Distinct psychological profiles among college students with substance use: A cluster analytic approach

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1 **Distinct psychological profiles among college students with**

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3

Abstract

Substance use in youth is a central public health concern, related to deleterious consequences at psychological, social, and cognitive/cerebral levels. Previous research has identified impulsivity and consumption motives as key factors in the emergence of excessive substance use among college students. However, most studies have focused on a specific substance and have considered this population as a unitary group, ignoring the potential heterogeneity in psychological profiles. We used a cluster analytic approach to explore the heterogeneity in a large sample (N=2,741) of substance users (i.e., tobacco, alcohol, cannabis, ecstasy, cocaine, heroin) on impulsivity and consumption motives. We identified four clusters: The first two clusters, associated with good self-esteem, low anxiety, and moderate substance use, were respectively characterized by low impulsivity and consumption motives (Cluster 1) and by high social and enhancement motives without marked impulsivity (Cluster 2). The two other clusters were conversely related to low self-esteem and high anxiety, and characterized by high consumption motives (particularly conformity) together with elevated urgency (Cluster 3) and by globally increased impulsivity and consumption motives (Cluster 4). These two clusters were also associated with higher substance use. These results highlight the existence of distinct psychological profiles of substance users and underline the need to develop targeted prevention and intervention programs (e.g., focusing on the specific impulsivity facets and consumption motives presented by each subgroup). Based on these findings, we also suggest extending the exploration of distinct profiles of substance users by targeting other psychological variables (e.g., self-esteem).

Keywords: motives; impulsivity; college students; cluster analysis

1. Introduction

Substance use is a major concern in Western societies and widespread among college students, as about 60% of young adults drink alcohol frequently, 10% are regular smokers, and more than 20% consume illicit drugs such as marijuana, cocaine, or heroin (Center for Behavioral Health Statistics and Quality, 2015). Moreover, substance use in young people is often associated with important consequences; such as poor academic performance, legal problems, interpersonal conflicts, suicidal ideations, or cognitive impairments (Ayala et al., 2017; see Skidmore et al., 2016 for a review). The identification of people at-risk to consume such substances is thus crucial to further develop individualized prophylactic interventions (e.g., Grant et al., 2007; Skidmore et al., 2016). Nevertheless, whereas previous works have identified the main psychological variables involved in the emergence and maintenance of substance use, it remains unclear whether most users show an identical psychological profile or whether subgroups with dissociated psychological characteristics exist.

The current literature related to the determinants of substance use in youth has identified the effect of common factors (e.g., peer influence, externalized behaviors), whereas the specific variables associated with each substance use appear more related to individual factors (e.g., gender, school years) (Fitzgerald et al., 2018). Beyond these general variables, psychological studies have identified both trait and behavioral impulsivity as a critical factor influencing substance use, specifically the inability to take the expected consequences into consideration (Charles et al., 2016; Magallón-Neri et al., 2015) and the tendency to seek for new and enjoyable sensations (Charles et al., 2016; Malmberg et al., 2012). Importantly, trait impulsivity is considered to be a good predictor of treatment outcomes in substance use disorders (see Loree

et al., 2015 for a review), which underlines its involvement in the inability to control substance use and the need to understand its role in the consumption patterns observed among young people. Several conceptualizations of impulsivity have emerged in the last decades. Among them, the UPPS (Whiteside & Lynam, 2001) constitutes an internationally recognized model in addiction research. This model describes impulsivity through four facets reflecting both trait and behavioral components: Urgency (impetuous actions following intense emotional states), lack of Premeditation (absence of consequences consideration), lack of Perseverance (difficulty to stay focused on a demanding/boring task), and Sensation seeking (search for stimulations and new experiences). This model has allowed for the specification of impulsivity facets related to different types of substance use. Initial studies have revealed that impulsivity is generally associated with hazardous alcohol use (Shin et al., 2012), but more recent works have shown that, in a sample of youth with substance use disorders, high sensation seeking and lack of perseverance were prevalent among individuals with problematic alcohol use, urgency was related to cannabis consumption, and lack of perseverance was related to use of other drugs (Thomsen et al., 2018).

