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BRIEF REPORT

Social Decision Making in Binge Drinking: An Exploration Through Moral Dilemmas

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Objective: The continuum hypothesis proposes that binge drinking and severe alcohol use disorder (SAUD) share qualitatively similar cognitive and emotional impairments. In SAUD, these deficits have a demonstrated impact on social decision making, resulting in a utilitarian bias. Namely, when confronted with moral dilemmas, patients with SAUD tend to focus on the consequences of their actions rather than on social norms. However, social decision-making abilities remain unexplored in binge drinking. We offered the first insights on the generalization of the continuum hypothesis to social decision making, through a multinomial processing tree model applied to moral dilemmas, the "CNI model" of moral decision making. ***Method:*** We compared 35 binge drinkers (20 females) and 36 light drinkers (21 females) on a battery of 48 moral dilemmas involving interpersonal relations from the CNI model, through multinomial modeling analyses. In each dilemma, participants were asked if they would perform the described action, generating individual scores for sensitivity to consequences, sensitivity to norms, and inaction tendency. ***Results:*** The statistical model related to the CNI approach fits the data well. Binge drinkers and controls did not differ regarding their sensitivity to consequences nor their sensitivity to moral norms, and both groups displayed an equal inaction tendency in response to moral dilemmas. ***Conclusions:*** We provided insights to better understand the specific (socio)cognitive domains impaired in subclinical populations with alcohol use disorder. We showed preserved social decision making in binge drinking, which suggests that the continuum hypothesis documented for classical neurocognitive functions does not extend to complex social abilities.

Public Health Significance Statement
Moral dilemmas imply a choice between two options, both having positive and negative consequences on other individuals. Severe alcohol use disorder is associated with a focus on consequences (rather than on social norms) in such dilemmas. We show that such bias does not extend to subclinical populations, as binge drinkers do not present biased moral decision making compared to low drinkers. This indicates that the continuum hypothesis, suggesting similar—but lower—impairments in binge drinking than in severe alcohol use disorder, might not apply to complex social abilities.

Keywords: moral dilemmas, social decision making, binge drinking, multinomial processing tree

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Alcohol use disorder is associated with cognitive, emotional, and interpersonal impairments, encompassing executive functions, decision making, and social cognition (Ariesen et al., 2023; Gautier et al., 2021; Maharjan et al., 2022; Pabst et al., 2022). Most previous studies in this field capitalized on neuropsychological tasks unrelated to real-life situations, but a new line of research emerged during the last decade, determining how these deficits impact the actual decisions made in ecological contexts. Some studies (Carmona-Perera et al., 2013, 2014; Khemiri et al., 2012) demonstrated that patients with severe alcohol use disorder (SAUD) present biased social decision making when confronted with traditional moral dilemmas (e.g., the "trolley problem" where a runaway trolley is about to kill five people present on its track, the participant being asked to choose between letting the trolley kill these five people or voluntarily diverting it on another track, killing another person; Foot, 1967). Such classical approach of moral psychology opposes utilitarian and deontological perspectives. On the one hand, utilitarianism is a consequentialist morality, evaluating an action solely based on expected consequences, hence prescribing to act in a way that maximizes collective well-being (Prairat, 2007; Sen, 1979). On the other hand, deontology considers the morality of the action itself, independently of its empirical circumstances (Prairat, 2007). In the trolley problem, the utilitarian response is to divert the trolley as this decision minimizes negative consequences (i.e., it leads to the death of one person instead of five), whereas the deontological response is to let the trolley go, preventing the participant to directly cause the death of another person. When compared to healthy controls, patients with SAUD show a utilitarian rather than deontological bias. These results suggested that the deficits reported among patients with SAUD for cognition and social cognition have a genuine impact on their ability to make moral and social decisions when confronted to close-to-real-life situations, paving the way for clinical interventions focused on these abilities. However, the question remains whether such moral decision-making abilities are also impaired in subclinical alcohol consumption patterns, and particularly in binge drinking.

