Risk-Taking Propensity and Reward-Processing: Decision-Making Differences Between Binge Drinkers and Non-drinkers

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RESUMEN

Introducción: el consumo excesivo de alcohol es un patrón de consumo que afecta la salud y el bienestar y está asociado con la toma de decisiones riesgosas, incluidas la conducción en estado de ebriedad y el comportamiento sexual de riesgo. **Objetivo:** esta investigación tuvo como objetivo contrastar el rendimiento en tareas de toma de decisiones entre un grupo control de no bebedores y un grupo con consumo excesivo de alcohol, y determinar la medida conductual de toma de decisiones que distingue de manera más efectiva el consumo excesivo de alcohol. **Método:** la muestra estuvo compuesta por 43 controles y 25 consumidores. Utilizamos las siguientes tareas de comportamiento: Balloon Analogue Risk Task (BART), Iowa Gambling Task (IGT), Delay Discounting (DD), y las versiones fría y caliente del Columbia Card Task (CCT-cold y CCT-hot, respectivamente) para medir la toma de decisiones. **Resultados:** se encontraron diferencias significativas entre los grupos con las tareas BART y CCT-cold. Además, el análisis de correlación de Pearson mostró una correlación negativa entre BART, CCT-hot y CCT-cold (bajo rendimiento) y la cantidad de consumo de alcohol. El análisis de discriminación mostró que las tareas BART y CCT-cold son los mejores predictores del consumo excesivo de alcohol. **Discusión y conclusiones:** el estudio encuentra diferencias significativas en la toma de decisiones entre los grupos, particularmente en tareas relacionadas con riesgos. Esto sugiere la importancia de diseñar intervenciones específicas centradas en estas vulnerabilidades cognitivas.

Palabras clave: toma de decisiones, consumo excesivo de alcohol, conductas de riesgo, proceso cognitivo-emocional.

ABSTRACT

Introduction: binge drinking is a pattern of alcohol consumption that impacts health and well-being, and it is associated with risky decision-making, including drunk driving and risky sexual behavior. **Objective:** this research aimed to contrast the performance in decision-making tasks between a control group of non-drinkers and a binge-drinking group, and to ascertain the behavioral measure of decision-making that most effectively distinguishes binge drinking behavior. **Method:** the sample was composed of 43 controls and 25 consumers. We used the following behavioral tasks: Balloon Analogue Risk Task (BART), Iowa Gambling Task (IGT), Delay Discounting (DD), and the cold and hot versions of the Columbia Card Task (CCT-cold and CCT-hot), in order to measure decision-making. **Results:** significant differences between the groups were found with the BART and CCT-cold tasks. In addition, Pearson's correlation analysis showed a negative correlation among BART, the CCT-hot and CCT-cold (low performance), and the quantity of alcohol use. The discrimination analysis showed that BART and CCT-cold tasks are the best predictors of binge drinking. **Discussion and conclusions:** the study finds significant decision-making differences between binge drinkers and controls, particularly in risk-related tasks. These insights suggest targeted interventions could mitigate the harmful effects of binge drinking by focusing on these cognitive vulnerabilities.

Keywords: decision-making, binge drinking, risk behavior, cognitive-emotional process.

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INTRODUCTION

Binge drinking is defined as the consumption of five or more drinks on a single occasion for men or four or more drinks on a single occasion for women (Bohm et al., 2021). This pattern of consumption is a risk behavior in which people seek pleasurable effects despite the possible negative consequences to their family, work, school, etc. This behavior is often linked with various risky behaviors that may lead to harm, such as assault (Ito et al., 1997), drunk driving (Taylor et al., 2010), and sexual risk-taking (Rehm et al., 2012). According to the National Survey of Drug, Alcohol, and Tobacco Consumption in Mexico (Secretaría de Salud, 2017), 77.3% of the adult population have consumed alcohol at some time in their lives (88.3% of men and 67.3% of women), while binge drinking in the last year was 22.1% (34.4% of men and 10.8% of women), and possible alcohol dependence was 2.5% (1.7 million) (4.6% of men and 0.6% of women).

