tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

American Psychological Association | ibnec

Psychology & Neuroscience

1983-3288/18/$12.00

http://dx.doi.org/10.1037/pne0000133

Acute Effects of Alcohol Intoxication on Decision Making and Impulsivity in At-Risk Gamblers With or Without Problematic Dinking

AQ: 1

AQ: au

Belén del Valle Vera and Angelina Pilatti

AQ: 2

Universidad Nacional de Córdoba and Consejo Nacional de Investigaciones Científicas y Técnicas, Córdoba, Argentina

Javier Garimaldi

Universidad Nacional de Córdoba

Ricardo Marcos Pautassi

Universidad Nacional de Córdoba and Consejo Nacional de Investigaciones Científicas y Técnicas, Córdoba, Argentina

The study analyzed decision making under ambiguity and risk, impulsivity, and acute effects of alcohol intoxication on these processes in subjects exhibiting either one, both, or none of these conditions: problem drinking and at-risk gambling involvement. Subjects (N = 110, ages 18–57; 57.3% men) were evaluated on the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994), the Game of Dice Task (GDT; Brand et al., 2005) and the Go-Stop Impulsivity Paradigm (GoStop; Dougherty, Mathias, & Marsh, 2003) before and after the ingestion of an alcohol (inducing ≈0.45 g/kg) or a placebo drink. At-risk gamblers (ARG+) showed better performance on the IGT than not-at-risk gamblers and nongamblers (ARG−). ARG+ and subjects intoxicated with alcohol picked more cards than their respective controls from the high frequency of punishment decks. ARG+ without problematic drinking exhibited greater impulsivity in the GoStop (i.e., exhibited a significantly lower percentage of response inhibition at the 50-ms latency) after the ingestion of alcohol. GDT scores were unaffected by gambling, problem drinking, or acute alcohol dosing. The study confirmed the facilitatory effect of acute alcohol on impulsivity. A new and important finding was the altered IGT performance in ARGs. This is particularly striking when considering that these are not pathological gamblers. Apparently, even this low level of gambling severity is sufficient to alter decision making. The lower level of sensitivity to frequency of punishment apparently improved performance in this population, but it can present risk for the development of more severe gambling behaviors, particularly when considering that the acute alcohol treatment increased their impulsivity and had an independent effect upon sensitivity to punishment.

Keywords: decision making, impulsivity, problematic drinking, gambling, alcohol intoxication

Impulsivity and decision making (DM) are two key features of neuropsychological assessment of addictive behaviors, problem drinking in particular (Everitt & Robbins, 2005; Verdejo-García, Lawrence, & Clark, 2008). DM refers to the ability to choose the most optimal alterna-

AQ: 5 AQ:6-7 Belén del Valle Vera and Angelina Pilatti, Facultad de Psicología, Universidad Nacional de Córdoba and Instituto de Investigaciones Psicológicas, Unidad Ejecutora, Consejo Nacional de Investigaciones Científicas y Técnicas, Córdoba, Argentina; Javier Garimaldi, Facultad de Psicología, Universidad Nacional de Córdoba; Ricardo Marcos Pautassi, Facultad de Psicología, Universidad Nacional de Córdoba and Instituto de Investigación Médica M. y M. Ferreyra, Consejo Nacional de Investigaciones Científicas y Técnicas.

Correspondence concerning this article should be addressed to Angelina Pilatti, Facultad de Psicología, Universidad Nacional de Córdoba, Enrique Barros y Enfermera Gordillo s/n. Ciudad Universitaria Córdoba 5000, Argentina. E-mail: angelinapilatti@conicet.gov.ar

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

tive after weighing rewarding and punishing consequences associated with different response options (Starcke & Brand, 2012). DM can be classified based on the available information about the possible outcomes. Decisions under ambiguity are those in which the possible outcomes and the probability of occurrence are unknown, whereas decisions under risk are those in which the probability of occurrence of different results is known or calculable (Brand, Recknor, Grabenhorst, & Bechara, 2007).

DM under ambiguity and under risk can be assessed by the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) and the Game of Dice Task (GDT; Brand et al., 2005), respectively. Subjects with alcohol- or other substance-use disorders (Dolan, Bechara, & Nathan, 2008; Kim, Sohn, & Jeong, 2011; Miranda, MacKillop, Meyerson, Justus, & Lovallo, 2009; van Toor et al., 2010), or those exhibiting chronic binge drinking (a problematic alcohol-use pattern not necessarily associated with alcohol-use disorder [AUD]; Goudriaan, Grekin, & Sher, 2011) have been shown to exhibit more disadvantageous choices in the IGT than healthy controls. Subjects diagnosed with AUD also exhibited impaired DM under risk (i.e., reduced number of safe elections on the GDT, Kim et al., 2011).

Impulsivity is a multidimensional construct that comprises the tendency to act with little or insufficient planning and with diminished regard for the immediate and long term consequences (Cyders et al., 2007). Behavioral impulsivity is usually classified as (a) motor (i.e., the inability to inhibit an ongoing action), (b) cognitive (i.e., the inability to gather the available information to select the most adequate behavioral response and the tendency to prefer riskier instead of more conservative options), and (c) choice (i.e., the tendency to prefer a small but immediate reward over a larger but delayed reward) impulsivity (Rogers, Moeller, Swann, & Clark, 2010). Alcohol-dependent subjects, when compared with healthy controls, tend to exhibit impaired performance in tasks evaluating inhibitory control and cognitive impulsivity (Bjork, Hommer, Grant, & Danube, 2004; Lawrence, Luty, Bogdan, Sahakian, & Clark, 2009), and also display both slower stop-signal and go-signal reaction times (RTs; Lawrence et al., 2009). These deficits are probably related to neural changes resulting from chronic, heavy alcohol exposure. But similar deficits can also arise after more modest alcohol exposure. Among social drinkers, deficits in inhibitory control have been positively associated to the level of alcohol consumption (Weafer, Millich, & Fillmore, 2011) and to the presence of heavy episodic drinking (Henges & Marczinski, 2012).

These findings and others (see Verdejo-Garcia et al., 2008) indicate impulsivity and DM are altered in subjects with AUD and also in those who do, despite not meeting the criteria for an alcohol-disorder, engage in heavy episodic drinking patterns (e.g., binge drinkers). Of special interest for the present study is that these processes are similarly impaired after acute (Dougherty, Marsh-Richard, Hatzis, Nouvion, & Mathias, 2008) and chronic (Clark & Robbins, 2002; Dalley, Everitt, & Robbins, 2011) alcohol administration to participants without AUD or a problematic drinking pattern. Social drinkers given an acute dose of alcohol have exhibited dose-dependent increases in DM under risk on the Risk-Taking Task (George, Rogers, & Duka, 2005; Lane, Cherek, Pietras, & Tcheremissine, 2004). This population has also exhibited acute, ethanol-induced behavioral impulsivity (Fillmore, Ostling, Martin, & Kelly, 2009; Reynolds, Richards, & de Wit, 2006). Taken together, these results indicate that impulsivity and DM seem to be altered in subjects with problematic drinking and, vice versa, that acute alcohol drinking increases impulsive behavior and alters DM.