Binge drinking (BD), characterized by the alternation between intense alcohol intoxications and abstinence periods (Maurage et al., 2020), constitutes the most prevalent consumption pattern in youth (Dormal et al., 2018; Grucza et al., 2009; Substance Abuse and Mental Health Services Administration, 2021). It is commonly defined as the repeated consumption of >56 g (women) or >70 g (men) of ethanol in less than 2 hr, bringing blood alcohol concentration to at least 0.08% (National Institute on Alcohol Abuse and Alcoholism, 2004). During the past 2 decades, a large amount of studies has shown that BD leads to rapid cerebral and cognitive consequences (Carbia et al., 2018; Lannoy et al., 2019; Pérez-García et al., 2022; Petit et al., 2013) and also to impairments in emotional and interpersonal abilities (Lannoy et al., 2021). Such evidence of cognitive and emotional deficits in BD led to the continuum hypothesis, suggesting that BD and SAUD would be associated with qualitatively similar impairments; BD might, therefore, constitute a first step toward SAUD (Bonomo et al., 2004; Lannoy et al., 2019). The continuum hypothesis, while largely supported by studies exploring cognition and social cognition, has not been tested for more complex and closer to real-life abilities and centrally for moral and social decision making. Indeed, while binge drinkers present reduced nonsocial decision-making abilities (notably explored through the Iowa Gambling Task, Goudriaan et al., 2007; Xiao et al., 2013), their ability to make efficient decisions in social or moral contexts remains unexplored.

Thus, we measured social decision making in BD through the innovative CNI model (Gawronski et al., 2017), overcoming the limits of the traditional approach of moral judgement. Indeed, this traditional approach presents several weaknesses, including (a) the lack of realism in the dilemmas used (Bauman et al., 2014; Gawronski et al., 2017); (b) the mere opposition between deontological and utilitarian responses, neglecting the fact that consequences and moral norms actually constitute independent factors (Conway & Gawronski, 2013); (c) the absence of manipulation of the central features of this opposition (Gawronski & Beer, 2017; Janoff-Bulman et al., 2009), as the traditional approach uses very homogeneous dilemmas involving a proscriptive norm and where the benefits of action systematically outweigh its costs (e.g., the trolley problem); and (d) the conflation between utilitarian judgment and action (as the option where someone chooses to act always corresponds to the utilitarian option) and hence between deontological judgments and inaction (Crone & Laham, 2017). To overcome these limitations, the CNI model compares the responses to four types of dilemmas involving different consequences and norms but also controlling for the general propensity to act or refrain from acting (action/inaction tendency; Gawronski et al., 2017, 2018). It thus allows to separately quantify the sensitivity to consequences (*C*) and moral norms (*N*; the two key aspects of utilitarianism and deontology), as well as the general preference for inaction versus action (*I*) in responses to moral dilemmas (CNI). All the dilemmas proposed in this model are moreover inspired by real-world cases, which increases their ecological validity (Gawronski et al., 2017). We compared young adults presenting BD habits with matched low drinkers on the CNI battery of moral dilemmas. According to the continuum hypothesis, we expected binge drinkers to display a utilitarian rather than deontological bias, as previously shown in SAUD.

Method

We performed our study in accordance with the ethical standards established by the Declaration of Helsinki, and it was approved by the ethics committee of the UCLouvain (Belgium). All participants provided written online informed consent before starting the study. At the end of the experiment, participants were debriefed and received financial compensation.

Transparency and Openness

We report how we determined all data exclusions, manipulations, and measures in the study. Materials, data, and analysis code for this study are available on Open Science Framework (https://osf.io/2qfsu/?view_only=f4c2221052274f188998aa5e88ae4941; Gautier et al., 2023). The study design and analyses were not preregistered.

