Cloninger’s Temperament and Character Dimensions of Personality and Binge Drinking Among College Students

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ABSTRACT

**Background:** Temperament and character dimensions of personality remain largely unexplored in young adults exhibiting binge drinking patterns. Moreover, the available studies do not consider gender differences, and dismiss possible personality heterogeneity among binge drinkers. In the present study, we aimed to compare temperament and character dimensions between young binge drinkers and age- and sex-matched social drinkers. We further applied cluster analysis to investigate the potential heterogeneity of personality patterns among binge drinking college students.

**Methods:** This study included 200 university students of 18–24 years of age, who were recruited via an invitation to take an alcohol use survey. These participants included 100 individuals (50 female and 50 male) with a binge drinking pattern, and 100 participants (50 female and 50 male) with a social drinking pattern. These subjects were evaluated with regards to their use of alcohol and other substances, impulsiveness, sensation-seeking, mood, and Cloninger’s Temperament and Character Inventory.

**Results:** Between-group comparisons revealed that both male and female binge drinkers were characterized by high levels of novelty-seeking, and low levels of persistence and self-directedness. However, cluster analyses within the binge drinker group revealed two distinct groups that differed between males and females. These groups shared similarities with Cloninger’s type I (high harm-avoidance) and II (high novelty-seeking) alcoholism typology.

**Conclusions:** The present findings support the subdivision of binge drinkers according to gender and personality dimensions. Male and female binge drinkers should not be considered a unitary group, but rather a population of individuals that encompasses at least two distinct personality patterns. These findings have major implications for prevention and treatment approaches.

**Key Words:** Personality, Temperament and Character Inventory, Alcohol Consumption, Binge Drinking, Cluster Analysis.
INTRODUCTION

The National Institute on Alcohol Abuse and Alcoholism defines binge drinking as a drinking pattern that brings blood alcohol concentration to 0.8 g/l (NIAAA, 2004). This alcohol consumption pattern is widespread among college students, and is considered a key public health priority in several Western countries based on its important health and academic consequences (Lorant et al., 2013). Binge drinking is related to elevated risks of physical injury, brain damage, aggression, high-risk sexual behavior, academic problems, psychiatric consequences, and subsequent alcohol use disorders (Hingson, 2010; Kuntsche et al., 2017; Miller et al., 2007). Studies among university students repeatedly demonstrate that binge drinking is related to personality traits of impulsiveness (Caswell et al., 2016; Jones et al., 2014; Moreno et al., 2012) and sensation seeking (Hittner and Swickert, 2006; Meil et al., 2016). Other studies reveal that binge drinking is related to anxiety and depressive mood, especially among females (reviewed by Kuntsche et al., 2017). However, beyond the identification of these personality traits, few studies have investigated the association of binge drinking with personality as a whole, and with the dimensions of temperament and character.

According to the psychobiological model of temperament and character developed by Cloninger (1987), temperament describes biologically based personality predispositions that are innate and stable throughout life, while character is determined more by environment than heredity and refers to individual differences in self-concepts, goals, and values that influence voluntary choices (Cloninger, 2008; Cloninger et al., 1994). Cloninger and colleagues (1994) described four dimensions of temperament: novelty-seeking (the tendency to respond to novel rewarding stimuli), harm-avoidance (one’s inclination to avoid harm), reward-dependence (the strength of one’s response to cues of social reward), and persistence (perseverance despite frustration and fatigue). There are also three dimensions of character: self-directedness (the ability to control and adapt one’s behavior in a situation in accordance with one’s goals and values), cooperativeness (the ability to empathize and cooperate with others), and self-transcendence (associated with spirituality). These three
dimensions of character are reportedly related to mental health and well-being in samples of adults
and adolescents (Cloninger and Zohar, 2011; Josefsson et al., 2011; Moreira et al., 2014).

Temperament and character dimensions can be evaluated using the Temperament and
Character Inventory (TCI) (Cloninger et al., 1994; Cloninger et al., 1993). This 240-item self-
questionnaire has been extensively applied in studies of alcohol use disorders (Foulds et al., 2017;
Oreland et al., 2017), and the results commonly emphasize a relationship between high novelty-
seeking behavior and predisposition to alcohol use (Basiaux et al., 2001; Cloninger et al., 1995;
Howard et al., 1997). Moreover, Cloninger et al. (1981; 1996) identified two distinct alcoholism
subtypes. Type I alcoholism is characterized by low scores on novelty-seeking and high scores on
harm-avoidance, and is associated with late-onset alcohol use, low heritability, a balanced gender
ratio, few social problems, and strong environmental influence. Type II alcoholism is characterized
by high scores on novelty-seeking and low scores on harm-avoidance, and with early-onset alcohol
use, strong genetic influence, an unbalanced gender ratio [initially limited to men; however, this
unbalanced gender ratio was challenged by Babor et al. (1992b)], severe alcoholism, little
environmental influence, and frequent antisocial personality disorder. Individuals with type I
alcoholism tend to drink alcohol as a coping strategy to relieve anxiety, while those with type II
alcoholism tend to drink to induce euphoria.