Gambling, the act of placing a wager (generally money) under the uncertain hope of getting a larger return, ranges from recreational to problematic and pathological gambling (Franco, Maciejewski, & Potenza, 2011). Problem gamblers have been shown to have poorer decision-making abilities in a motor-inhibition task (Grant, Chamberlain, Schreiber, Odlaug, & Kim, 2011), and pathological gamblers have exhibited, similarly to problem drinkers, alterations in DM (Clark, 2010; Verdejo-García et al., 2008) and impulsivity (Brevers et al., 2012). Some alterations have been observed even in recreational gamblers (i.e., persons who engage in any type of gambling activity but who do not fulfill the criteria for problem or pathological gambling). Specifically, recreational gamblers with a diagnosis of substance abuse have displayed heavier gambling and had different gam-

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

bling motivations than gamblers without substance use (Liu, Maciejewski, & Potenza, 2009). Moreover, recreational gamblers who exhibit higher levels of excitement seeking engage in more frequent gambling behaviors and display greater gambling symptomatology than those with lower levels of excitement seeking, a trait resembling impulsivity (McDaniel & Zuckerman, 2003; Pantalon, Maciejewski, Desai, & Potenza, 2008), suggesting an association between gambling involvement and some aspects of impulse control (i.e., sensation seeking).

The study of subjects with different levels of gambling severity holds promise as a means to clarify the progression from recreational to pathological gambling (Odlaug, Chamberlain, Kim, Schreiber, & Grant, 2011). This type of study may reveal cognitive deficits that precede the onset of pathological gambling (Odlaug et al., 2011). Little is known about DM and impulsivity processes in at-risk gamblers (ARGs; i.e., gamblers with low level of gambling severity) or in ARGs with a coexistence of problematic drinking. Also unknown is whether acute alcohol intake has different effects in these groups of subjects. The present study analyzed, in subjects with both problematic drinking and at-risk for problem gambling, only one, or none of these conditions: (a) shared and unique deficits in impulsivity and decision making, and (b) the effect of an acute dose of alcohol on impulsivity, as measured by the Go-Stop Impulsivity Paradigm (GoStop task; Dougherty, Mathias, & Marsh, 2003) and decision-making processes, as measured with the IGT (Bechara et al., 1994) and the GDT (Brand et al., 2005).

Method and Materials

Experimental Design

We used the following 2 × 2 × 2 factorial design: Problematic Dinking (PD+ or PD−) × At-Risk Gambling (ARG+ or ARG−) × Alcohol Dose (active placebo target BrAC = 0.01% or alcohol target BrAC = 0.05%). Participants were evaluated before and after treatment (i.e., pretreatment and posttreatment phases).

Recruitment and Selection Criteria

Participants were recruited through advertisements on social networks, newspapers, e-mail lists and flyers located on the campus of the National University of Córdoba (Argentina), or in the surrounding area. The advertisement asked for volunteers, ages 18 to 60, willing to participate in an alcohol and gambling study. Interested individuals completed a telephone screening and were included if they reported: (a) one or more last-month drinking episodes resulting in alcohol intoxication similar to that induced by the dose administered in the study, and (b) no psychiatric, neurological or clinical conditions, current treatment for alcohol or gambling disorders, current consumption of psychopharmacological medication (Fillmore & Weafer, 2012). Women also reported no chance of being pregnant and absence of breast-feeding.

The Alcohol Use Disorder Identification Test (AUDIT, Rubio Valladolid, Bermejo Vicedo, Caballero Sánchez-Serrano, & Santo-Domingo Carrasco, 1998) and the South Oaks Gambling Screen (SOGS, South Oaks Foundation, 1986) were employed to classify participants in each of the study conditions. Participants who scored ≥1 on the SOGS were identified as ARG+ and those scoring 0 were identified as not-ARGs/nongamblers (ARG−). Participants with a score ≥8 on the AUDIT (Allen, Reinert, & Volk, 2001) were classified as PDs+, whereas those with lower scores (i.e., <8) were categorized as PDs−).

Participants

One-hundred ten participants (57.3% men, M_{age} = 24.69 years, SD = 5.76) completed the study. Age and mean years of education were statistically similar across the groups ($p \geq .05$). Fifty-four participants were assigned to the placebo and 56 to the alcohol condition. A similar percentage of men and women were included in each condition ($\chi^2 = .001$, $p = .978$). Table 1 T1 describes sociodemographic variables and the occurrence of alcohol and gambling behaviors for PD+/ARG+, PD+/ARG−, PD−/ARG+, and PD−/ARG− groups. PD+ participants, compared with PD− participants, scored significantly higher on AUDIT, $F_{(1.108)} = 233.13$, $p < .001$, ($\eta^2 = 0.68$), drank significantly more grams of alcohol per drinking occasion, $F_{(1.108)} = 73.94$, $p < .001$, ($\eta^2 = 0.41$), and per month, $F_{(1.108)} = 55.7$, $p < .001$, ($\eta^2 = 0.34$), and had more drinking days per month, $F_{(1.108)} = 25.65$,

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

Table 1
AUDIT and SOGS Scores, Percentage of Regular Gamblers, and Indicators of Alcohol Consumption Patterns in the Total Sample and in Participants Exhibiting Gambling or Not Gambling (ARG+ and ARG−, Respectively), and With or Without Problematic Drinking (PD+ and PD−, Respectively)

		PD−		PD+	
Variables	Total (N = 110)	ARG− (n = 34)	ARG+ (n = 23)	ARG− (n = 30)	ARG+ (n = 23)
Sociodemographics					
Gender (men)	57.3%	52.9%	60.9%	46.7%	73.9%
Age	24.7 ± 5.7	25.9 ± 7.9	25 ± 5.5	24.7 ± 4.4	22.6 ± 2.7
Years of education	14.8 ± 2	15.1 ± 2.1	14.5 ± 1.7	15.1 ± 1.9	14.4 ± 2.2
Drinking behavior					
AUDIT Score	8.1 ± 3.9	4.5 ± 1.2	5.8 ± 2.2	11.1 ± 2.4	11.8 ± 2.7
Grams per drinking occasion	113.5 ± 66.2	69.8 ± 34.3	77.7 ± 44.5	142.4 ± 49.3	176.3 ± 72.4
Grams per month	567.5 ± 5629	239.7 ± 157.9	270.8 ± 232.9	919.8 ± 628.7	888.9 ± 649.5
Drinking days per month	5.8 ± 3.8	4 ± 2.6	4.5 ± 3.4	8.2 ± 3.9	6.7 ± 3.9
Prevalence of heavy episodic drinking	75.5%	55.9%	60.9%	93.3%	95.7%
Gambling behavior					
SOGS Score	.98 ± 1.47	0	2 ± 1.24	0	2.69 ± 1.49
Frequent gambler	30.9%	8.8%	47.8%	16.7%	65.2%

Note. AUDIT = Alcohol Use Disorder Identification Test; SOGS = South Oaks Gambling Screen.

$p < .01$, ($\eta^2 = 0.19$). Furthermore, PD+ participants were more likely to exhibit heavy episodic drinking (>56/70 g per drinking occasion, women and men, respectively) compared with PD− ($\chi^2 = 30.38$, $p < .001$). ARG+ participants scored significantly higher on the SOGS (South Oaks Foundation, 1986), $F_{(1.108)} = 180.17$, $p < .001$, ($\eta^2 = 0.62$), and were more likely to be frequent gamblers (gamble at least once a month) than ARG− ($\chi^2 = 41.8$, $p < .001$).

Measures

IGT. The IGT (Bechara et al., 1994) was developed to assess decision making. Participants were instructed to win as much fictitious money as possible within 100 trials. On each trial, the participant had to choose one card at a time from four decks. Decks A and B produce larger rewards but also larger losses (disadvantageous decks) while decks C and D produce smaller rewards but also smaller losses (advantageous decks). Decks A and C have low-magnitude/high-frequency punishments, whereas Decks B and D have high-magnitude/low-frequency punishments (Steingroever, Wetzels, Horstmann, Neumann, & Wagenmakers, 2013).

