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# Binging at the campus: Motivations and impulsivity influence binge drinking profiles in university students

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ABSTRACT

This study explored the involvement of two key psychological factors, drinking motives and impulsivity traits, in binge drinking. On the basis of a large screening phase (*N*=4424), 867 binge drinkers were selected and were first compared with 924 non-binge drinkers. Then, a cluster analysis was performed, focusing on the binge drinker sample, to explore the respective involvement of four drinking motives (DMQ-R model) and four impulsivity facets (UPPS model) in this habit. Centrally, the cluster analysis identified three clusters of binge drinkers presenting distinct psychological characteristics and alcohol consumption patterns: emotional, recreational, and hazardous binge drinkers. Hazardous binge drinkers were characterized by strong drinking motives but moderate impulsivity. Binge drinking should thus no more be considered as a unitary drinking pattern but rather as a habit encompassing a variety of psychological profiles. Moreover, risky drinking habits in young people might be mainly related to disproportionate drinking motives. Future studies should thus consider binge drinking heterogeneity, and prevention programs focusing on drinking motivations should be developed.

## 1. Introduction

Binge drinking, a pattern of alcohol consumption characterized by repeated alternations between intense alcohol intake and abstinence (Crego et al., 2009), has become widespread in adolescents and young adults (Kanny et al., 2013). Despite the large variation of binge drinking criteria across studies, this pattern is commonly defined as the consumption of 4 drinks for women and 5 drinks for men in a two-hour interval (NIAAA, 2004). The cognitive and cerebral correlates of binge drinking have been explored, showing altered performance in cognitive abilities (Field et al., 2008) and deleterious brain consequences (Hermens et al., 2013). Binge drinking is thus no longer considered a harmless recreational practice, but rather a risky behavior with major personal, cognitive, and social consequences. However, the specific psychological factors underlying the development of binge drinking have been less studied, and the individual or interpersonal factors leading young people to maintain binge drinking habits are still largely unexplored. Specifying such psychological factors would strongly deepen the understanding of this risky behavior and help identify at-risk individuals.

Studies focusing on the explanatory factors of binge drinking have mainly explored demographic and environmental variables, notably showing that binge drinking is more frequent in young single men with higher education (Luo et al., 2014; Wechsler et al., 1995) and is strongly influenced by social environment and peers (Wechsler et al., 1995; Weitzman et al., 2003). Moreover, binge drinking frequently co-occurs with other risky behaviors such as drug abuse or unsafe sex (Kuntsche et al., 2004; Wechsler et al., 1995), depressive symptoms (Bell et al., 2014), suicidality (Gonzalez and Hewell, 2012) or post-traumatic stress disorder (Kachadourian et al., 2014). While offering a valuable view of sociodemographic variables and comorbidities, these previous studies did not allow the identification of the key psychological factors related to binge drinking. Some studies have however investigated these psychological factors using experimental or neuroscience approaches, centrally suggesting a crucial importance of control and inhibitory processes (Field et al., 2008). Moreover, several models have been proposed to conceptualize the influence of these factors on alcohol consumption. In particular, Oei and Morawska (2004) offered a theoretical framework explaining engagement in problematic consumption by means of two psychological variables: drinking refusal self-efficacy (i.e., the ability to control one's own alcohol intake by refusing or inhibiting consumption when needed) and

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alcohol expectancies (i.e., the psychological or physical effects that the individual is looking for when drinking). A later experimental test of this model (Morawska and Oei, 2005) highlighted that binge drinking is initially characterized by medium levels of both drinking refusal self-efficacy and alcohol expectancies. However, the intensification of binge drinking habits leads to a joint growth of specific drinking expectancies and decrease of the ability to refuse alcohol, initiating a vicious circle of excessive alcohol consumption. This central role attributed to inhibitory control and alcohol expectancies was later supported, showing that binge drinking is strongly determined by impulsive decision making and by strong expectations and motivations towards alcohol (Clark et al., 2012). These two types of psychological factors thus seem crucial in the perpetuation of binge drinking habits.

On the one hand, regarding impulsivity, previous experimental studies have emphasized that binge drinking is associated with heightened impulsivity traits and reduced inhibitory control (VanderVeen et al., 2013). Earlier works have also suggested that impulsivity predicts alcohol consumption and is related to binge drinking pattern (Carlson et al., 2010; Henges and Marczinski, 2012). Impulsivity cannot, however, be considered a unidimensional construct (Cyders, 2015); rather, it is a multidimensional variable with distinct subcomponents. An internationally recognized model of impulsivity, the UPPS model (Whiteside and Lynam, 2001), disentangled impulsivity into four facets: urgency (engagement in unthoughtful behaviors when confronted with intense emotional states), lack of premeditation (non-consideration of an action's consequences before starting it), lack of perseverance (difficulty in staying focused on a demanding or boring task), and sensation seeking (the search for intense stimulations and openness to new experiences). These impulsivity subcomponents have been connected to specific cognitive mechanisms (e.g., inhibitory control, delay discounting), at behavioral and neurobiological levels (Wilbertz et al., 2014). Several studies have applied this model to alcohol-related disorders (Coskunpinar et al., 2013), showing that the different UPPS impulsivity facets predict various alcohol consumption patterns and that this model is a reliable theoretical framework to distinguish these patterns (Smith et al., 2007). However, while numerous studies on alcohol abuse and dependence have relied on the UPPS, this model has scarcely been investigated in binge drinking. Previous studies in young adults showed that excessive alcohol consumption was associated with sensation seeking (Stephenson et al., 2007) and urgency (Gonzalez et al., 2011; Martens et al., 2011). Nevertheless, most works were focused on a large population of college students, not specifically involved in frequent binge drinking habits. Moreover, some of these studies (e.g., Stephenson et al., 2007) have targeted a particular aspect of impulsivity, thus offering a limited understanding of the psychological factors involved. In more recent works considering the UPPS model, it has been suggested that binge drinking might be associated with urgency (Bø et al., 2016; Phillips et al., 2009; Xiao et al., 2009), lack of premeditation (VanderVeen et al., 2013), and sensation seeking (Shin et al., 2012). A meta-analysis (Coskunpinar et al., 2013) centrally underlined that the sensation seeking trait constitutes the most efficient predictor of binge drinking habits. These preliminary results thus reinforced the proposal that impulsivity is central to binge drinking.