Wills et al. (1994) investigated the role of personality in the developmental course of the
initiation of substance use (including alcohol, marijuana, and tobacco) in adolescents of 12 to 15
years of age, and found that substance use was associated with high levels of novelty-seeking and
low levels of harm-avoidance and reward-dependence. Cluster analysis revealed five different
profiles, with some adolescents characterized by high levels of novelty-seeking and others by low
levels. More recently, Adams et al. (2003) investigated a sample of adolescent males of 13 to 19
years of age who were seeking treatment for substance abuse and delinquency, and also found high
levels of novelty-seeking and low levels of reward-dependence. In contrast, the substance abuse
group showed higher harm-avoidance levels than the control group. Examination of the motives for substance use revealed that individuals with high novelty-seeking levels were motivated by obtaining positive rewards, whereas those with low novelty-seeking levels were motivated by avoiding negative emotions or negative life experiences. Finally, prospective studies conducted in a community sample of adolescents (Hartman et al., 2013) or among twins (Palmer et al., 2013) show that novelty-seeking is a significant and important predictor of later substance use disorder or substance dependence, particularly with regards to alcohol. Overall, the results of prior studies emphasize the roles of personality dimensions, particularly novelty-seeking, in the development of substance use disorders and dependence. The available data also suggest that these disorders are not related to a unique personality profile.

Although binge drinking is an active research domain, only two studies have examined how binge drinking behavior is related to character and dimensions of personality, and only one of these studies was conducted among college students. Townshend & Duka (2005) used the TCI in a sample of college students, and found no significant differences between binge drinkers and non-binge drinkers with regards to the seven personality dimensions. However, the study included small numbers of participants in each subgroup, and the groups included unequal numbers of males and females. Notably, gender effects have been reported on several TCI dimensions, including harm-avoidance and reward-dependence (Miettunen et al., 2007). More recently, in a community sample of adolescents (mean age, 14.5 years) from eight European study sites, Montigny et al. (2013) used the TCI to investigate the relationship between novelty-seeking and several externalizing behaviors, including binge drinking. They showed that binge drinking behavior was significantly loaded on a latent externalizing factor that was significantly correlated with novelty-seeking.

In summary, it remains unclear whether binge drinking behavior is associated with the dimensions of temperament and character evaluated by the TCI. Importantly, these dimensions have not been investigated among college students, with consideration of gender-related differences in
personality make-up. To address these gaps in the current knowledge, here we evaluated how temperament and character dimensions of personality were related to binge drinking behavior among male and female college students, with the aim of providing a more comprehensive view of the personality patterns associated with this behavior. We hypothesized that students exhibiting a binge drinking pattern would have higher levels of novelty-seeking compared to individuals showing a social drinking pattern. We further hypothesized that binge drinkers would be an inhomogeneous group with regards to temperament and character, and we examined this assumption using cluster analysis.

MATERIALS AND METHODS

Procedure and Participants

For this study, we recruited 391 participants (age, 18–24 years; 215 female and 176 male; predominantly Caucasians) among students at two French universities (Amiens and Reims). Recruitment of university students was performed via an advertisement inviting social drinkers to participate in a study of the relationship between social drinking, mood, and personality. We excluded total abstainers ($n = 8$), individuals with an IQ lower than 80 ($n = 18$), and those with a Beck Depression Inventory-II (BDI-II) score of $>27$ (the cut-off for severe depression symptoms in the French version) ($n = 8$). This filtering strategy was utilized to ensure that all participants were exposed to alcohol and had sufficient intellectual abilities to correctly complete the questionnaires, and to avoid potential confounding effects of depressive disorders on personality measures (for example, see Zaninotto et al., 2016). For each participant, we used the modified Alcohol Use Questionnaire (Mehrabian and Russell, 1978) to compute a binge drinking score, with cut-off points of $\leq 16$ indicating social drinking behavior (SD) and $\geq 24$ indicating binge drinking behavior (BD) as proposed by Townshend & Duka (2005). Using the upper cut-off, we identified a group of 50 BD females. We then randomly selected a group of 50 BD males that matched the female BD group
based on their binge drinking scores $[t(98) = 0.801; p = 0.42]$. Using the lower cut-off value, we identified a random group of 50 SD males and we selected a group of 50 SD females with matching binge drinking scores $[t(98) = 0.378; p = 0.70]$. Table 1 displays characteristics of the four groups.

None of the participants reported any current or previous psychiatric or neurological disorders, and all participants were free of any psychotropic medication. Participants were asked to abstain from alcohol or other recreational drugs prior to the evaluations. In accordance with the Declaration of Helsinki, all participants freely gave their formal written informed consent prior to study enrollment.