Participants

We recruited 71 university students (35 binge drinkers, 36 matched controls) through social networks. The sample size was estimated by performing a priori power analyses in G*Power v3.1.9.7., on the basis of the weighted effect size available in studies exploring moral decision making in SAUD (Carmona-Perera et al., 2013, 2014; Khemiri et al., 2012) as no previous study was available in BD, and in studies using the CNI model to compare groups among

psychopathological populations (Gawronski et al., 2017), keeping only the CNI factor leading to the smallest effect size. These analyses showed that a sample size of 35 participants per group was needed to detect a 3 (C, N, I factors) × 2 (Binge Drinkers, Controls) interaction of small to medium size. Inclusion criteria for both groups were: (a) native French speakers; (b) no personal history of psychiatric or neurological disorder; (c) no psychotropic medications; (d) no first-degree relatives with a history of SAUD; and (e) absence of past year drug consumption, except for alcohol, tobacco, and cannabis (with a consumption frequency lower than once per month for cannabis). Inclusion criteria for binge drinkers were: (a) BD score higher than 24 (computed as follows: 4 × [number of alcohol units per hour] + [number of moderate/severe drunkenness episodes in the past year] + 0.2 × [percentage of moderate/severe drunkenness on all drinking occasions]; Townshend & Duka, 2002, 2005), (b) Alcohol Use Disorders Identification Test (AUDIT) score lower than 20 (Saunders et al., 1993), (c) ratio of at least 30% of BD episodes on all drinking occasions, and (d) at least three abstinence days per week. Inclusion criteria for the control group were: (a) BD score lower than 16, (b) AUDIT score lower than 8, (c) consumption of less than 10 alcohol units per week (one alcohol unit containing 10 g of pure ethanol), (d) a maximum of three alcohol units per day, and (e) not being a teetotaller. As acute alcohol consumption can modify moral decision making (Paruzel-Czachura et al., 2023), we asked all participants to refrain consuming alcohol in the 24 hr preceding testing. We matched groups for age, sex, and education level.

Procedure

We used the CNI-based extended battery of 48 social–moral dilemmas provided by Körner et al. (2020). We translated the dilemmas in French following a reversed translation method (Vallerand, 1989); the French dilemmas are available online through the above-mentioned Open Science Framework link. The task comprises 12 scenarios, each slightly modified to generate four dilemmas varying on the consequences, norms involved, and actions required. For each dilemma, participants had to decide whether they would perform the described action (yes/no). As in Gawronski et al. (2017), we explicitly told participants that some scenarios may seem similar at first glance, but vary regarding some details, so they had to pay close attention to each scenario. We included two attention checks in the middle and end of the task (i.e., a text of a similar length than the dilemmas but just requesting the participant to answer "yes").

To control for psychopathological comorbidities, participants filled in questionnaires assessing depressive symptoms (Beck Depression Inventory; Beck & Beck, 1972), anxiety (State–Trait Anxiety Inventory; Spielberger & Gorsuch, 1983), and social anxiety (Liebowitz Social Anxiety Scale; Liebowitz, 1987). Participants also completed an Empathy scale (Empathy Quotient; Baron-Cohen & Wheelwright, 2004) and the Inventory of Interpersonal Problems–64 (Horowitz et al., 2003). The whole procedure took place online using the Qualtrics software, and participants received 10 € as a compensation.

Statistical Analyses

We excluded one scenario (i.e., the *abduction dilemmas*) from the analyses as recommended by Gawronski et al. (2020), because this scenario presents poor construct validity for the manipulation of moral norms. The CNI model is based on multinomial processing tree modeling (see Supplemental Figure), a statistical method dissociating the contribution of different processes to a given task (Hütter & Klauer, 2016). We compared the BD and control groups on each parameter of the model (C, N, I) to disentangle the contribution of these processes (i.e., sensitivity to consequences, to moral norms, and inaction tendency) in moral decision making. We computed the sum of "action" response to the four types of moral dilemmas for each participant (ranging from 0 to 11). Based on these scores and using the R package *MPTinR* (Singmann & Kellen, 2013) with random start values, five replications, and a maximum of 90,000 iterations, we estimated the individual parameters of sensitivity to consequences (*C*), sensitivity to norms (*N*), and general preference for inaction over action regardless of consequences and norms (*I*) for each participant (a more detailed explanation of the analyses can be found in the Supplemental Materials). The R software reported a warning message, revealing that nine individuals presented a perfect sensitivity to norms, their *N* parameter hence being estimated to 1. The CNI is a hierarchical model (Gawronski et al., 2017) where the *C* parameter is estimated first, then the *N* parameter, and finally the *I* parameter. Given that to estimate the *I* parameter, we take the probability $1\text{-}C \times 1\text{-}N \times I$, and that $N = 1$ for these individuals, the R algorithm failed to converge and estimate the *I* parameter because $1\text{-}N = 0$. The hierarchy of the model cannot be modified as the *I* parameter is theoretically conditioned to the absence of C and *N* (i.e., it describes whatever data were not captured by *C* and *N*). If the *N* parameter equals 1, the *I* parameter is not defined, and we obtained different values each time the analysis was run. The *I* parameter can therefore not be computed for these nine individuals (i.e., five binge drinkers and four controls) and was coded as missing data. We reconducted the main analyses after excluding these participants for whom the CNI modeling yielded an error message. As these analyses led to identical results than those obtained on the whole sample, we do not report them.