On the other hand, drinking expectancies have been shown to be closely related to drinking motives (Van Tyne et al., 2012) and to influence alcohol-consumption habits. From this perspective, Cooper's (1994) motivational model, which is among the most influential in alcohol research, primarily suggests that individuals consume alcohol to achieve specific outcomes related to positive reinforcement (i.e., social order, related to alcohol consumption in social contexts; and enhancement, related to the enjoyable sensations provided by alcohol consumption) and negative reinforcement (i.e., coping, related to alcohol consumption to face negative affect; and conformity, related to alcohol consumption to avoid negative judgments from others). This model has been empirically supported by studies showing that high drinking motives predict problematic drinking and that different motivations are related to different patterns of alcohol use, from moderate to heavy or hazardous drinking (Cooper, 1994; Kuntsche et al., 2005; Van Damme et al., 2013). A recent European study (Kuntsche et al., 2014) spotted these motives and showed that they are strongly related to alcohol consumption characteristics: social order is related to drinking frequency, enhancement to drunkenness frequency, and conformity is negatively linked to both outcomes (Kuntsche et al., 2014). Moreover, it has been shown that alcohol-dependent individuals had higher scores for negative reinforcement motives (Mezquita et al., 2011) and college drinkers for both positive and negative reinforcements; social drinking was related to enhancement and solitary drinking was related to coping (Gonzalez et al., 2009; Luce et al., 2007; Williams et al., 2015). More specifically, studies investigating motivations in binge drinking showed that this pattern is strongly predicted by drinking motives (Coleman and Cater, 2005; Jasinski and Ford, 2007), mostly by motives related to social interactions (Chauvin, 2012; Kuntsche et al., 2004; Norman et al., 2012; Van Tyne et al., 2012) and coping (Kuntsche et al., 2004). This strong involvement of drinking motivations in binge drinking has moreover been confirmed by diary studies in adolescents and young adults (O'Hara et al., 2015).

Previous studies thus clearly showed that impulsivity and drinking motives are central psychological factors involved in binge drinking, but interactions between these two variables might also play a role (Lammers et al., 2013). For example, the relation between alcohol consumption and negative urgency is influenced by coping motives, whereas the relation between alcohol consumption and positive urgency is influenced by enhancement and social motives (Coskunpinar and Cyders, 2012; Jones et al., 2014). Nonetheless, previous studies have been conducted in small samples and have not considered the possible existence of binge drinking subgroups, which reduces the ability to draw any definitive conclusions regarding the specific influence of impulsivity traits and drinking motives. Indeed, binge drinking, which has to date been considered a discrete condition, could instead be divided into subtypes. The joint exploration of impulsivity traits and motivations might determine the existence of such subtypes, as has been done in gambling (Milosevic and Ledgerwood, 2010) or gaming (Billieux et al., 2015) disorders. To precisely explore the role of these two principal psychological factors and to test the hypothesis of their differential involvement across various binge drinkers' subgroups, we took a cluster analysis approach in a large sample of university binge drinking students. We hypothesized that some binge drinkers are characterized by both strong drinking motives and impulsivity traits, thus representing a higher risk subgroup, whereas others will have high scores only on one dimension, leading to more moderate binge drinking habits and thus to more limited consequences.

## 2. Methods

### 2.1. Participants

A total of 4424 undergraduate students from the Université catholique de Louvain (Belgium) were screened with an online questionnaire. Participants were recruited through an announcement sent by e-mail to all university students (around 29,000 students), which reached a response rate of 14.57%. This response rate appears quite high in comparison with earlier studies in the alcohol-consumption field (Valencia-Martín et al., 2007). Moreover, a main strength of the present study compared to earlier ones is to include a representative population of university students, including participants from a wide range of Faculties and at various levels of their University track. All participants (48.39% women) were between 18 and 30 years old ($M$=21.44; $SD$=2.25) and were fluent French speakers. From this large initial sample, we categorized students into subgroups. The first one, a