### Measures

**Alcohol Use Questionnaire (AUQ) and Binge Drinking Score.** For each participant, we obtained a quantity-frequency index of their alcohol use for the previous six months using a revised version of the Alcohol Use Questionnaire initially developed by Merhabian & Russel (1978). The utilized version enabled calculation of the weekly level of alcohol use (units of alcohol per week, with one unit defined as 10 g of pure ethanol). We also calculated a binge drinking score based on the information regarding the speed of drinking (average drinks per hour on drinking occasions), number of times being drunk in the previous six months, and the percentage of times getting drunk when drinking (Townshend and Duka, 2002).

**Alcohol Use Disorders Identification Test (AUDIT).** The AUDIT comprises 10 questions regarding recent alcohol use, alcohol dependence symptoms, and alcohol-related problems. The summary score ranges from 0, indicating no problem drinking behavior, to 40, indicating marked levels of problem drinking behavior and alcohol dependence (Babor et al., 1992a).
Familial History of Alcohol Use and Age at First Drink. We used the Family Informant Schedule and Criteria (FISC; Mannuzza et al., 1985) and performed a structured interview to acquire information regarding familial history of alcohol use and age at first drink. Participants were considered to have a positive family history of alcohol use if they reported having at least one first-degree (parents and siblings) or second-degree (grandparents) family member with a past or present alcohol use disorder. Age at first drink was determined by asking the participants how old they were when they first start drinking alcoholic beverages, not including small tastes.

Use of Other Substances. We assessed tobacco consumption by inquiring about current cigarette smoking habits, and current smokers were evaluated with the Fagerström test for nicotine dependence (Heatherton et al., 1991). We also collected information about lifetime and regular (≥1 joint per week) use of cannabis.

Temperament and Character Assessment. The Temperament and Character Inventory, 125-item short version (TCI-125) is a self-report questionnaire with a “true/false” response format, which is designed to measure dimensions of Cloninger’s model of personality. We utilized the validated French version of this questionnaire (Chakroun-Vinciguerra et al., 2005), which has very good reliability, internal consistency, and stability over time. The final scores are rates of endorsement for each dimension, with a maximum value of 100%.

Intellectual Ability. We evaluated intellectual ability using the short-form version of the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III; Wechsler, 1997), which includes the Vocabulary, Similarities, Digit-Symbol-Coding, and Matrix Reasoning subtests (Grégoire and Wierzbicki, 2009).
Impulsiveness and Sensation Seeking. Impulsiveness was assessed using the 30 items of the Barratt Impulsiveness Scale (BIS-11; Bayle et al., 2000). Sensation seeking was assessed using the 40 items of the Sensation-Seeking Scale Form V (SSS-V; Loas et al., 2001). The total scores of these two self-reported questionnaires were considered as the variables of interest.

Anxiety and Depression. Anxiety was evaluated using the Spielberger’s State and Trait Anxiety Inventory (STAI; Spielberger et al., 1983). Depression was assessed using the BDI-II (Beck et al., 1996).

Statistical Analysis

Characteristics of the BD and SD Groups. We evaluated between-group differences in demographic and clinical characteristics using univariate analysis of variance (ANOVA) with the BD and SD groups and gender as between-subject factors for continuous variables, and using logistic regression analyses for categorical variables. We conducted a series of binary logistic regression analyses to assess the main and interactive effects of gender and group. The reference group was females (dummy coded as 0) for gender analyses, and was the SD group (dummy coded as 0) for group analyses. We performed hierarchical logistic regression analyses with both main effects entered at the first step, and all product terms for the gender × group interaction entered at the second step. We evaluated model fit using the $\chi^2$ statistic according to the procedures outlined by Jaccard (2001). To assess between-groups differences in the dimensions of temperament and character, we performed multivariate analysis of variance (MANOVA) followed by two-way ANOVA on the seven TCI-125 scores.
Cluster Formation and Analysis. To examine the potential heterogeneity of personality patterns among BD participants, we performed two-step cluster analysis using IBM-SPSS (version 23). This analysis was performed using an auto-clustering method, i.e., the number of clusters was not predetermined by the experimenter. In the first step, clusters are identified using quantitative and qualitative variables based on the distance criterion (log likelihood or Euclidean distance). In the second step, a hierarchical clustering method is used to assess multiple cluster solutions, and to automatically determine the optimal number of empirical clusters based on Bayesian or Akaike information criteria (BIC or AIC, respectively). Schematically, smaller BIC or AIC values associated with higher changes in the BIC or AIC ratio indicate an optimal model (Hair et al., 2014).

We considered three temperamental scores (novelty-seeking, harm-avoidance, and reward-dependence) as qualitative variables. Separate analyses were conducted for males and females to specifically characterize their profiles, and because of previously reported effects of gender on these temperaments dimensions. These analyses did not include any qualitative variable. We applied the log-likelihood distance measure to compute the likelihood distance between clusters, with participants assigned to the cluster leading to the largest likelihood. The Bayesian information criterion was used to select the number of clusters.