Results

Demographic, Psychopathological, and Alcohol-Related Measures

As shown in Table 1, groups did not differ for age, $t(69) = .142$, $p = .887$; sex, $\chi^2(1) = .10$, $p = .919$; and education level, $t(69) = .356$, $p = .723$. Binge drinkers presented higher AUDIT score, $t(48.02) = 10.57$, $p < .001$, $d = 2.53$, and BD score, $t(34.79) = 8.92$, $p < .001$, $d = 2.15$, than controls. Binge drinkers reported more drinking days per week, $t(66) = 7.73$, $p < .001$, $d = 1.15$; alcohol units consumed per occasion, $t(43.95) = 8.99$, $p < .001$, $d = 2.16$; and per week, $t(35.46) = 7.07$, $p < .001$, $d = 1.70$; and drunkenness episodes in the last year, $t(34.13) = 5.81$, $p < .001$, $d = 1.40$. They also reported higher number of alcohol units consumed per hour, $t(60.17) = 8.59$, $p < .001$, $d = 2.05$, and percentage of drunkenness episodes on any drinking occasion, $t(56.70) = 18.51$, $p < .001$, $d = 4.42$.

Regarding psychopathological measures, groups differed on anxiety, with binge drinkers showing higher scores on trait, $t(69) = 2.06$, $p = .043$, $d = .49$, and state, $t(69) = 2.23$, $p = .029$, $d = .53$, anxiety. Groups did not differ on depression, social anxiety, and empathy scores. Regarding interpersonal problems, the only significant difference concerned the *Intrusive/Needy* subscale, with binge drinkers presenting higher scores, $t(69) = 2.34$, $p = .022$, $d = .55$.

Table 1

Demographic, Alcohol Consumption, and Psychopathological Measures for Binge Drinkers and Controls: Mean (and Standard Deviation)

Demographic, alcohol consumption, and psychopathological measure	Binge drinkers ($N = 35$)	Controls ($N = 36$)
Demographic measures		
Age	22.83 (2.63)	22.92 (2.59)
Education (in years since starting primary school)	15.54 (1.93)	15.36 (2.34)
Sex (female/male)	20/15	21/15
Alcohol consumption measures		
AUDIT score**	11.83 (4.00)	3.94 (1.88)
Binge-drinking score**	52.45 (29.80)	7.27 (3.25)
Number of drinking days per week**	2.36 (1.03)	1.30 (0.79)[a]
Number of alcohol units per drinking occasion**	7.00 (2.88)	2.31 (1.13)
Number of alcohol units per week**	15.29 (10.84)	2.19 (1.61)
Alcohol consumption speed**	2.69 (0.85)	1.19 (0.59)
Number of drunkenness episodes in the last 12 months**	29.10 (28.44)	1.14 (1.25)
Percentage of drunkenness episodes on any drinking occasion**	63.06 (15.06)	7.74 (9.39)
Psychopathological measures		
STAI-state anxiety*	40.14 (9.22)	35.14 (9.68)
STAI-trait anxiety*	48.43 (12.06)	42.58 (11.86)
BDI	6.54 (5.30)	5.17 (4.62)
LSAS	50.89 (22.02)	44.86 (21.40)
Anxiety	27.49 (11.97)	24.81 (11.22)
Avoidance	23.57 (11.56)	20.28 (11.27)
Empathy quotient	42.20 (12.47)	41.89 (10.85)
Cognitive empathy	5.26 (2.98)	4.72 (2.16)
Emotional reactivity	6.00 (2.62)	6.14 (2.33)
Social skills	4.46 (2.03)	4.72 (2.12)
Interpersonal problems		
IIP-64 total	90.66 (28.38)	86.14 (30.73)
Domineering	7.06 (4.03)	5.56 (4.02)
Self-centered	7.91 (4.30)	7.89 (4.46)
Cold/distant	8.40 (5.51)	7.94 (5.52)
Socially inhibited	11.66 (5.80)	12.72 (6.67)
Nonassertive	14.54 (5.38)	15.28 (6.80)
Overly accommodating	14.51 (5.91)	14.69 (5.85)
Self-sacrificing	15.94 (6.37)	14.28 (6.34)
Intrusive/needy*	10.37 (5.47)	7.44 (5.09)