binge drinking group ($n$=867), was determined on the basis of the following criteria, recognized to characterize binge drinking habits (Keller et al., 2007): (a) having between 0.5 and four drinking occasions per week, and (b) drinking more than four alcohol units per occasion, an alcohol unit corresponding to 10 g of pure ethanol. The differential criteria across genders proposed in the NIAAA binge drinking definition were not taken into account at this first step in order to obtain a large and heterogeneous sample of binge drinkers, and to further evaluate the gender effect on impulsivity traits and drinking motives. The second subgroup, a control group, comprised non-binge drinkers[1] ($n$=924), who drank a maximum of three alcohol units per occasion on a maximum of three occasions per week, correctly matched with the binge drinkers group for age [$t(1684)=0.03$, $p=0.973$] and gender [$\chi^2(1, N=1791)=0.24$, $p=0.624$]. In a second step, this non-binge drinker group was split in three subgroups characterized by the number of drinking occasions [i.e., one drinking occasion per week ($n$=297), two drinking occasions per week ($n$=313), and three drinking occasions per week ($n$=314)], to explore the respective influence of different patterns of moderate alcohol consumption. All participants gave online consent before starting the survey and their anonymity was guaranteed (no personal data were collected, including Internet protocol addresses). The study protocol was approved by the ethical committee of the Université catholique de Louvain and was conducted in accordance with Declaration of Helsinki as revised in 2008.

### 2.2. Procedure and measures

The online survey was implemented in Qualtrics software (Qualtrics LLC, Provo, OR, USA) and assessed: (a) sociodemographic variables; (b) alcohol-consumption habits; (c) impulsivity; and (d) drinking motives. The sociodemographic variables measured were age, gender, education level, and native language. Alcohol consumption was assessed by the French version of the Alcohol Use Disorders Identification Test (AUDIT, Gache et al., 2005), a 10-item questionnaire measuring the general harmfulness of alcohol consumption. Several complementary items were used to specifically explore binge drinking habits by evaluating the number of alcohol units per week, the number of drinking occasions per week, the mean number of alcohol units per occasion, the consumption speed, and the number of "tipsy", "drunk", or "completely drunk" episodes during the last 6 months. Finally, psychological factors were measured by French validated questionnaires. Impulsivity was evaluated with the French UPPS-P Impulsive Behavior Scale (Billieux et al., 2012), a 20-item scale measuring five facets of impulsivity: positive urgency, negative urgency, lack of premeditation, lack of perseverance, and sensation seeking. Drinking motives were measured by a modified version of the French Drinking Motives Questionnaire-Revised (DMQ-R; Grant et al., 2007), a 28-item scale assessing five motivations to drink: social order, coping-anxiety, coping-depression, enhancement, and conformity. This modified version has been chosen based on earlier explorations (Grant et al., 2007) showing a better fit of the revised questionnaire in a sample of undergraduate students, an improved ability to predict alcohol consumption patterns and a more effective discrimination between problematic and non-problematic alcohol consumption on the basis of drinking motives, which is particularly relevant with regard to the present study. The internal reliability of the different subfacets was very good, as shown by the Cronbach's alphas (see Table 1).

[1] This subsample excluded non-drinkers ($n$=332, 7.86% of the whole sample) and occasional drinkers ($n$=575, 13.61% of the whole sample), which were not taken into account in our analyses.

### 2.3. Data analysis

Analyses were achieved with the program IBM SPSS Statistics 21. Group comparisons were computed between binge drinkers and non-binge drinkers (i.e., with the whole sample and with the three subgroups) for impulsivity facets, drinking motives, and alcohol consumption (AUDIT). A data clustering technique was then used to identify subgroups among the 867 binge drinkers. Data grouping was realized through a combination of hierarchical and non-hierarchical methods, as recommended by current theoretical trends (Hair et al., 2010). First, a hierarchical analysis was performed by using Ward's method with a squared Euclidean distance measure; second, cluster membership was determined through subsequent non-hierarchical K-means analysis. Cluster analysis is non-inferential, which implies that variables selection is a critical part of the analytic process. Subgroups of drinkers were thus identified in consideration of two types of established risk factors: impulsivity traits (UPPS-P) and drinking motives (DMQ-R). As we used two different scales with different score ranges, the use of raw scores would have led to biases in the analyses, all variables included were thus Z-scored. While it exists some debates on the usefulness of z-score computation in cluster analyses, this procedure is the most widely used in recent studies (e.g., DeJong and Donders, 2010; Lee et al., 2017; Rebetez et al., 2015; Rocca et al., 2016) because this transformation allows to share the same metric properties for each variable, enabling a reliable comparison. Moreover, preliminary to cluster analysis, Spearman's correlations were conducted to identify potential multicollinearity issues. Collinear variables indeed have a higher impact on the cluster creation process, which may lead to spurious grouping solutions (Hair et al., 2010). To limit this phenomenon, several variables were grouped: the positive and negative urgency subscales of the UPPS-P, significantly correlated ($r$=0.478, $p < 0.001$) were merged into a "urgency" factor, in line with previous recommendations (Billieux et al., 2015); the coping-anxiety and coping-depression subscales of the DMQ-R, also strongly correlated ($r$=0.566, $p < 0.001$) were regrouped into a general "coping" factor, but all the items described in the model (Grant et al., 2007) were included in the analyses. The other UPPS-P facets and drinking motives were kept in the model. The obtained clusters were then compared on the basis of external correlates (sociodemographic and alcohol variables). Eventually, a comparison was also performed between each cluster and the non-binge drinkers group by using the impulsivity and drinking motive variables.