The tendency to engage in risky behavior, such as binge drinking, has been studied using various behavioral tasks that manipulate outcomes like money and their determinants, including gains, losses, amounts, delivery times, and probabilities. The decision-making process involves two or more competing options encompassing two systems: one based on deliberate thought processes, where an evaluation of risks and benefits constitutes "cold" decision-making, and one that incorporates instincts and emotions, referred to as "hot" decision-making (Damásio, 1994). Tasks such as the Balloon Analogue Risk Task (BART) have provided evidence of a change in performance (select more pumps with high probabilities) when alcohol is consumed compared to healthy controls. It has been reported that lower performance on the BART is associated with excessive alcohol consumption (Campbell et al., 2013; Skeel et al., 2008). Similarly, it has been observed in the Iowa Gambling Task (IGT) that binge drinking groups and participants in the detoxification process tend to take more risks or choose disadvantageous options compared to healthy controls (Brevers et al., 2014; Kornreich et al., 2013; Noël et al., 2007; Fein et al., 2004; Xiao et al., 2013). Regarding impulsivity or delay discounting tasks, the binge drinking group tends to choose more immediate rewards (impulsivity) than the control group (Field et al., 2007; Petry, 2001; Vuchinich & Simpson, 1998). Considering the Columbia Card Task hot version (CCT-hot) and the Columbia Card Task cold version (CCT-cold), it was observed that these tasks revealed significant engagement in risky behaviors (characterized by the selection of a greater number of cards in a risky environment) among substance abusers when compared to healthy controls (Kluwe-Schiavon et al., 2016; Saleme et al., 2018). Few studies, however, have investigated the impact of binge drinking using these specific tasks.

Binge drinkers exhibit risky and ambiguous decision-making, indicative of impairments in working memory, inhibition, and response monitoring, which are core components of executive functions (Bø et al., 2017). Deficits in executive functions are associated with a broad spectrum of psychopathologies. Moreover, these deficits are linked to the ineffective employment of adaptive emotion regulation strategies, identified as crucial risk factors for diverse psychopathologies (Snyder et al., 2015). Although cognitive impairments in substance use disorders have been documented within the Research Domain Criteria framework, the prevalence of such impairments prior to substance abuse remains unclear. Therefore, cognitive function can be considered a hallmark feature of substance-use disorders, characterized by documented alterations in attention, inhibition/regulation, working memory, and decision-making domains (Ramey & Regier, 2019).

While individuals with alcohol dependence are more likely to experience greater levels of damage, it is important to note that damage associated with alcohol use also occurs among those who are not dependent (Lannoy et al., 2019; Rehm et al., 2012; Taylor et al., 2010). Therefore, it is important to identify drinkers according to different degrees of risk consumption in order to reduce all the associated damages (Babor et al., 2001). For this reason, the current study analyzed the performance of four behavioral tasks in the same sample, contrasting the performance of a healthy control group and a binge drinking group. Few studies have included these behavioral tasks within the same study (Goudriaan et al., 2007; Harmon et al., 2021; Mejía et al., 2022). The secondary aim is to identify the behavioral measure of decision-making that can best differentiate binge drinking. This study furnishes evidence that may enhance the content of programs aimed at preventing alcohol abuse as well as the cognitive assessment component of brief interventions for alcohol abuse.

METHOD

Participants

Participants in this study included 68 young adults from southern Sonora, Mexico (31 men, 37 women). The two groups consisted of 43 healthy young adults

(age: M = 21.55, SD = 3.09) and 25 young adults engaging in risky drinking behavior (age: M = 22.44, SD = 4.68). The participants were recruited utilizing a snowball sampling strategy. All participants were recruited online through social media platforms. A raffle modality was employed to incentivize their participation, with a raffle conducted for every 20 participants, offering a gift card as an incentive. Inclusion criteria were being over 18, having access to an electronic device, and disclosing substance use history. Informed consent was obtained in accordance with ethical principles of the Declaration of Helsinki (WMA, 2013).