Clustering methods are reportedly sensitive to outliers and multicollinearity issues (Hair et al., 2014); therefore, we computed the Mahalanobis distance of the three clustering variables separately for each gender, as well as the variance inflation factors (VIFs). The Mahalanobis distance indicated that no participant was under the critical $\chi^2 \ p$ value ($p < 0.001$). VIFs ranged from 1.03 to 1.40, indicating no multicollinearity issues, since only VIFs values of $< 3$ can potentially result in estimation problems (Hair et al., 2014). To assess the effects of clustering and gender on the various measurements, we performed two-way ANOVAs with gender and cluster as fixed factors for continuous variables, and we performed binary logistic regressions for categorical variables. The effect sizes of ANOVAs and MANOVAs were estimated by computing partial eta-squared.
significance level was set at 5% and Bonferroni correction was applied.

RESULTS

Description of the Samples

Table 1 summarizes the background characteristics of the SD and BD groups with stratification for gender. The SD and BD groups did not significantly differ with regards to age, education level, or general intellectual abilities. As expected, substance use data revealed higher alcohol-related scores in the BD groups compared to the SD groups. However, the two groups did not significantly differ in age at first drink \( [F(1, 96) = 2.143; \ p = 0.143; \ \eta^2_p = 0.01] \). Compared to the SD group, the BD group showed significantly higher self-rated impulsiveness \([\text{BIS-11}: F(1, 196) = 31.83; \ p < 0.001; \ \eta^2_p = 0.25]\) and sensation seeking \([\text{SSS-V}: F(1, 196) = 78.53; \ p < 0.001; \ \eta^2_p = 0.29]\).

In contrast, the groups did not differ with regards to depression and anxiety assessments \((p > 0.57\) for all differences). The results of binary logistic regression analysis after controlling for gender revealed a significant effect of group on lifetime cannabis use, with binge drinkers having \(3.25\times\) greater odds of lifetime cannabis consumption compared to social drinkers \((\text{adjusted odd-ratio} = 3.25; \ p < 0.001)\).

No adjusted gender or interaction effect reached a significant \(p\) value.

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\textbf{TCI Dimensions Among Binge Drinkers as a Unitary Group} & \\
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The MANOVA performed on the seven dimensions of the TCI revealed significant effects of group \([\text{Wilk’s lambda} = 0.740, F(7, 190) = 9.516, \ p < 0.001; \ \eta^2_p = 0.26]\) and gender \([\text{Wilk’s lambda} = 0.817, F(7, 190) = 6.09, \ p < 0.001; \ \eta^2_p = 0.18]\), as well as a significant group \(\times\) gender interaction & \\
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[Wilk’s lambda = 0.922, F(7, 190) = 2.97, p = 0.029; \eta^2_p = 0.08]. With regards to temperamental dimensions, consecutive univariate analyses revealed that BD participants exhibited higher novelty-seeking scores [F(1, 196) = 54.43; p < 0.001; \eta^2 = 0.22] and lower persistence scores [F(1, 196) = 10.48; p = 0.001; \eta^2_p = 0.05] compared to SD participants. Harm-avoidance dimension scores were lower in the BD group than the SD group, but this difference failed to reach significance based on the Bonferroni-adjusted p value [F(1, 196) = 6.53; p = 0.011; \eta^2_p = 0.03]. With regards to character dimensions, the BD group showed significantly lower self-directedness than the SD group [F(1, 196) = 9.86; p = 0.002; \eta^2 = 0.05]. Our analysis of gender effects revealed that women had significantly higher harm-avoidance dimension scores than men [F(1, 196) = 21.70; p < 0.001; \eta^2_p = 0.10]. No interaction effect reached a significant Bonferroni-adjusted p value. Table 2 displays the mean scores and standard deviations for the seven dimensions of the TCI in the BD and SD groups, with stratification for gender, as well as detailed p values for the resulting univariate analyses.

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**TCI Dimensions Among Binge Drinkers as a Non-Unitary Group**

Two-step cluster analysis yielded two subgroups within the male BD group, and two subgroups within the female BD group, with no excluded cases. The distribution between clusters was comparable between the two genders [\chi^2 = 0.361; p = 0.548], suggesting that the four groups could be compared using a 2 (cluster) × 2 (gender) series of ANOVAs.

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As expected, with regards to clustering variables, we found that cluster had significant effects on novelty-seeking [F(1, 96) = 100.89; p < 0.001; \eta^2_p = 0.51] and on harm-avoidance [F(1, 96) =
77.47; \( p < 0.001; \eta^2_p = 0.45 \) and gender \([F(1, 96) = 43.87; p < 0.001; \eta^2_p = 0.31]\). We did not identify any significant effects on reward-dependence \((p > 0.32 \text{ for all differences})\). For both genders, Cluster 1 included individuals with low novelty-seeking and high harm-avoidance scores, while Cluster 2 included individuals with high novelty-seeking and low harm-avoidance scores (see Table 3).