## 3. Results

### 3.1. Descriptive results for the two samples

The non-binge drinkers sample ($n$=924) comprised 536 men (58% of the sample) and the mean age was 21.36 years ($SD$=1.88). In this sample, 11.8% self-reported current or past psychological disorders (mainly depression and anxiety disorders), 9.6% smoked tobacco, 6.8% smoked cannabis, 1.2% consumed other drugs. The mean AUDIT score in the non-binge drinkers group was 6.76 ($SD$=4.06).

The binge drinkers sample ($n$=867) comprised 493 men (56.9% of the sample) and the mean age was 21.36 years ($SD$=2.48). In this sample, 8.5% self-reported current or past psychological disorders (mainly depression and anxiety disorders), 22.6% smoked tobacco, 18.6% smoked cannabis, and 2.9% consumed other drugs. The mean AUDIT score in this group was 14.42 ($SD$=5.27).

### 3.2. Comparison between binge drinkers and non-binge drinkers

As shown in Table 2, compared to non-binge drinkers, binge drinkers had a significantly lower score on the impulsivity facets of urgency and sensation seeking, a significantly higher score on the lack of premeditation facet, while there was no significant group difference

**Table 1**
Variables evaluated In the online survey.

| Questionnaire | Scale | Item example | Reliability coefficient (α)[a] |
|---|---|---|---|
| Impulsivity | | | |
| | Positive urgency | I tend to act without thinking when I am really excited | 0.79 |
| | Negative urgency | When I feel rejected, I will often say things that I later regret | 0.79 |
| | (Lack of) premeditation | My thinking is usually careful and purposeful | 0.93 |
| | (Lack of) perseverance | I generally like to see things through to the end | 0.95 |
| | Sensation seeking | I quite enjoy taking risks | 0.83 |
| Drinking Motives | | | |
| | Enhancement | I drink... Because I like the feeling | 0.83 |
| | Social order | I drink... Because it makes a social gathering more enjoyable | 0.79 |
| | Coping anxiety | I drink... Because I feel more self-confident or sure of myself | 0.66 |
| | Coping depression | I drink... Because it helps me when I am feeling depressed | 0.91 |
| | Conformity | I drink... To fit in with a group I like | 0.79 |
| AUDIT-Total | | | 0.82 |

[a] Obtained in the current sample.

**Table 2.**
Comparisons between binge drinker and non-binge drinker groups on impulsivity, drinking motives, and AUDIT.

| Variable | Binge drinkers (*n* =867) Mean (*SD*) | Non-binge drinkers (*n* =924) Mean (*SD*) | *t* | *η2* |
|---|---|---|---|---|
| Impulsivity | | | | |
| Urgency | 22.06 (4.08) | 22.69 (3.74) | 3.39** | 0.006 |
| Lack of premeditation | 10.64 (2.88) | 10.33 (3.26) | 2.13* | 0.003 |
| Lack of perseverance | 10.63 (3.33) | 10.33 (3.62) | 1.80 | |
| Sensation seeking | 10.62 (2.68) | 11.18 (2.27) | 4.79*** | 0.01 |
| Drinking motives | | | | |
| Enhancement | 13.50 (4.79) | 9.86 (3.84) | 17.82*** | 0.15 |
| Social order | 16.06 (3.88) | 13.34 (4.04) | 14.55*** | 0.11 |
| Coping | 19.08 (6.75) | 17.25 (6.04) | 6.06*** | 0.02 |
| Conformity | 6.58 (2.60) | 6.38 (2.33) | 1.71 | |
| AUDIT-Total | 14.42 (5.27) | 6.76 (4.06) | 34.56*** | 0.40 |

*Note.* *p < 0.05, **p < 0.01, ***p < 0.001.

regarding the lack of perseverance. Binge drinkers also presented higher scores for all drinking motives, except for conformity, as well as higher AUDIT scores.

This central role of drinking motives was supported by comparing binge drinkers with the three subgroups of non-binge drinkers, corrected Bonferroni *t*-tests highlighting higher scores in binge drinkers for: (1) social order motives compared to non-binge drinkers who drank one [$t$=3.19, $p < 0.001$], two [$t$=2.90, $p < 0.001$], or three [$t$=2.11, $p < 0.001$] times a week; (2) enhancement motives compared to non-binge drinkers who drank one [$t$=4.73, $p < 0.001$], two [$t$=3.77, $p < 0.001$], or three [$t$=2.50, $p < 0.001$] times a week; (3) coping motives compared to non-binge drinkers who drank one [$t$=2.63, $p < 0.001$] or two [$t$=2.04, $p < 0.001$] times a week.