GoStop. The GoStop task (Dougherty, Mathias, & Marsh, 2003) was designed to measure response inhibition. Series of five-digit numbers were displayed for 500 ms. Half of the numbers were target trials (matching stimuli: numbers matching the number that appeared above) and half were filler trials (nonmatching stimuli). The stop trial, which corresponds to half of the target trials, consists of numbers that change from black to red at 50, 150, 250 or 350 ms after the stimulus appears in the center of the monitor. Subjects were required to respond while the number was still on the screen. Participants were instructed to inhibit their responses on trials in which the number turned from black to red (i.e., stop trials). The failure to withhold a response to the red "stop" stimulus was a response-inhibition failure. The dependent measure was the percentage of correct inhibited responses after the stop signal appeared for each of the latencies. Lower percentages were indicative of greater impulsivity.

GDT. The GDT (Brand et al., 2005) was designed for assessing participants' aversion/attraction to make risky decisions. Participants were instructed to increase their fictitious capital within 30 throws of the dice. On each trial, they could choose between single numbers (i.e., three) or a combination of two (i.e., five and six), three (i.e., one, two, three) or four (i.e., one, two, three and four) numbers. The subjects knew the probability of winning/losing. The choice for a single number and for a combina-

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

tion of two, three, and four numbers consisted of a $1,000, $500, $200 and $100 gain/loss, respectively. The probability of winning with choices of a single number or a combination of two numbers is less than 50% (i.e., risky decisions). The probability of winning with combinations of three or four numbers is higher than 50% (i.e., safe decisions). The total net score results from the subtraction between safe and risky elections.

Subjective Intoxication Scale. Participants rated how intoxicated they felt by placing a mark on a line with values from 0 (*not at all intoxicated*) to 10 (*very intoxicated*; Fillmore & Blackburn, 2002).

Procedure

Upon arriving at the lab, the experimenter explained to the participant the procedure and cleared any questions. The participant signed an informed consent and then was submitted to a breathalyzer test to ensure a baseline breath-alcohol concentration (BrAC) of zero. He or she then completed the pretreatment phase (approximately 40 min) in the following order: IGT, GoStop, and GDT. Subsequently, the participant had 10 min to drink the beverage, which had been prepared out of his or her sight by mixing ethyl alcohol (Porta Hermanos, Córdoba, Argentina, 96%) and a grapefruit flavored soda as a vehicle in a 1:7 proportion. The placebo, prepared with a small volume of alcohol and flat tonic water to complete the rest of the placebo part, had two drops of rum on the top to enhance the credibility of the placebo. Assignment to the alcohol-dose condition (i.e., alcohol or active placebo) was random.

The volume of alcohol to be consumed by each participant was calculated with the Blood Alcohol Concentration Calculator software (Curtin, 2000) by entering the participants' weight and sex with a target BrAC of 0.05% (≈0.40 and 0.46 g/kg for women and men respectively: the alcohol condition) or 0.01 (≈0.13 and 0.15 g/kg for women and men respectively: the active placebo condition), depending on their assigned treatment condition.

Participants rinsed their mouths out with water 10 min after finishing the beverage, and 5 min later, the experimenter registered the BrAC levels and the first subjective intoxication rating. Posttreatment tests then began. Participants underwent the same procedure (i.e., measurement of BrAC and the subjective intoxication rating) before each computerized task within posttesting (i.e., 15, 25, and 40 min. postalcohol administration) and at the end of the last task. The tasks were completed in the same order as described for the pretest (i.e., IGT, GoStop, and GDT) to ensure that BrACs at the time of task administration were held constant within groups.

The University Internal Review Board approved all study procedures and the National Agency for Promotion of Science and Technology (FONCyT) reviewed the protocol.

Dependent Variables and Statistical Analysis

The main dependent variable in the IGT was the total net score, (C + D) – (A + B). Advantageous and disadvantageous elections and sensitivity to frequency of punishment, (B + D) – (A + C), were also separately examined. The dependent variables in the GoStop task and in the GDT were the percentage of response inhibition at each of the tested latencies (50, 150, 250 and 350ms), the total net score and the total number of safe and risky elections, respectively. Pre- and posttreatment scores for each of these variables were independently analyzed via repeated-measures analyses of variance (RM ANOVAs, between factors: ARG, PD, and alcohol dose; RMs: pre- and posttreatment scores, also referred to as time or time of measurement in the description of results). BrACs and subjective intoxication-perception scores were analyzed in participants given the alcohol drink via RM ANOVA (peak BrAC after placebo was 0.002%).

The main significant effects and significant interactions yielded by the ANOVAs were explored using Tukey's post hoc test and planned comparisons. Tukey was used for the analysis of significant main effects or significant interactions comprising between-group variables. We employed planned comparisons to explore significant main effects or interactions that involved RM s. The underlying logic is that there is no post hoc test that properly handles Type-I error in interactions comprising between and within factors (Winer, Brown, & Michels, 1991). Given this absence, planned comparisons are an alternative with a suitable compro-

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

mise between power and reliability. Alpha level was $\leq .05$.

Results

IGT (Becharaet al., 1994)

The RM ANOVA for total net scores yielded significant main effects of time, $F_{(1.102)} = 40.91$, $p < .001$, ($\eta^2 = 0.29$) and ARG, $F_{(1.102)} = 7.28$, $p < .01$, ($\eta^2 = 0.67$). As depicted in F1 Figure 1, greater net scores were found in the posttreatment assessment compared with the pretreatment, and ARG+ exhibited significantly greater overall net scores than ARG−. Neither PD nor alcohol dose significantly affected IGT net scores, nor were they involved in any significant interaction.

The RM ANOVA on number of cards selected from the advantageous decks (C and D) showed significant main effects of type of deck, $F_{(1,102)} = 35.35$, $p < .001$, ($\eta^2 = 0.26$), time of measurement, $F_{(1,102)} = 40.91$, $p < .001$, ($\eta^2 = 0.29$) and ARG, $F_{(1,102)} = 7.28$, $p < .01$, ($\eta^2 = 0.07$). The interaction between ARG and type of deck reached statistical significance, $F_{(1.102)} = 5.01$, $p < .05$, ($\eta^2 = 0.05$). Post hoc analyses revealed that ARG+ subjects ($M = 29.39$, $SD = 13.99$) selected significantly more cards from Deck C than ARG− subjects ($M = 21.68$, $SD = 10.14$). The three-way interactions between time, type of deck, and ARG, $F_{(1.102)} = 7.34$, $p < .01$, ($\eta^2 = 0.07$) and between time, type of deck, and alcohol dose, $F_{(1.102)} = 7.37$, $p < .01$, ($\eta^2 = 0.07$) were also significant. The planned comparison for pretest scores showed greater selection of cards from Deck C than from Deck D, in both ARG+ and ARG− participants. During the posttest, however, ARG+ participants selected significantly more cards from Deck C than ARG−. Selections from Deck D were similar across groups. The planned comparisons also indicated that, during

