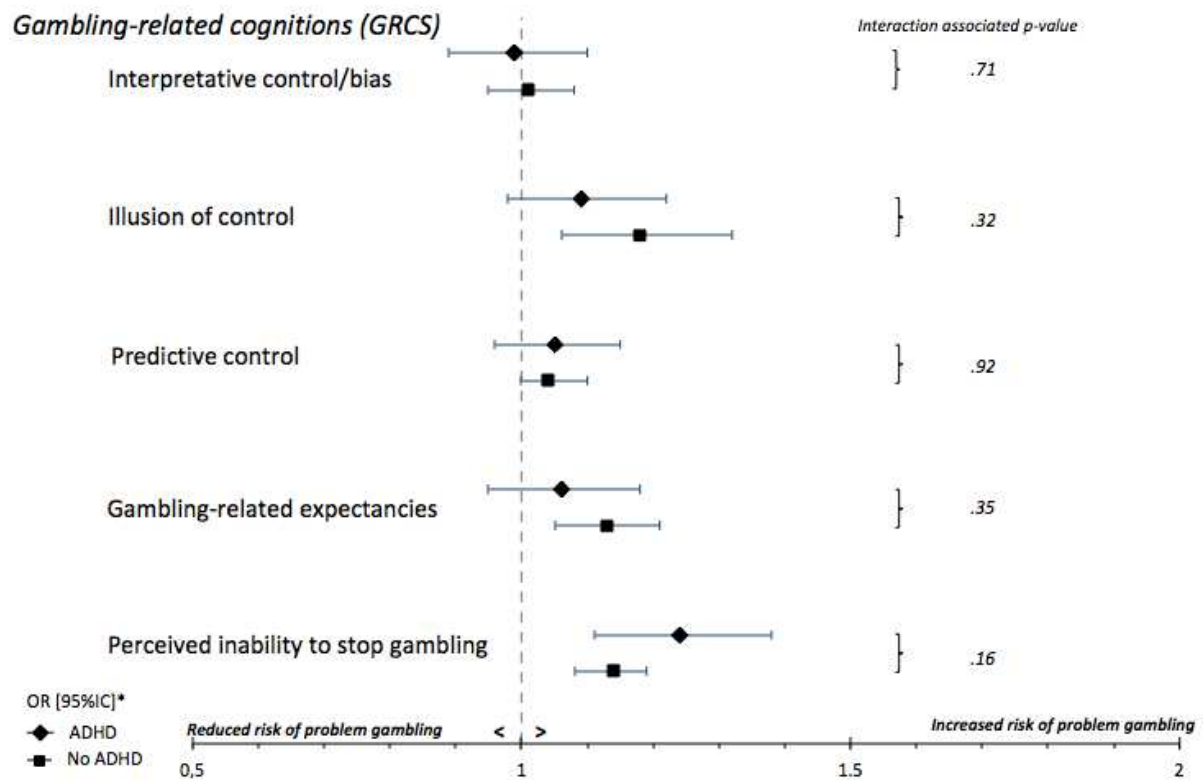
FIGURES

Figure 1. Association between impulsivity facets and problem gambling: comparison between gamblers with versus without ADHD



Note. We present here forest plots based on fitted multiple logistic regression models (dependent variable: problem gambling; independent variables: a given impulsivity facet, ADHD status, marital status, and the interaction term “a given impulsivity facet*ADHD status”). Multivariate models were adjusted for marital status. ADHD: attention-deficit/hyperactivity disorder; OR: Odds-ratio; UPPS-P: UPPS Impulsive Behavior Scale, short version.

Figure 2. Association between gambling-related cognitions and problem gambling: comparison between gamblers with versus without ADHD



Note. We present here forest plots based on fitted multiple logistic regression models (dependent variable: problem gambling; independent variables: a given gambling-related cognition, ADHD status, marital status, and the interaction term “a given gambling-related cognition*ADHD status”). Multivariate models were adjusted for marital status. ADHD: attention-deficit/hyperactivity disorder; GRCS: Gambling-related cognition scale; OR: Odds-ratio; UPPS-P: UPPS Impulsive Behavior Scale, short version.