### 3.3. Cluster analysis on binge drinkers

Cluster analysis was performed on the binge drinkers sample ($n$=867) and results indicated an optimal three-factor solution (see Fig. 1). The three clusters encompassed 31.1%, 51.9%, and 17% of the sample, each cluster being beyond 10% of the sample, as recommended by Hair et al. (2010). Table 3 reports the differences between clusters regarding impulsivity traits, drinking motives, and external correlates. First, Cluster 1 was mainly characterized by higher values for urgency [$F$(2,864)=114.78, $p < 0.001$, $\eta^2$=0.210] and sensation seeking [$F$(2,864)=161.51, $p < 0.001$, $\eta^2$=0.272], Cluster 2 by higher lack of premeditation [$F$(2,864)=362.28, $p < 0.001$, $\eta^2$=0.456] and perseverance [$F$(2,864)=479.77, $p < 0.001$, $\eta^2$=0.526], and Cluster 3 by moderate to high values on the four drinking motives [enhancement: $F$(2,864)=59.19, $p < 0.001$, $\eta^2$=0.120; social order: $F$(2,864)=123.78, $p < 0.001$, $\eta^2$=0.223; coping: $F$(2,864)=180.29, $p < 0.001$, $\eta^2$=0.294; and conformity $F$(2,864)=348.53, $p < 0.001$, $\eta^2$=0.447]. Second, cluster comparisons regarding external correlates indicated that alcohol consumption was higher in Cluster 3, as shown by the group comparison on the AUDIT questionnaire: the total AUDIT score was higher and the items related to problematic consumption were more prominent in Cluster 3 (see Fig. 2). Cluster 3 members had indeed greater difficulties to stop drinking or do what was expected from them, more often needed alcohol the day following drinking, felt higher culpability, and presented stronger memory loss related to alcohol consumption. Cluster 2 differed from Cluster 1 in terms of frequency and binge drinking behavior. Cluster 2 also reported being more frequently tipsy, but a lower drunkenness frequency. Members of Clusters 1 and 3 reported having been drunk or completely drunk more often in the last 6 months, which suggests poorer self-regulation abilities. These results clearly demonstrate important differences regarding alcohol consumption habits between clusters and supported their validity. Concerning socio-demographic variables, results only showed a higher percentage of men in Cluster 1 than in Cluster 2. Finally, there was no significant difference between clusters regarding psychopathological disorders.

### 3.4. Comparison between binge drinker clusters and non-binge drinkers group

ANOVAs were performed between the three clusters of binge drinkers and the non-binge drinker group. Globally, findings indicated that urgency and sensation seeking facets of impulsivity were stronger in Cluster 1, lack of premeditation and lack of perseverance facets of impulsivity were stronger in Cluster 2, and drinking motives were more important in all binge drinker clusters, with significantly higher scores in Cluster 3 (see Table 4).

## 4. Discussion

This study was the first to propose a joint analysis of drinking


**Fig. 1.** The three binge drinking clusters. Subgroups of binge drinkers determined by cluster analysis according to measures of impulsivity [UPPS-P: positive and negative urgencies (urgency), lack of premeditation (Lprem), lack of perseverance (Lpers), and sensation seeking (SS)] and drinking motives [DMQ-R: coping anxiety and depression (coping), conformity, social order, and enhancement].

motives and impulsivity traits in a large sample of binge drinkers by means of a cluster analysis. As the psychological factors underlying the development and maintenance of binge drinking habits are little known, our aims were to explore: (a) whether binge drinking can be associated with specific drinking motives and impulsivity traits, and (b) whether valid subgroups of binge drinkers can be identified, potentially being characterized by a distinct combination of these variables. Results showed the identification of three binge drinker subgroups that vary in terms of impulsivity traits and drinking motives, as well as in negative outcomes associated with their drinking habits. In view of these results, the three clusters were named as follows: Cluster 1 regrouped “emotional binge drinkers”, Cluster 2 comprised “recreational binge drinkers”, and Cluster 3 included “hazardous binge drinkers”.