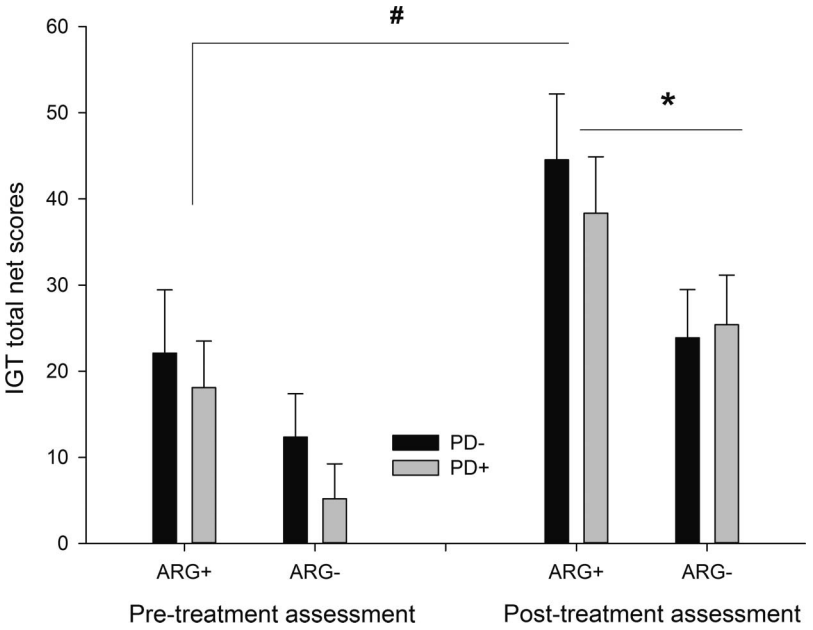

Figure 1. Total net scores obtained in the IGT during pre- and posttreatment assessments, in participants exhibiting ARG+ or ARG− behaviors and with PD+ or PD−, respectively. Data is presented collapsed across treatment (i.e., alcohol or placebo drink). This factor did not significantly affect IGT net scores, nor was involved in any significant interaction. The statistical analysis revealed significantly greater scores during the posttreatment, compared with the pretreatment, and significantly greater overall scores ARG+ than in ARG−. These effects are indicated by the pound and the asterisk, respectively. The vertical bars illustrate the *SEM*.

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

the pretest, cards from Deck D were significantly more selected than those from Deck C. During the posttest, those who received alcohol, but not their placebo counterparts, selected significantly more cards from Deck C than from Deck D.

The RM ANOVA for number of cards selected from the disadvantageous decks (A and B) showed main effects of type of deck, $F_{(1,102)} = 120.87$, $p < .001$, ($\eta^2 = 0.54$), time of measurement, $F_{(1,102)} = 40.91$, $p < .001$, ($\eta^2 = 0.29$), and ARG, $F_{(1,102)} = 7.28$, $p < .01$, ($\eta^2 = 0.07$). Post hoc analysis revealed that the participants made fewer disadvantageous elections during the posttest ($M = 43.18$, $SE = 1.36$ and $M = 34.18$, $SE = 1.6$, for the pre- and posttest respectively) and selected more cards from Deck B ($M = 25.05$, $SE = 1.05$) than from Deck A ($M = 13.63$, $SE = 0.53$). ARG+ ($M = 34.62$, $SE = 2.03$) made fewer selections from disadvantageous decks than ARG− ($M = 41.6$, $SE = 1.64$).

The RM ANOVA for frequency of punishment, (B + D) – (A + C) showed main effects of time of measurement, $F_{(1.102)} = 4.69$, $p < .05$, ($\eta^2 = 0.04$) and ARG, $F_{(1.102)} = 5.92$, $p < .05$, ($\eta^2 = 0.05$). The interactions between ARG and time, $F_{(1.102)} = 3.93$, $p < .05$, ($\eta^2 = 0.04$) and between alcohol dose and time reached significance, $F_{(1.102)} = 5.87$, $p < .05$, ($\eta^2 = 0.05$). The planned comparison indicated similar sensitivity to punishment in ARG+ and ARG−, and in subjects assigned to the alcohol or placebo conditions, during the pretest measurement. During the posttreatment, ARG+ exhibited significantly less sensitivity to punishment than ARG−, and those intoxicated with alcohol, compared with those given placebo, picked more cards from the high-punishment decks, exhibiting a lower sensitivity to frequency of punishment. These results are depicted in Figure 2. F2

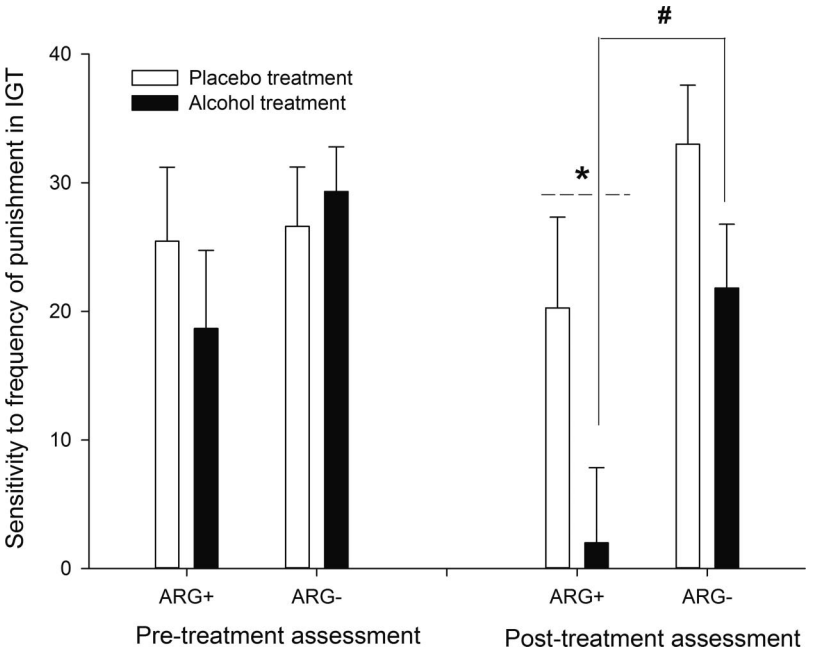

Figure 2. Sensitivity to frequency of punishment in the Iowa Gambling task, (B + D) − (A + C), in participants exhibiting at-risk (ARG+) or not-at-risk/non gambling (ARG−) behaviors, and given an alcohol drink (inducing a blood alcohol concentration of 0.05%), or a placebo drink immediately before the posttreatment assessment. The asterisk indicates that, during the posttreatment, ARG + exhibited significantly less sensitivity to punishment than ARG−; and the pound sign indicates a significant difference during the posttreatment between participants intoxicated with alcohol, compared with those given placebo. The vertical bars indicate the *SEM*.

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

GoStop (Dougherty et al., 2003)

The ANOVA for percentage of response inhibition at the 50-ms latency revealed a main effect of time, $F_{(1.102)} = 5.63$, $p < 0.05$, ($\eta^2 = 0.05$) and significant interactions between PD and ARG, $F_{(1.102)} = 5.4$, $p < 0.05$, ($\eta^2 = 0.05$) and between time and PD, $F_{(1.102)} = 4.44$, $p < 0.05$, ($\eta^2 = 0.04$). The four-way interaction between time, alcohol dose, PD, and ARG achieved significance, $F_{(1.102)} = 4.44$, $p < .05$, ($\eta^2 = 0.04$). This interaction was deconstructed via separate ANOVAs for the pre- and posttreatment assessments. The ANOVA for the pretreatment test indicated a lack of significant main effects or significant interactions. The ANOVA for the posttreatment test revealed a significant main effect of PD, $F_{(1.102)} = 4.61$, $p < .05$, ($\eta^2 = 0.04$) and a significant interaction between PD and ARG, $F_{(1.102)} = 6{,}7$, $p < .05$, ($\eta^2 = 0.06$). The three-way interaction between PD, ARG, and alcohol dose was also significant, $F_{(1.102)} = 5.72$, $p < 0.05$, ($\eta^2 = 0.05$). Post hoc tests revealed that ARG+ without problematic drinking (ARG+/PD− group) exhibited a significantly lower percentage of response inhibition than the rest of the groups after the ingestion of alcohol.