Instruments

An online platform compatible with Android was used for behavioral tasks (IGT, BART, DD, CCT-cold and hot versions) accessible at http://lcsia.com/Pruebas.html and both the demographic data and consumption habits were collected through a Google Forms questionnaire.

The Alcohol Use Disorders Identification Test (AUDIT) has been employed to ascertain both hazardous and detrimental drinking behaviors, as well as to detect alcohol dependence. The psychometric properties of the AUDIT have been confirmed In Mexico, underscoring the instrument's reliability as evidenced by a Cronbach's Alpha of .804. Furthermore, the validity of its internal structure was substantiated through a confirmatory factor analysis, which confirmed the model's three-factor validity (Dependence Symptoms, Harmful Alcohol Use, and Risky Use; Morales et al., 2019).

The Columbia Card Task (CCT) assesses decision-making. The participants choose from 32 cards, with some offering rewards of 10 or 30 points and others incurring losses of 250 or 750 points, with the number of loss cards varying from 1 to 3. In the 'hot' version, potential gains, losses, and loss card numbers are displayed with immediate feedback. In the 'cold' version, participants decide how many cards to flip without feedback. It distinguishes deliberative from affective process. We used the average number of cards chosen in both versions as an outcome variable; higher scores indicate riskier decisions (Figner and Voelki, 2004). Evidence suggests that performance on the CCT, both in its hot and cold versions, correlates with performance on other executive functioning measures. The parameters within the CCT are implicated in decision-making processes involving risk, highlighting its significance in understanding the cognitive mechanisms underpinning risky behaviors (Buelow, 2014). The CCT has demonstrated minimal practice effects and increased reliability. No significant differences were observed in CCT performance between Time 1 and Time 2 (t [79] = −1.85, p = .068, d = 0.24) (Buelow & Barnhart, 2017).

The Balloon Analogue Risk Task (BART) assesses risk-taking behavior. Participants inflate virtual balloons and earn points with each pump, but there's a risk of the balloon bursting, which causes point loss. Balloon burst probabilities vary across blocks. Participants decide to cash out or continue inflating. Frequent balloon bursts indicate a greater risk tendency. The analysis focused on the average frequency of pumps adjusted for unexploded balloons by probabilities (I: 1/8, II: 1/32, III: 1/128) (Lejuez et al., 2002). Performance on the BART has been linked to real-world risk-taking behaviors, sensation-seeking, and impulsivity, reflecting its utility in measuring propensities towards engaging in risky activities (Buelow & Blaine, 2015; Harmon et al., 2021). The BART has exhibited moderate correlations over time. Participants exhibited an increase in the number of pumps per unexploded balloon (t [303] = −2.93, p = .004, d = .168), and accrued greater monetary rewards (t [303] = −2.76, p =.006, d =.158), at Time 2 compared to Time 1 (Buelow et al., 2023).

The Iowa Gambling Task (IGT) involves four decks of cards with varying wins, losses, and odds of loss. Opting for decks with lower losses is advantageous in the long term, while high-gain decks pose short-term benefits but also greater risks. Analysis assessed the proportion of advantageous and disadvantageous choices per block, where 1 represents more advantageous and 0 disadvantageous choices, across 100 trials (Bechara et al., 1994). Performance on the IGT has been associated with damage to the dorsolateral prefrontal cortex, insula, and ventromedial prefrontal cortex. Additionally, it correlates with impulsivity scales, indicating its relevance in assessing the neurological underpinnings of decision-making (Harmon et al., 2021). The IGT has exhibited no significant correlations between performance on Trials 1-40 at Time 1 and Time 2. However, weak correlations were observed between performance on Trials 41-100 at Time 1 and Time 2. Paired-samples t-tests on both sets of trials (1-40: t [93] = −4.50, p = .001, d = 0.47; 41-100: t [93] = −2.98, p = .004, d = 0.31) confirmed a significantly lower risk-taking tendency at Time 2 compared to Time 1 (Buelow & Barnhart, 2017).