**Table 3**
Comparisons between the three binge drinking clusters.

| Variable | | Cluster 1 | Cluster 2 | Cluster 3 | | | | |
|---|---|---|---|---|---|---|---|---|
| | | (*n* =270; 31.1%) | (*n* =450; 51.9%) | (*n* =147; 17%) | | | | |
| | | Emotional | Recreational | Hazardous | | | | |
| | | binge drinkers | binge drinkers | binge drinkers | | | | |
| | Range | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) | *F* | C1-C2 | C1-C3 | C2-C3 |
| **Cluster profile** | | | | | | | | |
| Impulsivity | | | | | | | | |
| Urgency | 8–32 | 24.81 (2.21) | 21 (4) | 20.24 (4.47) | 114.78*** | 14.37*** | 13.96*** | 1.95 |
| Lack of premeditation | 4–16 | 7.90 (1.72) | 12.31 (2.09) | 10.56 (2.82) | 362.28*** | 29.24*** | 11.94*** | 8.05*** |
| Lack of perseverance | 4–16 | 7.26 (2.04) | 12.73 (2.15) | 10.38 (3.06) | 479.77*** | 34.15*** | 12.42*** | 10.30*** |
| Sensation seeking | 4–16 | 12.60 (1.43) | 9.45 (2.60) | 10.54 (2.53) | 161.51*** | 18.40*** | 10.68*** | 4.50*** |
| Drinking motives | | | | | | | | |
| Enhancement motive | 5–25 | 12.44 (4.61) | 12.95 (4.56) | 17.14 (4.04) | 59.19*** | 1.46 | 10.39*** | 9.94*** |
| Social order motive | 5–25 | 14.60 (3.57) | 15.66 (3.52) | 19.97 (2.77) | 123.78*** | 3.86*** | 15.85*** | 13.54*** |
| Coping motive | 13–65 | 17.84 (5.16) | 17.19 (4.28) | 27.16 (9.24) | 180.29*** | 1.83 | 13.22*** | 17.80*** |
| Conformity motive | 5–25 | 5.70 (1.28) | 5.85 (1.30) | 10.42 (3.78) | 348.53*** | 1.59 | 18.83*** | 21.99*** |
| **External correlates** | | | | | | | | |
| Age | 18–30 | 21.73 (2.39) | 21.09 (2.35) | 21.61 (2.91) | 32.06*** | 3.41*** | 0.44 | 2.17* |
| AUDIT-Total | 3–32 | 13.53 (4.95) | 14.28 (5.22) | 16.50 (5.49) | 15.96*** | 1.92 | 5.63*** | 4.41*** |
| Total alcohol units/week | 4.12–85 | 17.41 (11.90) | 18.94 (11.09) | 20.36 (11.30) | 3.41** | 1.75 | 2.47* | 1.34 |
| Number of occasions per week | 0.8–4 | 2.39 (1.03) | 2.54 (0.99) | 2.76 (1.02) | 6.59*** | 1.88 | 3.57*** | 2.42** |
| Number of alcohol units per occasion | 4.25–25 | 7.21 (3.14) | 7.51 (3.23) | 7.38 (2.95) | 0.78 | | | |
| Consumption speed (units per hour) | 1–6 | 2.13 (1.17) | 2.21 (1.24) | 2.32 (1.16) | 1.52 | | | |
| Number of times tipsy (last 6 months) | 0–130 | 20.47 (15.52) | 26.61 (20.33) | 23.73 (15.37) | 8.20*** | 4.20*** | 1.90 | 1.68 |
| Number of times drunk (last 6 months) | 0–90 | 8.20 (12.17) | 10.37 (13.50) | 10.50 (12.65) | 2.47 | | | |
| Number of times completely drunk (last 6 months) | 0–70 | 2.84 (7.50) | 2.75 (6.09) | 2.86 (4.57) | 0.02 | | | |
| Percentage of drunkenness (last 6 months) | 0–100 | 30.95 (28.05) | 24 (24.52) | 31.83 (27.15) | 7.53*** | 3.13** | 0.30 | 2.95** |
| | | Percentage | Percentage | Percentage | $\chi^2$ | | | |
| Gender (men – women) | | 63.3–36.7 | 53.3–46.7 | 55.8–44.2 | 6.96* | 6.89** | 2.27 | 0.27 |
| Psychological disorder | | 11.1 | 7.1 | 8.2 | 3.49 | | | |
| Tobacco consumption | | 28 | 18.4 | 25.9 | 9.64** | 8.75** | 0.22 | 3.76 |
| Cannabis consumption | | 21.4 | 16.2 | 21.1 | 3.61 | | | |
| Drug consumption | | 3.1 | 2.9 | 2.7 | 0.05 | | | |

Note. Differences between C1-C2, C1-C3, and C2-C3 are computed by post-hoc *t*-tests for continuous variables. Statistically significant at
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

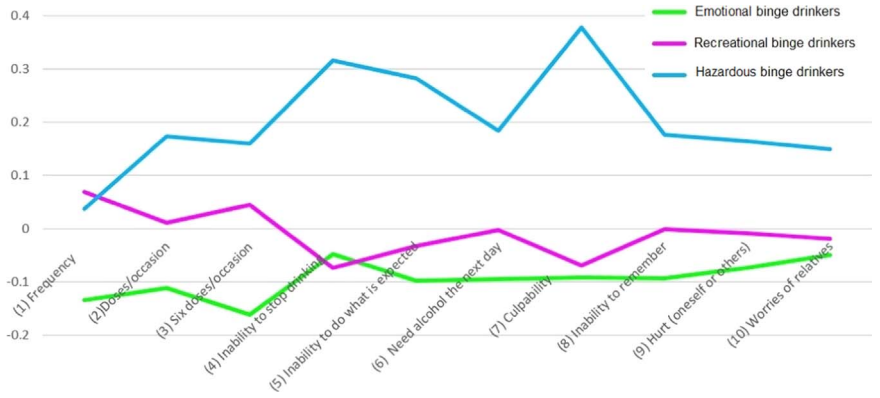


**Fig. 2.** Comparison of the three clusters for the 10 items of the Alcohol Use Disorders Identification Test (AUDIT). The AUDIT comprises the following questions: (1) How often do you have a drink containing alcohol? ; (2) How many drinks containing alcohol do you have on a typical day when you are drinking? ; (3) How often do you have six or more drinks on one occasion? ; (4) How often during the last year have you found that you were not able to stop drinking once you had started? ; (5) How often during the last year have you failed to do what was normally expected from you because of drinking? ; (6) How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session? ; (7) How often during the last year have you had a feeling of guilt or remorse after drinking? ; (8) How often during the last year have you been unable to remember what happened the night before because you had been drinking? ; (9) Have you or someone else been injured as a result of your drinking? ; and (10) Has a relative or friend or a doctor or another health worker been concerned about your drinking or suggested you cut down? The Y-axis is based on the calculation of z-scores.