With regards to external variables, we found that cluster had significant effects on BIS-11 \([F(1, 96) = 31.83; p < 0.001; \eta^2_p = 0.25]\) and SSS-V \([F(1, 96) = 18.89; p < 0.001; \eta^2_p = 0.16]\), with higher scores in individuals from Cluster 2. We also found that cluster had a significant effect on STAI-state \([F(1, 96) = 12.44; p = 0.001; \eta^2_p = 0.11]\), with higher scores in individuals from Cluster 1.

**Comparison of TCI Dimensions Between Clustered Groups and the Control Group**

To test whether the BD Clusters differed from the SD group with regards to novelty-seeking and harm-avoidance, we performed two consecutive ANOVAs with group (Cluster 1, Cluster 2, SD) and gender (male, female) as between variables. Group had a significant effect on novelty-seeking \([F(2, 194) = 78.70; p < 0.001; \eta^2_p = 0.45]\). Bonferroni-corrected post-hoc comparisons revealed that for both genders, the Cluster 2 subgroups showed significantly higher novelty-seeking levels compared to Cluster 1 and the SD group \((p < 0.001 \text{ for all comparisons})\). On the other hand, the Cluster 1 subgroups did not significantly differ from the SD group \((p > 0.753)\). We also found that harm-avoidance was significantly affected by group \([F(2, 194) = 31.74; p < 0.001; \eta^2_p = 0.25]\) and gender \([F(1, 194) = 37.55; p < 0.001; \eta^2_p = 0.16]\), and that there was a significant group × gender interaction \([F(2, 194) = 5.16; p = 0.007; \eta^2_p = 0.05]\). Bonferroni-corrected post-hoc comparisons revealed that harm-avoidance levels were significantly lower in Clusters 2 compared to in Clusters 1 and the SD group for both genders \((p < 0.002)\), and that females had higher harm-avoidance levels than males. Importantly, harm-avoidance was not significantly different between Cluster 1 and the SD group among men \((p = 1)\), but it was significantly higher in Cluster 1 than in the SD group among females \((p = 0.001)\). Figure 1 displays a graphical comparison of the means and standard deviations.
of novelty-seeking and harm-avoidance in the six groups.

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DISCUSSION

In the present study, our first aim was to compare the temperament and character dimensions of young healthy male and female college students exhibiting a pattern of binge drinking behavior versus a matched group of individuals showing a non-binge social drinking behavior. Our second aim was to explore whether the individuals exhibiting a binge drinking pattern could be considered a homogeneous group based on these TCI personality dimensions.

Our initial analysis involved comparisons of demographics and other characteristics between binge drinkers and social drinkers. The results showed that alcohol-related measures and the prevalence of lifetime cannabis use were higher in male and female binge drinkers than in male and female social drinkers. Consistent with previous data from the literature, we also found that the binge drinking groups showed higher levels of impulsivity (Caswell et al., 2016; Moreno et al., 2012) and sensation seeking (Hittner and Swickert, 2006; Meil et al., 2016). Partial eta-squared values indicated that these effects were large, supporting the concept that impulsiveness and sensation seeking are risk markers for excessive and problematic alcohol use among young adults. On the other hand, age at first drink did not significantly differ between any groups, as could be hypothesized (Morean et al., 2014). However, a recent review of the literature suggests that age at first drink shows poor test-retest reliability, and that the definition varies widely, such that it is unsuitable for use as an indicator of later alcohol-related problems (Kuntsche et al., 2016). Finally, our binge drinking and social drinking groups were comparable in terms of depression and anxiety, thereby excluding any potential confounding effects from these variables on the temperament and character measures (Ball et al.,...
With regards to temperament and character dimensions, multivariate analyses revealed higher levels of novelty-seeking and lower levels of persistence and self-directedness among male and female binge drinkers (considered as two unitary groups) compared to social drinkers. The observation of high novelty-seeking among binge drinkers is consistent with previous data from studies of substance use among university students (Bidwell et al., 2015; Meil et al., 2016; Montigny et al., 2013), as with the vast data from alcoholic patients (Foulds et al., 2017; Noel et al., 2011). Our present findings are also consistent with the relationship between novelty-seeking behaviors and the neurobiological processes involved in addictions (Wingo et al., 2016).

The observed low persistence levels in our binge drinking group are linked to behavior traits such as changeable, irresolute, and easily discouraged (Cloninger et al., 1993). Persistence is related to a brain circuit involving the ventral striatum, including the nucleus accumbens (Gusnard et al., 2003), which is considered a key region in the processing of reward-related stimuli, including those associated with drug abuse (Volkow and Morales, 2015). Although studies using the TCI found no significant differences in persistence between adult alcohol-dependent patients and controls (Basiaux et al., 2001), a study of adolescents (13 to 18 years of age) revealed that low persistence levels predicted earlier alcohol initiation and later development of substance use disorders (Hartman et al., 2013). These authors theorized that the immediacy of reward from substances could be far more reinforcing for individuals with low persistence, putting them at greater risk for substance use.