Delay Discounting (DD) assesses how individuals devalue rewards based on delays. Participants choose between immediate and delayed rewards. Preferring immediate, smaller rewards indicates impulsivity. We used a preprogrammed-adjusting

amount procedure with 7 delays (7, 30, 180, 365, and 1095 days). Analysis measured the Area Under the Curve (AUC), with 0.0 indicating maximum impulsivity and 1.0 indicating strong self-control (Myerson et al., 2001). Performance in delay discounting tasks is associated with a demonstrated insensitivity to future consequences, as extensively documented in the literature regarding this topic (Acuff et al., 2023). The DD task has demonstrated substantial test-retest correlations (.67 and .76, $p < .001$), indicating the longitudinal stability of individual differences in decision-making behavior throughout middle and late adolescence (Anokhin et al., 2015).

Procedure

This cross-sectional study aimed to compare the performance of two distinct groups, namely the binge drinking group and the healthy controls, across three behavioral tasks. Data collection occurred from November 2021 to February 2022, with each session lasting approximately one hour.

Before starting the evaluation, each participant received a unique code for accessing the tasks on the platform. Participants were instructed to complete a Google Forms questionnaire on their mobile devices, providing demographic information and granting informed consent based on ethical principles for human medical research (WMA, 2013). They accessed the platform via the link http://lcsia.com/Pruebas.html and completed the following tasks sequentially: IGT, BART, DD Task, and the CCT in both its hot and cold versions. Participants received assistance if they had questions or encountered any issues during the tasks.

The study categorized participants into two groups: healthy controls, who reported no alcohol or illegal drug use, and a binge drinking group, based on their typical alcohol consumption per occasion, question no. 2 of the Alcohol Use Disorders Identification Test AUDIT (Miles et al., 2001). Individuals who reported consuming five or more drinks per drinking occasion were classified as binge drinkers, taking into account liver metabolism and alcohol consumption risk factors (Martínez & Pallarés, 2013).

Data analysis

The study conducted descriptive analyses, including frequencies, means, and standard deviations for demographic characteristics and dependent variables of the behavioral tasks. Normality assessments were performed using the Kolmogorov-Smirnov and Levene tests to evaluate variances' homogeneity. Results indicated suitability for parametric tests (Table 1). Independent samples t-tests were employed to compare group performances in each behavioral task. Pearson correlations explored decision-making measure associations across all participants. Additionally, correlations between demographic traits and consumption habits were examined. Discriminant analysis identified the most distinguishing measurement variables for group differentiation in decision-making. Power indices and variance homogeneity for the model were calculated. All analyses were conducted in IBM SPSS Statistics v27® (IBM, 2020).

Table 1
Kolmogorov-Smirnov test

	M	*SD*	Skewness	Kurtosis	*Z*	*p*
BART block 1	2.79	1.47	-.43	-.34	.894	.402
BART block 2	5.65	2.47	.98	.47	1.032	.237
BART block 3	8.19	5.45	1.5	2.94	1.163	.134
CCT (Cold)	14.13	7.21	.04	-.65	.689	.730
CCT (Hot)	13.62	5.60	.37	.29	.694	.720
Area under the curve (DD)	.29	.23	1.22	1.09	1.284	.074
IGT 1	.34	.16	-.04	.33	.754	.620
IGT 2	.41	.18	.39	.75	1.010	.259
IGT 3	.44	.20	.04	.04	.816	.519
IGT 4	.43	.20	-.01	.39	.685	.737
IGT 5	.43	.24	.33	-.002	.868	.438

Note: *M*: mean; *SD*: standard deviation; Skewness: measure of symmetry; Kurtosis: measure of whether the data are heavy-tailed or light-tailed relative to a normal distribution; *Z*: value of test statistic; *p*: *p*-value of the statistical significance.