The first subgroup, emotional binge drinkers, has high levels of both urgency and sensation seeking. This group is characterized by heightened impulsivity traits, but further comparison also showed that their drinking motives, particularly enhancement, social order, and coping are elevated in comparison with non-binge drinkers, which emphasizes the critical role of drinking motives in binge drinking. Results in the emotional group suggest that this type of binge drinking can be conceptualized as a (maladaptive) emotion regulation strategy. Such a view is in accordance with previous studies showing that alcohol consumption can be used to increase positive affect or decrease negative ones (Cox et al., 2015). On the one hand, binge drinking can serve to overcome or reduce negative affect (in relation to urgency and coping motives), as previously shown in different patterns of alcohol consumption, notably among undergraduate students (Terlecki and Buckner, 2015). On the other hand, binge drinking can be a way to enhance or maintain positive affect (in relation to urgency, sensation seeking, enhancement, and social order motives). In fact, enhancement motive has been found to be a mediator between increased alcohol consumption and impulsivity (Loxton et al., 2015), but this study was based on a unidimensional view of impulsivity and no significant relationship was found with sensation seeking. With respect to Cooper's model (1994), both emotion regulation-related motives (coping and enhancement) were associated with drinking problems and when typical levels of alcohol use were controlled, coping remained as the only predictive motive related to alcohol problems. In this subgroup, the pattern of alcohol consumption currently appears to be the least problematic in terms of AUDIT score. However, this group also shows a high frequency of drunkenness episodes, suggesting reduced self-regulation abilities. Moreover, this cluster is characterized by unbalanced gender-ratio (63.3% of men), which is in line with previous studies demonstrating the gender effect on these impulsivity traits (Cross et al., 2013). Using the alternative five factor model, a recent study indeed showed higher impulsivity-sensation seeking in men (Adan et al., 2016). Moreover, the multidimensional model of impulsivity supported higher sensation seeking scores in men (Billieux et al., 2012; Cyders, 2013), combined with increased positive urgency (Cyders, 2013). Higher scores for women have nevertheless been reported when positive and negative urgencies are combined in a

**Table 4**
Comparison between binge drinking clusters and non-binge drinker group on impulsivity and drinking motives.

| Variable | Cluster 1 (*n* =270) Emotional binge drinkers Mean (*SD*) | Cluster 2 (*n* =450) Recreational binge drinkers Mean (*SD*) | Cluster 3 (*n* =147) Hazardous binge drinkers Mean (*SD*) | Control group (*n* =924) Non-binge drinkers Mean (*SD*) | *F* | C1-nBD | C2-nBD | C3-nBD |
|---|---|---|---|---|---|---|---|---|
| Impulsivity | | | | | | | | |
| Urgency | 24.81 (2.21) | 21 (4) | 20.24 (4.47) | 22.69 (3.74) | 78.46*** | 8.88*** | 7.65*** | 7.16*** |
| Lack of premeditation | 7.90 (1.72) | 12.31 (2.09) | 10.56 (2.82) | 10.33 (3.26) | 144.62*** | 11.79*** | 11.77*** | 0.81 |
| Lack of perseverance | 7.26 (2.04) | 12.73 (2.15) | 10.38 (3.06) | 10.33 (3.62) | 182.39*** | 13.33*** | 12.99*** | 0.15 |
| Sensation seeking | 12.60 (1.43) | 9.45 (2.60) | 10.54 (2.53) | 11.18 (2.27) | 117.47*** | 9.81*** | 12.64*** | 3.12** |
| Drinking motives | | | | | | | | |
| Enhancement motive | 12.44 (4.61) | 12.95 (4.56) | 17.14 (4.04) | 9.86 (3.84) | 159.72*** | 9.25*** | 13.16*** | 21.19*** |
| Social order motive | 14.60 (3.57) | 15.66 (3.52) | 19.97 (2.77) | 13.34 (4.04) | 146.94*** | 4.64*** | 10.40*** | 19.20*** |
| Coping motive | 17.84 (5.16) | 17.19 (4.28) | 27.16 (9.24) | 17.25 (6.04) | 127*** | 1.46 | 0.19 | 16.98*** |
| Conformity motive | 5.70 (1.28) | 5.85 (1.30) | 10.42 (3.78) | 6.38 (2.33) | 190.44*** | 4.63*** | 4.48*** | 17.68*** |

Note. Differences between C1-nBD, C2-nBD, and C3-nBD are computed by post-hoc *t*-tests. Statistically significant at
*p < 0.05.
** p < 0.01.
*** p < 0.001.

grouped facet (Billieux et al., 2012), in line with was has been done in the present study. Gender differences regarding urgency, and particularly positive urgency, thus need to be further explored in binge drinking.