The analyses for response-inhibition scores at the 250-ms, 150-ms or 350-ms latency lacked significant main effects or significant interactions. Pre- and posttreatment data are presented in Table 2. T2

GDT (Brand et al., 2005)

The ANOVA only indicated that scores significantly increased during the posttreatment—relative to the pretreatment—significant main effect of time, $F_{(1.102)} = 7.16$, $p < .01$, ($\eta^2 = 0.06$). PD, ARG, and alcohol dose did not significantly affect GDT net scores or safe and risky elections, nor were they involved in any significant interaction.

BrACs

A significant main effect of time of measurement was found, $F_{(3.306)} = 99.17$, $p < .001$, ($\eta^2 = 0.49$). Post hoc analysis revealed that BrACs were stable between Measurements 1 and 2, but significantly declined in the third and fourth measurements. No significant main effect of PD or ARG was found. BrACs are presented in Table 3. T3

Subjective Intoxication Responses

The ANOVA yielded a main effect of alcohol dose, $F_{(1.102)} = 86.61$, $p < .001$, ($\eta^2 = 0.46$). Participants treated with alcohol reported higher subjective levels of intoxication than participants in the placebo condition (see Figure 3). F3 The interaction between alcohol dose and PD, $F_{(1.102)} = 3.11$, $p = .08$, ($\eta^2 = 0.03$) bordered statistical significance. The planned-comparison analysis showed that PD+ subjects who received alcohol, but not PD− subjects who received alcohol, were significantly less sensitive to the acute alcohol intoxication.

Discussion

In the present study, we examined shared and unique deficits in behavioral impulsivity (using the GoStop task; Dougherty, Mathias, & Marsh, 2003) and decision making (using the IGT and GDT tasks; Bechara et al., 1994 and Brand et al., 2005, respectively) in subjects with problematic drinking and who were at-risk for problem gambling, only one, or none of these conditions. We also inspected the effect of an acute dose of alcohol on behavioral impulsivity and decision-making processes. Despite evidence of acute effects of alcohol on impulsivity and decision making (Dougherty et al., 2008) or identified shared and unique deficits between pathological gamblers and alcohol-dependent subjects (Lawrence et al., 2009), little was known about the populations studied here. Recent studies highlighted the importance of studying ARGs to gain insight into the progression from recreational to pathological gambling (Grant et al., 2011). To our knowledge, this is the first study that examined the acute effect of alcohol on behavioral impulsivity and decision making in subjects with problematic drinking and at-risk for problem gambling. We discuss our findings below.

The lack of baseline differences on decision making and behavioral impulsivity as a function of problematic drinking and at-risk gambling behavior was unexpected (Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2005, 2011; Kertzman, Lidogoster, Aizer, Kotler, & Dannon, 2011; Lawrence et al., 2009), but could be

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z xppws S=1 4/26/18 8:27 Art: 2017-0191

Table 2

Pre- and Posttreatment Total Net Scores in the Game of Dice Task (GDT), and Pre- and Posttreatment Response Inhibition Scores in the GoStop Task in Participants Exhibiting Gambling or Nongambling Behavior (ARG+ and ARG−, Respectively), and With or Without Problematic Drinking (PD+ and PD−, Respectively) Who Had Been Given an Alcohol or Placebo Drink

	PD−				PD+			
	ARG−		ARG+		ARG−		ARG+	
Scores	Alcohol (n = 16)	Placebo (n = 18)	Alcohol (n = 12)	Placebo (n = 11)	Alcohol (n = 16)	Placebo (n = 14)	Alcohol (n = 12)	Placebo (n = 11)
GDT								
Pretreatment net scores	18.5 ± 3.74	21.33 ± 2.82	20 ± 3.2	23.27 ± 1.48	21.5 ± 1.63	16.14 ± 3.1	19.5 ± 3.42	11.45 ± 6.17
Posttreatment net scores	21.12 ± 3.06	25.33 ± 1.62	23.67 ± 2.53	21.64 ± 3.04	21.62 ± 1.98	20.28 ± 2.28	20 ± 2.98	20.91 ± 2.83
GoStop pretreatment scores								
% Inhibition 50 ms	91.25 ± 3.08	79.72 ± 5.28	77.92 ± 6.44	83.18 ± 5.36	79.37 ± 6.37	85.71 ± 3.47	89.17 ± 5.57	93.18 ± 2.36
% Inhibition 150 ms	60.94 ± 4.45	57.22 ± 6.11	56.25 ± 5.71	66.82 ± 5.15	58.44 ± 6	65.36 ± 4.37	67.92 ± 5.31	69.54 ± 5.41
% Inhibition 250 ms	36.56 ± 3.97	35.00 ± 6.06	25 ± 3.48	45.91 ± 5.51	38.44 ± 5.87	36.78 ± 4.85	45.83 ± 4.84	46.36 ± 4.86
% Inhibition 350 ms	19.06 ± 3.14	19.72 ± 2.69	14.58 ± 2.34	25.54 ± 4.59	19.06 ± 3.33	23.93 ± 3.79	17.08 ± 2.64	22.27 ± 6.48
GoStop posttreatment scores								
% Inhibition 50 ms	88.75 ± 2.87	79.72 ± 5.37	65 ± 6.74	80 ± 6.71	76.87 ± 5.93	88.21 ± 5.18	91.25 ± 5.26	90 ± 3.16
% Inhibition 150 ms	59.37 ± 4.13	59.44 ± 6.79	51.67 ± 5.98	60.45 ± 8.57	58.12 ± 5.36	67.5 ± 5.85	70.83 ± 5.67	70.45 ± 6.65
% Inhibition 250 ms	34.06 ± 3	32.78 ± 5.53	27.92 ± 4.28	43.64 ± 7.07	36.56 ± 4.42	41.43 ± 5.25	42.5 ± 6.44	45.45 ± 6.89
% Inhibition 350 ms	20.31 ± 3.04	18.89 ± 2.9	17.92 ± 2.34	17.27 ± 2.81	26.25 ± 4.17	20.36 ± 5.17	24.17 ± 4.39	25.45 ± 5.06

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

Table 3
Breath-Alcohol Concentrations in Participants Exhibiting At-Risk or Not-At-Risk/Nongambling Behaviors (ARG+ and ARG−, Respectively), and With or Without Problematic Drinking (PD+ and PD−, Respectively) Who Had Been Given an Alcohol Drink Before Test

	PD−		PD+	
Breath-alcohol concentrations	ARG− alcohol (n = 16)	ARG+ alcohol (n = 12)	ARG− alcohol (n = 16)	ARG+ alcohol (n = 12)
First measurement	.059 ± .002	.056 ± .003	.057 ± .002	.057 ± .003
Second measurement	.056 ± .002	.057 ± .004	.057 ± .003	.057 ± .003
Third measurement	.046 ± .003	.047 ± .002	.046 ± .002	.042 ± .002
Fourth measurement	.04 ± .002	.039 ± .003	.037 ± .001	.031 ± .002

explained by sample characteristics. In the present study, the participants displayed lower levels of severity than alcohol dependents (Dolan et al., 2008; Miranda et al., 2009) and pathological gamblers (Goudriaan et al., 2005; Power, Goodyear, & Crockford, 2012) from previous studies.