Table 2
Means and standard deviations by groups for demographic data

	Healthy controls 43		Binge drinking 25				
	Male	Female	Male	Female			
	15	28	16	9			
N	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Age	21.55	3.09	22.40	4.68	-.940	.351	.21
Years of study	13.60	3.35	13.60	3.19	-.026	.980	.006
Monthly income	3441	5084	5452	6629	-1.39	.168	.34
Number of drinks	0	0	8.76	5.28	-10.68	.000	-.76
Illegal drugs	0	0	.48	.91	-2.32	.023	-.34
Cigarette smoking	.60	3.8	2.68	5.83	-1.17	.007	.42

Note: a student's t-test was used to contrast the variables between groups; *N*: Size of the sample; *M*: mean; *SD*: standard deviation; *t*: value of test statistic; *p*: *p*-value of the statistical significance; d: effect size.

RESULTS

Group characteristics

No significant age (p = .351), education (p = .980), or income (p = .168) differences existed between healthy and binge drinking groups. However, significant distinctions emerged in alcohol consumption (p = .000), cigarette use (p = .007), illegal drug use (p = .023), and gender (χ^2 = 5.40, gl = 1, p = .020) (Table 2).

Iowa Gambling Task Results

Performance on the IGT task showed no significant group differences (Table 3). Notably, binge drinking participants made more card choices in the initial block characterized by greater uncertainty due to task unfamiliarity. However, the healthy control group surpassed the binge drinking group in card choices in the final two blocks, suggesting improved performance as participants became more familiar with the task and its probabilities.

BART Task Results

In the BART, overall group performance didn't significantly differ, except in block 3 (p = .010), but the healthy control group outperformed the binge drinking group in all BART blocks (Table 3).

Delay Discounting Task Results

Analysis of the area under the curve found no significant group differences. Hyperboloid function fitting was adequate for both healthy controls (R^2 = .962) and binge drinkers (R^2 = .967). The K value was slightly

Table 3
Means and standard deviations by group for BART, DD & IGT

		BART					IGT				
Group		Type 1	Type 2	Type 3	Explo-sions	*DD*	Block 1	Block 2	Block 3	Block 4	Block 5
Healthy controls	M	2.88	5.87	9.36	12.9	.30	.35	.41	.42	.42	.42
	SD	1.56	2.86	6.25	4.82	.23	.17	.15	.19	.20	.23
Alcohol users	M	2.60	5.28	6.22	11.88	.28	.33	.43	.47	.46	.44
	SD	1.35	2.97	3.12	4.57	.24	.14	.22	.22	.20	.27
t		.737	.808	2.34	.856	.422	-.451	-.472	-.962	-.931	-.455
p		.464	.422	.022	.395	.674	.653	.639	.340	.356	.651
d		.21	.2	.63	.21	.08	.12	.1	.24	.2	.07

Note: BART: Balloon Analogue Risk Task; DD: Area Under the Temporary Discount Curve; IGT: Iowa Gambling Task; *M*: mean; *SD*: standard deviation; *t*: value of test statistic; *p*: *p*-value of the statistical significance; *d*: effect size.

lower in healthy controls (b = .01) than in the binge drinking group (b = .015), indicating slightly greater impulsivity in the latter group (Table 3).

Columbia Card Task Results

Results of the CCT-cold task showed no significant differences between the groups, except in the least favorable scenario (p = .045; Table 4). Healthy controls demonstrated greater sensitivity to context changes involving loss cards, loss amounts, and gain amounts. Controls chose more cards (M = 15, SD = 6.7) than the binge drinking group (M = 12.6, SD = 7.8). Both groups chose fewer cards with more loss cards, and a slight decrease in card choice was observed as loss amounts increased from 250 to 750. The control group had a higher card choice index for larger wins. In the worst task condition, controls also chose more cards (M = 14.5, SD = 8.3).

In the CCT-hot task, no significant group differences were found in any condition. However, performance varied in conditions with feedback. Healthy controls consistently chose more cards than binge drinkers, demonstrating sensitivity to gain and loss amounts. In terms of losing cards, controls chose more in 1 card (M = 16.2, SD = 5.4) and 3 cards (M = 12.4, SD = 5). Similarly, in losses, controls selected more cards at 250 (M = 13.9, SD = 4) and 750 (M = 14.6, SD = 5.6). Gain amounts had minimal impact on responses, but controls chose more cards for 10 (M = 13.7, SD = 5) and 30 (M = 14.7, SD = 5.2). In both the best and worst-case conditions, healthy controls outperformed binge drinkers (Best, M =16.2, SD = 6.1; Worse, M = 12.1, SD = 5.1).