The low self-directedness levels among our sample of binge drinkers denote low levels of self-determination. This difference did not originate from higher depression levels, as found among patients with major depressive disorders (Celikel et al., 2009), since our BD and SD groups did not significantly differ in Beck Depression Inventory scores. Low levels of self-directedness have been reported among non-alcoholic female relatives of alcohol-dependent probands (Raucher-Chene et al., 2012), and a pattern of low self-determination and cooperativeness is considered a core feature of
personality disorders (Svrakic et al., 1993). Thus, this pattern could reflect a vulnerability pathway with alcohol use as a strategy for coping with mood and/or personality disorders (Norberg et al., 2010).

Cluster analysis results in the identification of two distinct clusters among male and female binge drinkers, enabling a reinterpretation of our initial findings. Cloninger’s type I and type II typology describes one subgroup characterized by high novelty-seeking and low harm-avoidance, and another subgroup characterized by low novelty-seeking and high harm-avoidance. While the original model indicated a gender imbalance between groups (Cloninger et al., 1981), our present findings showed that both clusters contained equal numbers of males and females, confirming the report of Babor et al. (1992b). However, we found that novelty-seeking and harm-avoidance levels in Clusters 1 and 2 significantly differed from those of the SD group among women, while only Cluster 2 significantly differed from the SD group among men. Moreover, contrary to Cloninger’s typology, the two presently identified clusters did not significantly differ with regards to age at first drink or family history of alcoholism.

Our present analysis provides new evidence that binge drinking behavior is not related to a unique pattern of personality. We identified at least two main opposite clusters: one characterized by a high novelty-seeking, low harm-avoidance, and high impulsivity and sensation-seeking; and the other characterized by lower novelty-seeking, higher harm-avoidance, lower impulsivity, and higher anxiety.

These findings have potential implications for clinical practice and for prevention of alcohol misuse among college students. Firstly, they prompt reexamination of the individual determinants of binge drinking behavior from the view of a non-homogeneous population, and consideration of the existence of at least two major subgroups that are related to Cloninger’s typologies. Secondly, our findings suggest that prevention campaigns or programs must be able to account for this heterogeneity. For instance, prevention and intervention programs commonly target protective
behavioral strategies, which can reportedly moderate the relationship between impulsive sensation seeking and binge drinking, and personality-targeted interventions may help reduce binge drinking behavior among highly impulsive sensation-seeking college students (Borden et al., 2011). On the other hand, binge drinkers of the low novelty-seeking and high harm-avoidant subtype may be more receptive to prevention campaigns emphasizing the harm associated with binge drinking, such as alterations of cognitive functions (Scaife and Duka, 2009; Townshend and Duka, 2005) or brain structures (Maurage et al., 2012; Smith et al., 2017). At the clinical level, harm-avoidant binge drinkers could benefit from targeted interventions that improve positive emotions, such as well-being therapy (Berman et al., 2015), or from metacognitive interpersonal therapy focused on both substance abuse and co-occurring avoidant personality disorders (Dimaggio et al., 2015).

The present results must be considered in the context of several study limitations. This study was exclusively based on retrospective self-reported measures of alcohol consumption, raising the possibility of errors in recall or evaluation. With respect to the examined sample, it entirely comprised university students and a sizable majority was Caucasian, limiting generalization of the findings to the whole population. We matched the male and female binge drinking populations based on their intensity of binge drinking, with the intent of comparing their personality patterns at comparable levels of alcohol misuse. However, in natural settings, males have higher binge drinking scores than females and might therefore have sharper personality patterns. Similarly, we excluded participants with high scores on the Beck Depression Inventory. This was done to prevent the potential confounding effect of severe depression symptoms on the TCI; however, it may have influenced the clinical characteristics of the groups, such as the harm-avoidant binge drinkers.

In conclusion, our present results provide first evidence that binge drinking behavior is associated with specific personality patterns, and that binge drinkers may not be considered a homogeneous group. Among male binge drinkers, half were characterized by high levels of impulsivity, novelty-seeking, and sensation-seeking and low levels of harm-avoidance; while the
other half exhibited the opposite pattern. Among the latter group, the etiology of binge drinking
might originate from other factors. Among female binge drinkers, nearly half were characterized by
high levels of impulsivity, novelty-seeking, and sensation-seeking and by low levels of harm-
avoidance; while the others exhibited the reverse pattern and displayed higher levels of state anxiety.
This heterogeneity among young adults exhibiting binge drinking behaviors is in line with recent
findings relating to drinking motives and impulsivity among binge drinkers (Lannoy et al., 2017).
These results highlight the necessity of using differentiated approaches at both the prevention and the
clinical levels.