New information provided by the study was the enhanced decision making under ambiguity exhibited by ARGs in the IGT compared with their not-at-risk/nongambling counterparts. This performance indicated, at least partially, a greater selection of cards from the advantageous yet highly punishing Deck C by ARGs. Traditionally, the IGT has been interpreted based on the selection of advantageous or disadvantageous decks (Bechara et al., 1994). Other studies, however, underscore the importance of also considering the frequency of punishments

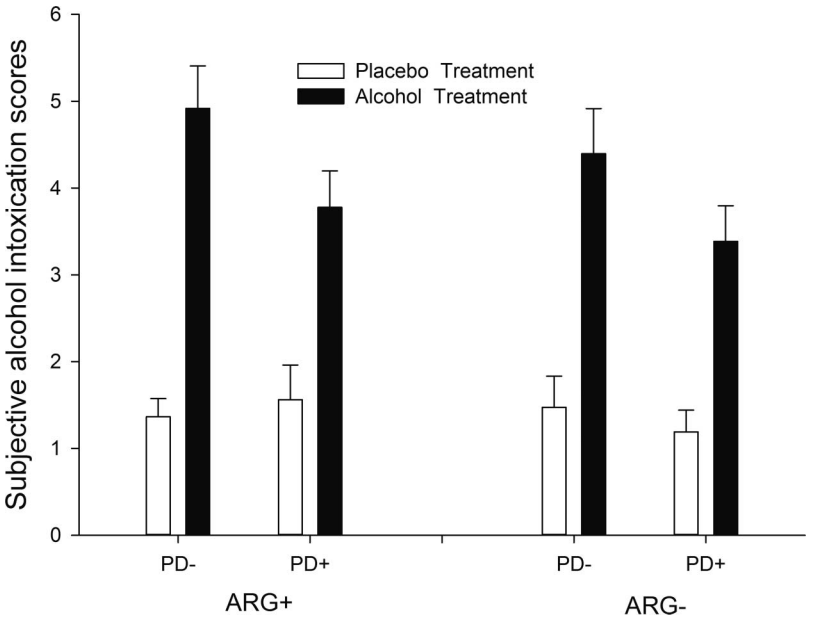

Figure 3. Subjective intoxication responses, in participants exhibiting at-risk or not-at-risk/non gambling behaviors (ARG+ and ARG−, respectively), and with or without problematic drinking (PD+ and PD−, respectively). The participants were given an alcohol drink, or a placebo before the test. Subjective intoxication responses were assessed three times during the intoxication. The figure depicts the mean response across measurements. The vertical bars indicate the *SEM*. Please refer to the text for an account of significant differences across groups.

(Steingroever et al., 2013) and the ability to avoid punishment (González, Ponce, Diaz, & Marino, 2010). We find it interesting that intoxicated participants also picked more cards from the advantageous but high-punishment Deck C, suggesting that an acute dose of alcohol made participants less sensitive, or blind, to high-frequency punishment.

Although the altered sensitivity to punishment apparently improved performance in ARGs, it can represent a risk factor for the escalation in the gambling-severity continuum with the development of more severe gambling behaviors (Loxton, Nguyen, Casey, & Dawe, 2008; Wardell, Quilty, Hendershot, & Bagby, 2015). The greater performance of ARGs may also relate to them being better at recognizing the underlying logic of the IGT (Bechara et al., 1994). Many gambling activities have an ability component that implies using a variety of strategies to improve performance (Grant, Odlaug, Chamberlain, & Schreiber, 2012; Myrseth, Brunborg, & Eidem, 2010). Goudriaan et al. (2005) found a correlation between the use of strategies to reduce the amount of losses and performance on the IGT. Supporting this hypothesis, 82% of the ARGs in our study reported a preference for strategic/skill games. But other factors, such as stress, might be influencing performance on the IGT. Stressed participants, compared with their nonstressed counterparts, needed more time to learn the underlying (i.e., not explicit) rules of the IGT (Preston, Buchanan, Stansfield, & Bechara, 2007). It is possible that ARGs, who are likely more familiar at performing gambling tasks, displayed lower levels of stress when performing the IGT. These possibilities are not mutually exclusive. ARGs might have exhibited altered sensitivity to punishment, improved abilities to perform strategic gambling games, lower levels of stress, and faster learning of the task.

Alcohol treatment significantly exacerbated impulsivity in the GoStop among PD− ARGs tested at the 50-ms latency. These results are consistent with evidence indicating higher levels of motor impulsivity after the administration of alcohol (Dougherty et al., 2008; McCarthy, Niculete, Treloar, Morris, & Bartholow, 2012; Weafer & Fillmore, 2008). Alcohol treatment, however, did not affect GDT (Brand et al., 2005) performance. Although the latter result is consistent with previous work (Acuña, Castillo, Bechara, & Godoy, 2013), in the present study, the GDT was completed approximately 40 min postadministration, when alcohol concentration levels were declining. This may explain the lack of effects of alcohol treatment. Additionally, we used a lower dose of alcohol than that used in most previous studies (i.e., between 0.60 and 0.80 g/kg; see Cronce & Corbin, 2010; Lane et al., 2004; Phillips & Ogeil, 2007, 2010).

The repeated, pre- and posttreatment, administration of the behavioral tasks is a limitation of the present study, as it is associated with improved performances because of a learning effect. Despite this limitation, this type of design is the most suitable to test the kind of hypotheses postulated here (Schweizer et al., 2006). Specifically, having a baseline before alcohol intoxication is fundamental to disaggregate the pharmacological effects of this or other addictive substances. Other limitations include the use of a single alcohol dose, the lack of examination of sex effects, and the lack of examination of the effect of expecting to receive alcohol.

Overall, our findings confirmed the facilitatory effect of acute alcohol on behavioral impulsivity and found an altered IGT (Bechara et al., 1994 performance in ARGs. The latter result is particularly striking when considering that these gamblers exhibited low levels of gambling severity (i.e., were not pathological gamblers). Apparently, even this low level of gambling engagement is sufficient to alter decision making. The lower level of sensitivity to punishment improved performance in this population, but it can also be a risk factor for the development of more severe gambling behaviors, particularly when considering that alcohol also increased their impulsivity and had an independent effect upon sensitivity to punishment.

References

Acuña, I., Castillo, D., Bechara, A., & Godoy, J. C. (2013). Toma de decisiones en adolescentes: Rendimiento bajo diferentes condiciones de información e intoxicación etílica [Decision making in adolescents: low performance different conditions of information and intoxication alcoholic]. *International Journal of Psychology & Psychological Therapy, 13,* 195–214. Retrieved from http://www.redalyc.org/pdf/560/56027416004.pdf

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

Allen, J. P., Reinert, D. F., & Volk, R. J. (2001). The Alcohol Use Disorders Identification Test: An aid to recognition of alcohol problems in primary care patients. *Preventive Medicine, 33,* 428–433. http://dx.doi.org/10.1006/pmed.2001.0910

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50,* 7–15. http://dx.doi.org/10.1016/0010-0277(94)90018-3

Bjork, J. M., Hommer, D. W., Grant, S. J., & Danube, C. (2004). Impulsivity in abstinent alcohol-dependent patients: Relation to control subjects and type 1-/type 2-like traits. *Alcohol, 34,* 133–150. http://dx.doi.org/10.1016/j.alcohol.2004.06.012

Brand, M., Fujiwara, E., Borsutzky, S., Kalbe, E., Kessler, J., & Markowitsch, H. J. (2005). Decision-making deficits of Korsakoff patients in a new gambling task with explicit rules: Associations with executive functions. *Neuropsychology, 19,* 267–277. http://dx.doi.org/10.1037/0894-4105.19.3.267

Brand, M., Recknor, E. C., Grabenhorst, F., & Bechara, A. (2007). Decisions under ambiguity and decisions under risk: Correlations with executive functions and comparisons of two different gambling tasks with implicit and explicit rules. *Journal of Clinical and Experimental Neuropsychology, 29,* 86–99. http://dx.doi.org/10.1080/13803390500507196

Brevers, D., Cleeremans, A., Goudriaan, A. E., Bechara, A., Kornreich, C., Verbanck, P., & Noël, X. (2012). Decision making under ambiguity but not under risk is related to problem gambling severity. *Psychiatry Research, 200,* 568–574. http://dx.doi.org/10.1016/j.psychres.2012.03.053