The second subgroup, recreational binge drinkers, represents the majority of the sample. Binge drinkers from this cluster are characterized by heightened impulsivity, as shown by low levels of perseverance and premeditation. Comparison with the non-binge drinkers group also supports the role of drinking motives, particularly enhancement and social order (see Fig. 1). As suggested in past studies, the lacks of premeditation and perseverance may be characteristic of the living habits found in university students [e.g., using alcohol consumption as a reward for hard work, as a mean to procrastinate, or when bored (Jasinski and Ford, 2007)]. Moreover, alcohol consumption motivated by pleasure (enhancement motives) or social aspects (social order motives) can also be representative of this population and was related to drinking frequency and drunkenness (Kuntsche et al., 2014). In this subgroup, students have a high frequency of alcohol consumption and often drink more than six units on one occasion, representing the typical binge drinking pattern. Results indicated no significant difference with Cluster 1 regarding problematic consumption. Nevertheless, this subgroup reported being less frequently drunk than other groups, suggesting preserved control on alcohol consumption. In view of this result, it can be hypothesized that this group might return to a regulated pattern of alcohol consumption in later adulthood, as their binge drinking habits appear to be mostly related to their current environment.

Finally, the third subgroup, hazardous binge drinkers, appears to constitute the more problematic group, as reflected by their higher AUDIT score. Binge drinkers from this cluster are mainly characterized by high scores on all drinking motives which have been recently associated to extreme drinking (White et al., 2016). They consume alcohol for conformity and coping purposes, the latter being the strongest predictor of drinking-related problems (Cooper, 1994). In line with previous studies suggesting that binge drinking could be a first stage towards alcohol-related disorders (Sanhueza et al., 2011), this cluster appears to group the students who are the most likely to evolve towards alcohol-dependence, particularly in view of their very high scores on the AUDIT items related to negative consequences.

A central aspect of the present results is that the most problematic cluster regarding alcohol consumption is not mainly characterized by impulsivity traits, but rather by pronounced drinking motives. Indeed, although impulsivity has been shown to be a hallmark of addictions (Coskunpinar et al., 2013), influential models of binge drinking posit that this drinking pattern, which is not necessarily addictive, is more strongly related to important expectancies and motivations towards alcohol (Oei and Morawska, 2004). Our results thus suggest that impulsivity traits, particularly urgency and sensation seeking, are globally less pronounced in binge drinkers than in non-binge regular drinkers. Some subgroups of binge drinkers (Clusters 1 and 2) however presented elevated impulsivity in comparison to all other drinkers. Nevertheless, it is worth noting that the current results were based on self-reported measures of impulsivity. Future studies should specify the role played by impulsivity using experimental measures, as the correlations observed between self-reported and experimental measures of impulsivity traits are generally relatively modest (Cyders and Coskunpinar, 2011). Conversely, concerning drinking motives, studies stated a good consistency between self-reported measures and actual alcohol-consumption (Kuntsche and Kuendig, 2012).

As this study was the first to propose subtyping of binge drinking on the basis of psychological factors, the original results obtained here need to be replicated and extended. In this study, impulsivity and drinking motives have been explored because they are widely validated and have been repeatedly associated with alcohol-related disorders. Future studies should however explore binge drinkers' subgroups by considering a more exhaustive assessment of psychological factors. Studies also have to more comprehensively explore the role of comorbid psychopathology and involved psychological processes (e.g., emotional reactivity, emotional regulation, repetitive thinking) to clearly describe the psychological profiles of each subgroup (e.g., emotional binge drinkers). Moreover, while all the items related to coping motives were kept in the analyses, the two coping subscales (depression and anxiety) were merged in this study to avoid multicollinearity, the present results should therefore be confirmed by using the original DMQ-R version. Beyond this, the study emphasized that binge drinking is a heterogeneous problematic behavior, which raises important implications. First, at the fundamental level, this study allows a better understanding of binge drinking and the role of psychological factors implicated in this pattern of harmful alcohol consumption. The present results contribute to the specification of Oei and Morawska (2004) model by describing the existence of different binge drinkers' subgroups. They also suggest that problematic consumption in student binge drinkers is mainly related to drinking motives related to positive and negative reinforcement, thus supporting Cooper's model (1994). The study also provides suggestions about the potential evolution of alcohol disorders: As hazardous binge drinkers did not report high impulsivity traits, it could be hypothesized that impulsivity impairments are initially limited and progressively develop during the transition between binge drinking and alcohol-dependence. However, our design did not allow to explore the causal link between these variables, and longitudinal studies are needed to test this proposal. Second, at the therapeutic level, the present findings suggest that prevention among hazardous binge drinkers should aim at modifying drinking motives, as they may constitute an important component of risky drinking. Our results also underline that binge drinkers are not a unitary group; rather, they are separated into several subgroups with distinct psychological characteristics. Even if clinical interview and experimental tasks should be used in the future to further evaluate these psychological characteristics (notably by offering objective measures of impulsivity), the current results suggest that preventive interventions need to be adapted to the targeted subgroup of binge drinkers, for example by focusing on the restructuring of dysfunctional metacognitions (e.g., drinking alcohol to avoid negative judgments of others), on the help to control drinking (e.g., implemented intention; Gollwitzer, 1999), or on the establishment of adaptive emotional regulation strategies.

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## Conflicts of interest

None.

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