Correlation analysis

The correlation matrix showed statistically significant results for the correlations between binge drinking and: cigarette consumption (r = .367, p = .001); drug consumption (r = .380, p = .001), the BART performance (r = -.261, p = .027), the CCT-cold (r = -.248, p = .046), and CCT-hot (r = -.297, p = .017).

Discriminant analysis

In the discriminant analysis comparing healthy controls and alcohol consumers, the obtained discriminant function was not statistically significant, indicating that the variables did not effectively differentiate between the groups (Table 5). The test for the equivalence of the covariance matrices Box's M result (98.91, p = .159) confirmed equal variances.

Structural coefficients revealed that the BART task had the highest discrimination score, followed by CCT-cold, albeit moderately. These two variables were the best at distinguishing between binge drinkers and healthy controls, while others had lower scores.

Table 4

Means and standard deviations by the group for the Columbia Card Task

				Loss cards		Loss amount		Gain amount		Condition	
	Groups		Mean	1	3	250	750	10	30	Best	Worse
COLD	Healthy controls	M	15	16.2	13.8	15.2	14.7	14.9	15	17.3	14.5
		SD	6.7	7	6.9	6.7	7	7	6.7	8.2	8.3
	Alcohol users	M	12.6	13.3	11.9	13.4	11.7	11.7	13.4	15.4	10.5
		SD	7.8	8.4	7.8	7.7	8.3	7.6	4.8	9.7	7.9
	t		1.35	1.53	1.08	1.04	1.64	1.74	.938	.916	2.04
	p		.180	.131	.282	.301	.106	.086	.352	.363	.045*
	d		.33	.37	.25	.24	.39	.43	.27	.21	.19
HOT	Healthy controls	M	14	16.2	12.4	13.9	14.6	13.7	14.7	16.2	12.1
		SD	4.8	5.4	5	4	5.6	5	5.2	6.1	5.9
	Alcohol users	M	12.7	14.3	11.4	12.6	13.1	12.2	13.5	14.5	10.8
		SD	6.7	7.5	6.3	7.2	6.7	6.6	7	8.9	7.7
	t		.989	1.26	.722	.967	.999	1.06	.936	1.05	.756
	p		.327	.213	.473	.337	.322	.290	.353	.295	.452
	d		.22	.29	.17	.22	.24	.25	.19	.22	.18

Note: CCT: Columbia Card Task; COLD: CCT cold condition without feedback; HOT: CCT hot condition with feedback; *M*: mean; *SD*: standard deviation; *t*: value of test statistic; *p*: *p*-value of the statistical significance; *d*: effect size.

Table 5
Summary of discriminant functions

Function	1
Own value	.200
Variance %	100%
Canonical correlation	.408
Wilk's Lambda	.833
R^2	10.30
df	11
p	.503

Note: Function: This indicates the first canonical linear discriminant function; Own value: eigenvalue to describe how much discriminating ability a function possesses; Variance %: This is the proportion of discriminating ability of the continuous variables found in a given function; Canonical Correlation: The canonical correlations of the predictor variables; Wilks' Lambda: the multivariate statistic to test canonical correlations; R^2: R-squared of the proportion of the variance; *df*: effect degrees of freedom for the given function; *p*: *p*-value of the statistical significance.

Overall, the discriminant function model explained 67.2% of participant grouping, but it's important to note that the model lacked statistical significance, and the Lambda statistic deviated from zero.