Clark, L. (2010). Decision-making during gambling: An integration of cognitive and psychobiological approaches. *Philosophical Transactions of the Royal Society of London, Series B*: Biological Sciences, *365,* 319–330. http://dx.doi.org/10.1098/rstb.2009.0147

Clark, L., & Robbins, T. (2002). Decision-making deficits in drug addiction. *Trends in Cognitive Sciences, 6,* 361–363. http://dx.doi.org/10.1016/S1364-6613(02)01960-5

Cronce, J. M., & Corbin, W. R. (2010). Effects of alcohol and initial gambling outcomes on within-session gambling behavior. *Experimental and Clinical Psychopharmacology, 18,* 145–157. http://dx.doi.org/10.1037/a0019114

Curtin, J. (2000). Blood Alcohol (BAL) Calculator (2.1.0) [Software]. Madison, WI: University of Wisconsin. Retrieved from http://dionysus.psych.wisc.edu/Methods%5Calcohol%5CDoseCalculation.htm

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,* 107–118. http://dx.doi.org/10.1037/1040-3590.19.1.107

Dalley, J. W., Everitt, B. J., & Robbins, T. W. (2011). Impulsivity, compulsivity, and top-down cognitive control. *Neuron, 69,* 680–694. http://dx.doi.org/10.1016/j.neuron.2011.01.020

Dolan, S. L., Bechara, A., & Nathan, P. E. (2008). Executive dysfunction as a risk marker for substance abuse: The role of impulsive personality traits. *Behavioral Sciences & the Law, 26,* 799–822. http://dx.doi.org/10.1002/bsl.845

Dougherty, D. M., Marsh-Richard, D. M., Hatzis, E. S., Nouvion, S. O., & Mathias, C. W. (2008). A test of alcohol dose effects on multiple behavioral measures of impulsivity. *Drug and Alcohol Dependence, 96,* 111–120. http://dx.doi.org/10.1016/j.drugalcdep.2008.02.002

Dougherty, D. M., Mathias, C. W., & Marsh, D. M. (2003). *GoStop Impulsivity Paradigm (Version 1.0)* [Manual]. Houston, TX: Neurobehavioral Research Laboratory and Clinic, University of Texas Health Science Center at Houston.

Everitt, B. J., & Robbins, T. W. (2005). Neural systems of reinforcement for drug addiction: From actions to habits to compulsion. *Nature Neuroscience, 8,* 1481–1489. http://dx.doi.org/10.1038/nn1579

Fillmore, M. T., & Blackburn, J. (2002). Compensating for alcohol-induced impairment: Alcohol expectancies and behavioral disinhibition. *Journal of Studies on Alcohol, 63,* 237–246. http://dx.doi.org/10.15288/jsa.2002.63.237

Fillmore, M. T., Ostling, E. W., Martin, C. A., & Kelly, T. H. (2009). Acute effects of alcohol on inhibitory control and information processing in high and low sensation-seekers. *Drug and Alcohol Dependence, 100,* 91–99. http://dx.doi.org/10.1016/j.drugalcdep.2008.09.007

Fillmore, M. T., & Weafer, J. (2012). Acute tolerance to alcohol in at-risk binge drinkers. *Psychology of Addictive Behaviors, 26,* 693–702. http://dx.doi.org/10.1037/a0026110

Franco, C. A., Maciejewski, P. K., & Potenza, M. N. (2011). Past-year recreational gambling in a nationally representative sample: Correlates of casino, non-casino, and both casino/non-casino gambling. *Psychiatry Research, 188,* 269–275. http://dx.doi.org/10.1016/j.psychres.2011.04.008

George, S., Rogers, R. D., & Duka, T. (2005). The acute effect of alcohol on decision making in social drinkers. *Psychopharmacology, 182,* 160–169. http://dx.doi.org/10.1007/s00213-005-0057-9

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

González, M. L., Ponce, J., Díaz, H. M., & Marino, J. C. (2010). Influencia de variables cognitivas en el Iowa Gambling Task (RACC). *Revista Argentina de Ciencias del Comportamiento, 2,* 32–42.

Goudriaan, A. E., Grekin, E. R., & Sher, K. J. (2011). Decision making and response inhibition as predictors of heavy alcohol use: A prospective study. *Alcoholism: Clinical and Experimental Research, 35,* 1050–1057. http://dx.doi.org/10.1111/j.1530-0277.2011.01437.x

Goudriaan, A. E., Oosterlaan, J., de Beurs, E., & van den Brink, W. (2005). Decision making in pathological gambling: A comparison between pathological gamblers, alcohol dependents, persons with Tourette syndrome, and normal controls. *Cognitive Brain Research, 23,* 137–151. http://dx.doi.org/10.1016/j.cogbrainres.2005.01.017

Grant, J. E., Chamberlain, S. R., Schreiber, L. R. N., Odlaug, B. L., & Kim, S. W. (2011). Selective decision-making deficits in ARGs. *Psychiatry Research, 189,* 115–120. http://dx.doi.org/10.1016/j.psychres.2011.05.034

Grant, J. E., Odlaug, B. L., Chamberlain, S. R., & Schreiber, L. R. (2012). Neurocognitive dysfunction in strategic and non-strategic gamblers. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 38,* 336–340. http://dx.doi.org/10.1016/j.pnpbp.2012.05.006

Henges, A. L., & Marczinski, C. A. (2012). Impulsivity and alcohol consumption in young social drinkers. *Addictive Behaviors, 37,* 217–220. http://dx.doi.org/10.1016/j.addbeh.2011.09.013

Kertzman, S., Lidogoster, H., Aizer, A., Kotler, M., & Dannon, P. N. (2011). Risk-taking decisions in pathological gamblers is not a result of their impaired inhibition ability. *Psychiatry Research, 188,* 71–77. http://dx.doi.org/10.1016/j.psychres.2011.02.021

Kim, Y. T., Sohn, H., & Jeong, J. (2011). Delayed transition from ambiguous to risky decision making in alcohol dependence during Iowa Gambling Task. *Psychiatry Research, 190,* 297–303. http://dx.doi.org/10.1016/j.psychres.2011.05.003

Lane, S. D., Cherek, D. R., Pietras, C. J., & Tcheremissine, O. V. (2004). Alcohol effects on human risk taking. *Psychopharmacology, 172,* 68–77. http://dx.doi.org/10.1007/s00213-003-1628-2

Lawrence, A. J., Luty, J., Bogdan, N. A., Sahakian, B. J., & Clark, L. (2009). Problem gamblers share deficits in impulsive decision-making with alcohol-dependent individuals. *Addiction, 104,* 1006–1015. http://dx.doi.org/10.1111/j.1360-0443.2009.02533.x

Liu, T., Maciejewski, P. K., & Potenza, M. N. (2009). The relationship between recreational gambling and substance abuse/dependence: Data from a nationally representative sample. *Drug and Alcohol Dependence, 100,* 164–168. http://dx.doi.org/10.1016/j.drugalcdep.2008.09.011

Loxton, N. J., Nguyen, D., Casey, L., & Dawe, S. (2008). Reward drive, rash impulsivity and punishment sensitivity in problems gamblers. *Personality and Individual Differences, 45,* 167–173.