Note. AUDIT = Alcohol Use Disorders Identification Test; STAI = State–Trait Anxiety Inventory; BDI = Beck Depression Inventory; LSAS = Liebowitz Social Anxiety Scale; IIP-64 = Inventory of Interpersonal Problems–64.

[a] Three missing data.

* $p < .05$. ** $p < .001$.

CNI Model

No data were missing or excluded as all participants succeeded the attention checks and completed the whole battery of dilemmas. The CNI model fit the data for 97.18% of the participants, with an α criterion of $p = .05$ for significant deviations between predicted and observed probabilities of *action* versus *inaction* responses. The summed fit score confirmed the goodness-of-fit of the model ($p = .750$).

Groups did not differ for *C*, $t(69) = 1.00$, $p = .318$; and *N*, $t(69) = .184$, $p = .854$, parameters. Given the nonnormal distribution of the data and the ceiling effect of the *I* parameter (half the participants having an *I* parameter estimated to 1), we tested the inaction tendency using a 0/1 binary logistic regression. Results revealed no group difference, $\chi^2(1) = 1.036$, $p = .309$. When analyzing the data within each group, both the *C* (binge drinkers: $M = .373$, $SD = 0.187$; controls: $M = .328$, $SD = 0.192$) and *N* (binge drinkers: $M = .623$, $SD = 0.254$; controls: $M = .634$, $SD = 0.248$) parameters were significantly greater than 0, indicating that participants were sensitive to both consequences, $t(34) = 11.80$, $p < .001$, $d = 1.99$, for binge drinkers; and $t(35) = 10.22$, $p < .001$, $d = 1.70$, for controls; and norms, $t(34) = 14.49$, $p < .001$, $d = 2.45$, for binge drinkers; and $t(35) = 15.34$, $p < .001$, $d = 2.56$, for controls. The *I* parameter (binge drinkers: $M = .841$, $SD = 0.203$; controls: $M = .745$, $SD = 0.305$) significantly deviated from their neutral reference point of 0.5, $t(29) = 9.21$, $p < .001$, $d = 1.68$ for binge drinkers and $t(31) = 4.55$, $p < .001$, $d = .80$ for controls, indicating a general preference for inaction in both samples.

No correlation emerged between the three parameters and our psychopathological and alcohol-related variables (see Supplemental Table).

Discussion

Previous studies using classical neurocognitive tasks showed the validity of the continuum hypothesis, suggesting that BD and SAUD share qualitatively similar impairments for cognitive abilities. We tested whether this hypothesis can be generalized to social decision making through the CNI model of moral decision making. The CNI model fit our data well, confirming its reliability. Centrally, we showed that the utilitarian bias identified earlier in SAUD is not found in BD, as binge drinkers did not differ from low drinkers on moral decision making: Groups were equally sensitive to consequences and moral norms, and both showed an inaction tendency. As our study was sufficiently powered, capitalized on a widely validated task, with a larger sample size than usually proposed in BD studies (e.g., Lannoy et al., 2017, 2018; Xiao et al., 2013) and strict inclusion criteria to differentiate the groups as well as to avoid the influence of biasing variables, our results support the proposal that, in this specific sample of binge drinkers and using the CNI model, the continuum hypothesis cannot be generalized to the higher level and closer-to-real-life ability that is moral decision making.