DISCUSSION AND CONCLUSIONS

This study employed a decision-making battery to differentiate between healthy controls and binge drinking groups, and aimed to identify behavioral measures that could predict alcohol consumption risk. Although few statistically significant differences were observed, the healthy control group outperformed in decision-making tasks. While the sample wasn't clinical, individuals with risky alcohol consumption demonstrated a propensity for risky behavior in unfavorable scenarios (CCT-cold) and difficulties learning from feedback in ambiguous situations (BART). Risky alcohol consumption is known to affect executive functioning and decision-making. The study suggests that although the effects might not be pronounced yet, excessive alcohol consumption can evolve into chronic dependence, emphasizing the importance of early intervention.

The BART stood out as the most effective in differentiating and predicting alcohol consumption in both groups, offering practicality in assessment. This study also provided valuable insights into the CCT, particularly the CCT-cold version, as a potential predictor of alcohol consumption. The control group's superior performance in BART, obtaining more adjusted balloons, aligns with previous studies showing differences in risk-taking between healthy control groups and alcohol consumers, as well as in substance use, gambling, and risky sexual behavior. This is consistent with other studies (Aklin et al., 2005; Lejuez et al., 2002; Mejía et al., 2022) where they demonstrated the difference in performance and risk-taking between control groups and alcohol consumers, as well as other types of substance use (Lejuez et al., 2002), gambling (Mishra et al., 2017), and risky sexual behavior (Bornovalova et al., 2008).

Unique findings emerged for the CCT. While no prior studies evaluated this task in alcohol consumers, significant differences surfaced in the Worse condition of the cold task, indicating that control participants exercised greater caution in unfavorable contexts. Both groups exhibited sensitivity to context changes, reflecting the influence of feedback on the affective system in the hot condition, corroborating the dual processing model of decision-making. These results were very similar to the study by Mejía et al. (2022), with consumers of substances where both groups were sensitive to context change, which gives further evidence to the dual processing model of decision making.

The IGT also demonstrated differences in performance. The binge drinking group initially took more risks and selected more cards in the uncertainty phase but exhibited better learning in later blocks, resulting in a higher index of advantageous choices for the control group. These results align with research indicating that alcohol consumption groups tend to favor disadvantageous cards and take greater risks in the task. These results are consistent with other studies (Mejía et al., 2022; Verdejo-García et al., 2007; Xiao et al., 2013) that show that groups of alcohol consumption tend to choose a higher rate of disadvantageous cards and take greater risks in the task.

Regarding the DD task, no significant differences were observed in the area under the curve. However, other studies have shown more pronounced effects in alcohol-dependent patients and non-dependent individuals, which were not evident here. In other studies, it has been evidenced in a more noticeable way with patients dependent on alcohol (Petry, 2001), as well as in people who are not dependent on alcohol (Field et al., 2007; Vuchinich & Simpson, 1998), which was not observed in this study.

Correlation analyses unveiled low but significant relationships between alcohol, cigarette, and drug use, as expected. Alcohol consumption correlated negatively with performance in the BART,

CCT-cold, and CCT-hot, suggesting that higher alcohol consumption was associated with poorer performance in these tasks.

In the discriminant analysis, while not statistically significant, it highlighted the predictive variables for alcohol consumption risk. BART and CCT-cold emerged as the most influential measures in distinguishing between the control and binge drinking groups. In this study, while we contrast the performance between groups, we recommend that future studies explore dysexecutive syndrome and neurodevelopmental impairments that may contribute to early deficits in excessive alcohol use.

In future research, it is advisable to include clinical samples and compare them with substance use measures in order to validate the diagnosis of alcohol use disorder and distinguish risky use from dependence. It is recommended to expand the sample size, balance the gender distribution among the groups, and utilize the complete AUDIT measure to encompass various consumption patterns. Analyzing consumption pattern variables as continuous measures without group divisions and employing predictive models to assess the complete sample can offer more comprehensive insights.

The findings of this study have implications for prevention and intervention strategies. Informing prevention programs about the effects of binge drinking on executive functions, specifically decision-making, is crucial to motivate the adoption of safe patterns of alcohol use, especially among emerging adults. Early intervention can potentially save time, costs for both individuals and society, and reduce the complexity of addressing alcohol-related problems.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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