McCarthy, D. M., Niculete, M. E., Treloar, H. R., Morris, D. H., & Bartholow, B. D. (2012). Acute alcohol effects on impulsivity: Associations with drinking and driving behavior. *Addiction, 107,* 2109–2114. http://dx.doi.org/10.1111/j.1360-0443.2012.03974.x

McDaniel, S. R., & Zuckerman, M. (2003). The relationship of impulsive sensation seeking and gender to interest and participation in gambling activities. *Personality and Individual Differences, 35,* 1385–1400. http://dx.doi.org/10.1016/S0191-8869(02)00357-4

Miranda, R., Jr., MacKillop, J., Meyerson, L. A., Justus, A., & Lovallo, W. R. (2009). Influence of antisocial and psychopathic traits on decision-making biases in alcoholics. *Alcoholism: Clinical and Experimental Research, 33,* 817–825. http://dx.doi.org/10.1111/j.1530-0277.2009.00901.x

Myrseth, H., Brunborg, G. S., & Eidem, M. (2010). Differences in cognitive distortions between pathological and non-pathological gamblers with preferences for chance or skill games. *Journal of Gambling Studies, 26,* 561–569. http://dx.doi.org/10.1007/s10899-010-9180-6

Odlaug, B. L., Chamberlain, S. R., Kim, S. W., Schreiber, L. R. N., & Grant, J. E. (2011). A neurocognitive comparison of cognitive flexibility and response inhibition in gamblers with varying degrees of clinical severity. *Psychological Medicine, 41,* 2111–2119. http://dx.doi.org/10.1017/S0033291711000316

Pantalon, M. V., Maciejewski, P. K., Desai, R. A., & Potenza, M. N. (2008). Excitement-seeking gambling in a nationally representative sample of recreational gamblers. *Journal of Gambling Studies, 24,* 63–78. http://dx.doi.org/10.1007/s10899-007-9075-3

Phillips, J. G., & Ogeil, R. P. (2007). Alcohol consumption and computer blackjack. *Journal of General Psychology, 134,* 333–353. http://dx.doi.org/10.3200/GENP.134.3.333-354

Phillips, J. G., & Ogeil, R. P. (2010). Alcohol influences the use of decisional support. *Psychopharmacology, 208,* 603–611. http://dx.doi.org/10.1007/s00213-009-1762-6

Power, Y., Goodyear, B., & Crockford, D. (2012). Neural correlates of pathological gamblers preference for immediate rewards during the Iowa Gambling Task: An fMRI study. *Journal of Gambling Studies, 28,* 623–636. http://dx.doi.org/10.1007/s10899-011-9278-5

tapraid5/pne-pne/pne-pne/pne99918/pne0149d18z | xppws | S=1 | 4/26/18 | 8:27 | Art: 2017-0191

Preston, S. D., Buchanan, T. W., Stansfield, R. B., & Bechara, A. (2007). Effects of anticipatory stress on decision making in a gambling task. *Behavioral Neuroscience, 121,* 257–263. http://dx.doi.org/10.1037/0735-7044.121.2.257

Reynolds, B., Richards, J. B., & de Wit, H. (2006). Acute-alcohol effects on the Experiential Discounting Task (EDT) and a question-based measure of delay discounting. *Pharmacology, Biochemistry and Behavior, 83,* 194–202. http://dx.doi.org/10.1016/j.pbb.2006.01.007

Rogers, R. D., Moeller, F. G., Swann, A. C., & Clark, L. (2010). Recent research on impulsivity in individuals with drug use and mental health disorders: Implications for alcoholism. *Alcoholism: Clinical and Experimental Research, 34,* 1319–1333.

Rubio Valladolid, G., Bermejo Vicedo, J., Caballero Sánchez-Serrano, M. C., & Santo-Domingo Carrasco, J. (1998). Validación de la prueba para la identificación de trastornos por uso de alcohol (AUDIT) en Atención Primaria [Validation of the Alcohol Use Disorders Identification Test (AUDIT) in primary care]. *Revista Clínica Española, 198,* 11–14.

Schweizer, T. A., Vogel-Sprott, M., Danckert, J., Roy, E. A., Skakum, A., & Broderick, C. E. (2006). Neuropsychological profile of acute alcohol intoxication during ascending and descending blood alcohol concentrations. *Neuropsychopharmacology, 31,* 1301–1309. http://dx.doi.org/10.1038/sj.npp.1300941

South Oaks Foundation. (1986). *South Oaks Gambling Screen: Spanish*. Retrieved from http://www.ipgap.indiana.edu/images/documents/SOGS_spanishversion.pdf

Starcke, K., & Brand, M. (2012). Decision making under stress: A selective review. *Neuroscience and Biobehavioral Reviews, 36,* 1228–1248. http://dx.doi.org/10.1016/j.neubiorev.2012.02.003

Steingroever, H., Wetzels, R., Horstmann, A., Neumann, J., & Wagenmakers, E. J. (2013). Performance of healthy participants on the Iowa Gambling Task. *Psychological Assessment, 25,* 180–193. http://dx.doi.org/10.1037/a0029929

Van Toor, D., Roozen, H. G., Evans, B. E., Rombout, L., Van de Wetering, B. J., & Vingerhoets, A. J. (2010). The effects of psychiatric distress, inhibition, and impulsivity on decision making in patients with substance use disorders: A matched control study. *Journal of Clinical and Experimental Neuropsychology, 33,* 161–168. http://dx.doi.org/10.1080/13803395.2010.493300

Verdejo-García, A., Lawrence, A. J., & Clark, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience and Biobehavioral Reviews, 32,* 777–810. http://dx.doi.org/10.1016/j.neubiorev.2007.11.003

Wardell, J. D., Quilty, L. C., Hendershot, C. S., & Bagby, R. M. (2015). Motivational pathways from reward sensitivity and punishment sensitivity to gambling frequency and gambling-related problems. *Psychology of Addictive Behaviors, 29,* 1022–1030. http://dx.doi.org/10.1037/adb0000066

Weafer, J., & Fillmore, M. T. (2008). Individual differences in acute alcohol impairment of inhibitory control predict ad libitum alcohol consumption. *Psychopharmacology, 201,* 315–324. http://dx.doi.org/10.1007/s00213-008-1284-7

Weafer, J., Milich, R., & Fillmore, M. T. (2011). Behavioral components of impulsivity predict alcohol consumption in adults with ADHD and healthy controls. *Drug and Alcohol Dependence, 113,* 139–146. http://dx.doi.org/10.1016/j.drugalcdep.2010.07.027

Winer, B. J., Brown, D. R., & Michels, K. M. (1991). *Statistical principles in experimental design* (Vol. 2). New York, NY: McGraw-Hill.

Received September 21, 2017
Revision received January 29, 2018
Accepted March 23, 2018 ■

AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES 1

AQau—Please confirm the given-names and surnames are identified properly by the colors.
■= Given-Name, ■= Surname
The colors are for proofing purposes only. The colors will not appear online or in print.

AQ1—Author: Please provide a running head (a shortened version of the title) no more than 50 characters in length, including spaces.

AQ2—Author: Please confirm/provide author affiliation.

AQ4—Author: Loxton, Nguyen, Casey, & Dawe, 2008 is not listed in your references. Please list in the references or remove all citations to it from the text.

AQ5—Author: Please be sure to provide the name of the department(s) with which you and your coauthors are affiliated at your respective institutes if you have not already done so. If you are affiliated with a governmental department, business, hospital, clinic, VA center, or other nonuniversity-based institute, please provide the city and U.S. state (or the city, province, and country) in which the institute is based. Departments should be listed in the author footnote only, not the byline. If you or your coauthors have changed affiliations since the article was written, please include a separate note indicating the new department/affiliation: [author's name] is now at [affiliation].

AQ6—Author: Please indicate whether a change in affiliation has occurred.

AQ7—Author: Corresponding Au: Please provide full mailing address, including street address, city, state, and zip code, and e-mail address. If in Canada or Australia, include street address, city, province/territory, country, and postal code. If in another country, include street address, city, country, and postal code.