Although binge drinkers have well-established deficits on classic neuropsychological tasks focusing on specific functions in none-cological context, our results suggest that they would not present a significant difficulty or bias in more multidetermined and ecological tasks simultaneously involving a wide range of cognitive and social cognition abilities. Several reasons might explain this result. First, the CNI model and the associated task, in contradiction with classical neurocognitive tasks, are not designed to identify deficits per se, as no correct response is expected, but rather to detect subtle biases in moral decision making. As cognitive deficits would favor a deontological bias while socioemotional ones would favor a utilitarian bias, the joint presence of these two categories of deficits might result in an absence of bias in BD. Second, the compensation hypothesis suggests that binge drinkers could counterbalance their impairments in specific abilities by mobilizing other brain areas usually not related to the cognitive functions involved in the task (Lannoy et al., 2019; Maurage et al., 2013). As moral decision making requires a combination of various cognitive abilities, their impairment in specific subcomponents of the task (e.g., social cognition or decision making) might be masked using alternative cognitive resources allowing to perform the task efficiently. The multidetermined nature of moral decision making might thus constitute an advantage for binge drinkers, allowing them to compensate for deficits in some specific functions by mobilizing other resources. Such compensation would conversely be impossible for patients with SAUD, presenting a highly reduced cognitive reserve. Third, a major difference between BD and SAUD is that the latter suffer from intense social exclusion progressively reducing their social interactions. Conversely, BD often takes place in social contexts, especially in our sample of college students where fraternities/sororities and students associations have a primary importance, leading binge drinkers to frequently practice their interpersonal abilities. Moreover, binge drinkers do not report interpersonal difficulties in daily life and might thus present a preserved ability to perform tasks involving real-life social contexts, as shown here. Deficits in social decision making may thus increase when transitioning from BD to SAUD, with individuals progressively reducing social interactions and, hence, their ability to react appropriately in social or moral situations.

However, it should be acknowledged that, as previous studies exploring moral decision making in SAUD exclusively capitalized on the traditional approach, these earlier results cannot be directly compared to those obtained here with the CNI model. It would hence be useful to test the CNI model in SAUD to (a) determine whether patients with SAUD present biased moral decision making when explored through a more reliable approach and (b) directly compare groups with different alcohol consumption patterns, which would allow a more precise test of the continuum hypothesis. Indeed, the CNI model was for now only tested in acute alcohol consumption (Paruzel-Czachura et al., 2021), but the short-term cognitive, emotional, and cerebral consequences of acute alcohol consumption are distinct and noncomparable to the long-term ones generated by SAUD (Bernardin et al., 2014; Dry et al., 2012; Garrisson et al., 2021; Stavro et al., 2012). Moreover, other factors, including unmeasured emotional and cognitive variables, could have impacted our results, as they are known to play a role in moral decision making. For example, short-term positive emotions reduce sensitivity to moral norms (Gawronski et al., 2018). We show no correlation between the three parameters of the model and our psychological variables (e.g., depression, anxiety, social anxiety, empathy), but these questions should be addressed more deeply in future studies with larger sample sizes and more precise measures (e.g., current emotional state) to better address the correlations between the CNI parameters and cognitive or affective variables. Future studies specially focused on the mechanisms implied in the effect of alcohol consumption on moral decision making should use larger sample sizes to increase the probability to detect small to medium effect size, as done in previous studies exploring individual differences in the CNI model (e.g., Körner et al., 2020; Paruzel-Czachura & Farny, 2023). While our results offer valuable insights on the extension of the continuum hypothesis to complex social abilities by showing no deficit in moral decision making for binge drinkers, more studies on broader samples are needed. Moreover, our results should be extended through the exploration of moral decision making using other paradigms.

In conclusion, we showed preserved moral decision making in BD among a sample of college students. Our results suggest that the continuum hypothesis documented for classical neurocognitive functions may not extend to complex social abilities, but more studies on broader samples are needed to confirm this proposal. Such preservation of moral decision making in BD might be related to cerebral and cognitive compensation and to their apparently preserved social interactions. We propose that the later development of SAUD would lead to the appearence of these deficits through reduced cognitive reserve and impoverished social interactions.

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