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<th></th>
<th>Binge Drinkers</th>
<th>Social Drinkers</th>
<th>Inferential statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n = 50)</td>
<td>Females (n = 50)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>20.18 (1.53)</td>
<td>20.12 (1.49)</td>
<td>20.62 (1.48)</td>
</tr>
<tr>
<td>Education Level</td>
<td>12.78 (1.09)</td>
<td>12.98 (1.27)</td>
<td>12.98 (1.28)</td>
</tr>
<tr>
<td>WAIS-III SF-IQ</td>
<td>98.68 (9.86)</td>
<td>97.06 (9.68)</td>
<td>98.52 (9.40)</td>
</tr>
<tr>
<td>Binge drinking scores</td>
<td>35.74 (11.58)</td>
<td>33.88 (11.65)</td>
<td>7.80 (3.70)</td>
</tr>
<tr>
<td>Drink speed</td>
<td>3.60 (1.38)</td>
<td>3.44 (1.33)</td>
<td>1.53 (0.77)</td>
</tr>
<tr>
<td>Past 6 month episodes of drunkeness</td>
<td>12.46 (10.99)</td>
<td>9.32 (8.30)</td>
<td>0.24 (0.47)</td>
</tr>
<tr>
<td>% of drunkenness by occasion</td>
<td>44.40 (23.38)</td>
<td>54.00 (20.80)</td>
<td>7.30 (5.99)</td>
</tr>
<tr>
<td>Alcohol units by week</td>
<td>10.78 (7.43)</td>
<td>8.45 (8.93)</td>
<td>2.49 (3.17)</td>
</tr>
<tr>
<td>Age started drinking</td>
<td>14.38 (1.80)</td>
<td>15.02 (1.63)</td>
<td>14.98 (1.99)</td>
</tr>
<tr>
<td>Fagerström a</td>
<td>3.65 (0.42)</td>
<td>3.25 (0.50)</td>
<td>3.29 (0.65)</td>
</tr>
<tr>
<td>BIS-11</td>
<td>66.10 (11.45)</td>
<td>64.38 (10.27)</td>
<td>58.48 (9.55)</td>
</tr>
<tr>
<td>Sensation-Seeking-Scale-V</td>
<td>25.58 (4.95)</td>
<td>23.88 (5.99)</td>
<td>17.82 (6.04)</td>
</tr>
<tr>
<td>Beck Depression Inventory-II</td>
<td>7.14 (4.80)</td>
<td>8.08 (6.04)</td>
<td>6.98 (5.88)</td>
</tr>
<tr>
<td>STAI-Trait</td>
<td>35.22 (7.09)</td>
<td>39.88 (9.83)</td>
<td>36.88 (9.37)</td>
</tr>
<tr>
<td>STAI-State</td>
<td>31.10 (7.31)</td>
<td>34.20 (9.79)</td>
<td>31.38 (8.47)</td>
</tr>
</tbody>
</table>

**Note:** Data are presented as Mean (SD), unless otherwise specified; for binary logistic regression Females and Social Drinkers were the reference groups; WAIS-III SF = Wechsler Adult Intelligence Scale 3rd Edition short form, AUDIT = Alcohol Use Disorders Identification Test; BIS = Barratt Impulsiveness Scale; STAI = State-Trait Anxiety Inventory; * among current cigarette smokers. AOR = Adjusted odds ratios; 95% CI = 95% confidence interval; * = p < 0.05; ** = p < 0.01; *** = p < 0.001. Significant Bonferroni corrected p-values are indicated in bold characters.
Table 2. Comparison of the seven dimensions of the TCI-125 between Binge drinkers and Social Drinkers according to gender.

<table>
<thead>
<tr>
<th></th>
<th>Binge Drinkers</th>
<th>Social Drinkers</th>
<th>Inferential statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n= 50)</td>
<td>Females (n= 50)</td>
<td>Males (n= 50)</td>
</tr>
<tr>
<td><strong>Temperament dimensions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novelty-Seeking</td>
<td>59.00 (17.81)</td>
<td>55.60 (20.24)</td>
<td>41.20 (17.54)</td>
</tr>
<tr>
<td>Harm-Avoidance</td>
<td>31.60 (20.54)</td>
<td>51.50 (24.77)</td>
<td>44.80 (21.62)</td>
</tr>
<tr>
<td>Reward-Dependence</td>
<td>61.22 (16.72)</td>
<td>62.30 (21.15)</td>
<td>59.36 (19.59)</td>
</tr>
<tr>
<td>Persistence</td>
<td>40.80 (30.49)</td>
<td>48.00 (33.81)</td>
<td>54.80 (27.05)</td>
</tr>
<tr>
<td><strong>Character dimensions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Directedness</td>
<td>62.48 (18.46)</td>
<td>67.76 (17.89)</td>
<td>71.84 (14.36)</td>
</tr>
<tr>
<td>Cooperativeness</td>
<td>72.88 (14.91)</td>
<td>69.92 (19.31)</td>
<td>74.48 (15.54)</td>
</tr>
<tr>
<td>Self-Transcendence</td>
<td>33.34 (21.52)</td>
<td>23.18 (16.44)</td>
<td>25.84 (16.73)</td>
</tr>
</tbody>
</table>

*Note: * = p < 0.05; ** = p < 0.01; *** = p < 0.001. Significant Bonferroni corrected p-values are indicated in bold characters.
Table 3. Comparison of Male and Female Binge Drinker Clusters on TCI scores and clinical variables.

<table>
<thead>
<tr>
<th></th>
<th>Male Binge Drinkers</th>
<th>Female Binge Drinkers</th>
<th>Inferential statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cluster 1</td>
<td>Cluster 2</td>
<td>Cluster 1</td>
</tr>
<tr>
<td></td>
<td>(N = 25, 50%)</td>
<td>(N = 25, 50%)</td>
<td>(N = 22, 44%)</td>
</tr>
<tr>
<td>Clustering variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCI Novelty-Seeking</td>
<td>45.40 (12.41)</td>
<td>72.60 (10.42)</td>
<td>40.45 (14.55)</td>
</tr>
<tr>
<td>TCI Harm-Avoidance</td>
<td>41.60 (20.75)</td>
<td>21.60 (14.91)</td>
<td>73.41 (12.76)</td>
</tr>
<tr>
<td>TCI Reward-Dependence</td>
<td>62.16 (19.22)</td>
<td>60.28 (14.13)</td>
<td>65.55 (23.48)</td>
</tr>
<tr>
<td>External variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCI Persistence</td>
<td>37.60 (29.62)</td>
<td>44.00 (31.62)</td>
<td>43.64 (37.36)</td>
</tr>
<tr>
<td>TCI Self-Directedness</td>
<td>64.00 (21.23)</td>
<td>60.96 (15.50)</td>
<td>66.55 (17.87)</td>
</tr>
<tr>
<td>TCI Cooperativeness</td>
<td>77.76 (12.71)</td>
<td>68.00 (15.58)</td>
<td>69.09 (20.29)</td>
</tr>
<tr>
<td>TCI Self-Transcendence</td>
<td>27.72 (15.55)</td>
<td>38.96 (25.26)</td>
<td>24.77 (19.36)</td>
</tr>
<tr>
<td>Binge drinking scores</td>
<td>30.28 (7.22)</td>
<td>41.20 (12.63)</td>
<td>32.32 (12.42)</td>
</tr>
<tr>
<td>Drink speed</td>
<td>3.32 (0.94)</td>
<td>3.88 (1.69)</td>
<td>3.41 (1.37)</td>
</tr>
<tr>
<td>% of drunkenness by occasion</td>
<td>8.84 (6.17)</td>
<td>16.08 (13.47)</td>
<td>7.50 (6.97)</td>
</tr>
<tr>
<td>Alcohol units by week</td>
<td>40.80 (18.46)</td>
<td>48.00 (27.35)</td>
<td>55.91 (20.16)</td>
</tr>
<tr>
<td>Age started drinking</td>
<td>14.24 (1.92)</td>
<td>14.52 (1.71)</td>
<td>15.23 (1.60)</td>
</tr>
<tr>
<td>AUDIT</td>
<td>9.76 (2.99)</td>
<td>12.48 (5.39)</td>
<td>10.59 (4.36)</td>
</tr>
<tr>
<td>Fagerström a</td>
<td>3.14 (1.34)</td>
<td>4.00 (2.49)</td>
<td>2.20 (0.84)</td>
</tr>
<tr>
<td>BIS-11</td>
<td>59.72 (10.12)</td>
<td>72.48 (8.99)</td>
<td>59.50 (8.39)</td>
</tr>
<tr>
<td>Sensation Seeking Scale-V</td>
<td>23.08 (4.65)</td>
<td>28.08 (3.93)</td>
<td>21.73 (6.90)</td>
</tr>
<tr>
<td>Beck Depression Inventory-II</td>
<td>6.84 (5.13)</td>
<td>7.44 (4.54)</td>
<td>9.50 (5.84)</td>
</tr>
<tr>
<td>STAI-Trait</td>
<td>35.92 (7.74)</td>
<td>34.52 (6.46)</td>
<td>43.77 (9.66)</td>
</tr>
<tr>
<td>STAI-State</td>
<td>32.60 (7.55)</td>
<td>29.30 (6.89)</td>
<td>38.95 (10.60)</td>
</tr>
</tbody>
</table>

Note: Data are presented as Mean (SD), unless otherwise specified; for binary logistic regression Females and Cluster 1 were the reference groups; BD = Binge Drinking; TCI = Temperament and Character Inventory; BIS = Barratt Impulsiveness Scale; AUDIT = Alcohol Use Disorders Identification Test; STAI = State-Trait Anxiety Inventory. NA = not available a among current cigarette smokers. AOR = Adjusted odds ratios; 95% CI = 95% confidence interval; * = p < 0.05; ** = p < 0.01; *** = p < 0.001. Significant Bonferroni corrected p-values are indicated in bold characters.
Figure Captions

**Fig. 1.** Comparisons of novelty-seeking and harm-avoidance levels (mean and standard deviation) among the cluster subgroups of binge drinkers and social drinkers according to gender.