In addition, some studies have emphasized the importance of targeting subjective reasons given by young people for using substances (Dow & Kelly, 2013). From this perspective, a reliable way to evaluate consumption motives can be derived from Cooper's (1994) motivational model (e.g., Hides et al., 2008; Patrick et al., 2018). This model is among the most influential in addiction research and postulates that individuals consume drugs for positive and/or negative reinforcements related to internal and/or external sources. Accordingly, Cooper (1994) defines four motives, namely social order (positive-external), enhancement (positive-internal), conformity

(negative-external), and coping (negative-internal). Studies have supported this model by showing the involvement of motives in substance use disorders (see Cooper et al., 2016 for a review; Lee et al., 2017). Indeed, whereas substance users reported coping and social motives (Hides et al., 2008; Wong et al., 2013), enhancement and conformity did not seem specifically related to drug consumption (Hides et al., 2008). When exploring the comorbid use of alcohol and cannabis in youth, social motives were mainly related to alcohol use; enhancement motives predicted both alcohol and cannabis consumption, whereas coping motives were related to cannabis but not alcohol use (Skalisky et al., 2019).

The joint influence of impulsivity and consumption motives has also been reported to predict cannabis (e.g., Hecimovic et al., 2014) or alcohol (e.g., Jones et al., 2014) use among young people. In particular, it has been shown that the associations between problematic drinking and sensation seeking or lack of premeditation were mediated by enhancement motives, and that the association with negative urgency was influenced by coping, social, and enhancement motives (Adams et al., 2012; Jones et al., 2014). However, possible interactions between these variables have to be further explored in multiple substance use. Indeed, although the current literature has led to a better understanding of the impulsivity facets and motives involved in different consumptions (e.g., Hides et al., 2008; Thomsen et al., 2018), there is a need for studies considering multiple substance use, which is a very common pattern in college students. Furthermore, research increasingly shows that it is central to consider the possible existence of subgroups characterized by distinct psychological profiles (e.g., Malmberg et al., 2012). Nevertheless, previous studies focusing on substance use have mainly explained heterogeneity through social and environmental variables (e.g., Assanangkornchai et al., 2018; Evans-Polce et al.,

2016; Schilling et al., 2017), without considering the role of central psychological factors. Heterogeneity of psychological profiles has been confirmed in young adults with excessive alcohol or cannabis use (e.g., Gierski et al., 2017; Lannoy et al., 2017; Martinez-Loredo et al., 2018; Pedersen et al., 2017), but the joint role of impulsivity facets and consumption motives in substance use remains to be established.

The current study aimed to explore the use of various substances in a sample of college students and particularly examined (1) the psychological profiles of individuals with substance use, and (2) the comorbidities and severity of substance use behaviors in each profile. Based on impulsivity and consumption motives, we used a cluster analytic approach to explore the existence of distinct psychological profiles among college students. We then evaluated the differences between clusters regarding the prevalence and intensity of substance use, the presence of anxiety, and self-esteem level. Indeed, high anxiety and low self-esteem are crucial factors associated with substance use in young people (e.g., Blank et al., 2016; Walther et al., 2012) and may help to characterize the profiles of substance users. Capitalizing on European and French prevalences, we focused this study on several substances, namely tobacco, alcohol, cannabis, ecstasy, cocaine, and heroin (European Monitoring Center for Drugs and Drug Addiction[1], 2015). According to previous studies (e.g., Lammers et al., 2013; Lannoy et al., 2017), we hypothesized that profiles combining high impulsivity and stronger motives would be related to increased and harmful substance use.

2. Materials and Methods

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[1] Observatoire Europeen des Drogues et des Toxicomanies

2.1. Participants and Design

We recruited a convenient sample of 2,741 college students from the *University of Caen Normandie* (France; academic year 2016-2017). This study was part of a large research project exploring substance consumption in young adults (ADUC; Alcohol and Drug at University of Caen). Participants were contacted by email to answer an online survey screening substance use in university students (anonymity was guaranteed). A total of 34,215 emails were sent and 2,741 participants were included in the study after removing missing data and abstainers (Figure 1). There was no other inclusion or exclusion criteria. The current response rate (13.87%[2]) as well as the ratio between completed responses and included participants (62.84%) were comparable to previous studies among college students (e.g., Ehret et al., 2013; McCabe et al., 2002; Neighbors et al., 2006). The study protocol was approved by the National computer and freedom commission (CNIL[3]; file number u24-20171109-01R1) and conducted according to the Declaration of Helsinki. All students provided informed consent before taking part in the study.

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[2] The response rate is line with the usual response rates observed at the University of Caen Normandie; e.g., 17.64% of students at the University of Caen Normandie answered a survey about blood donation in 2016; 11.41% answered a survey about healthcare access among students in 2018.
[3] Commission Nationale Informatique et Liberté

Figure 1.
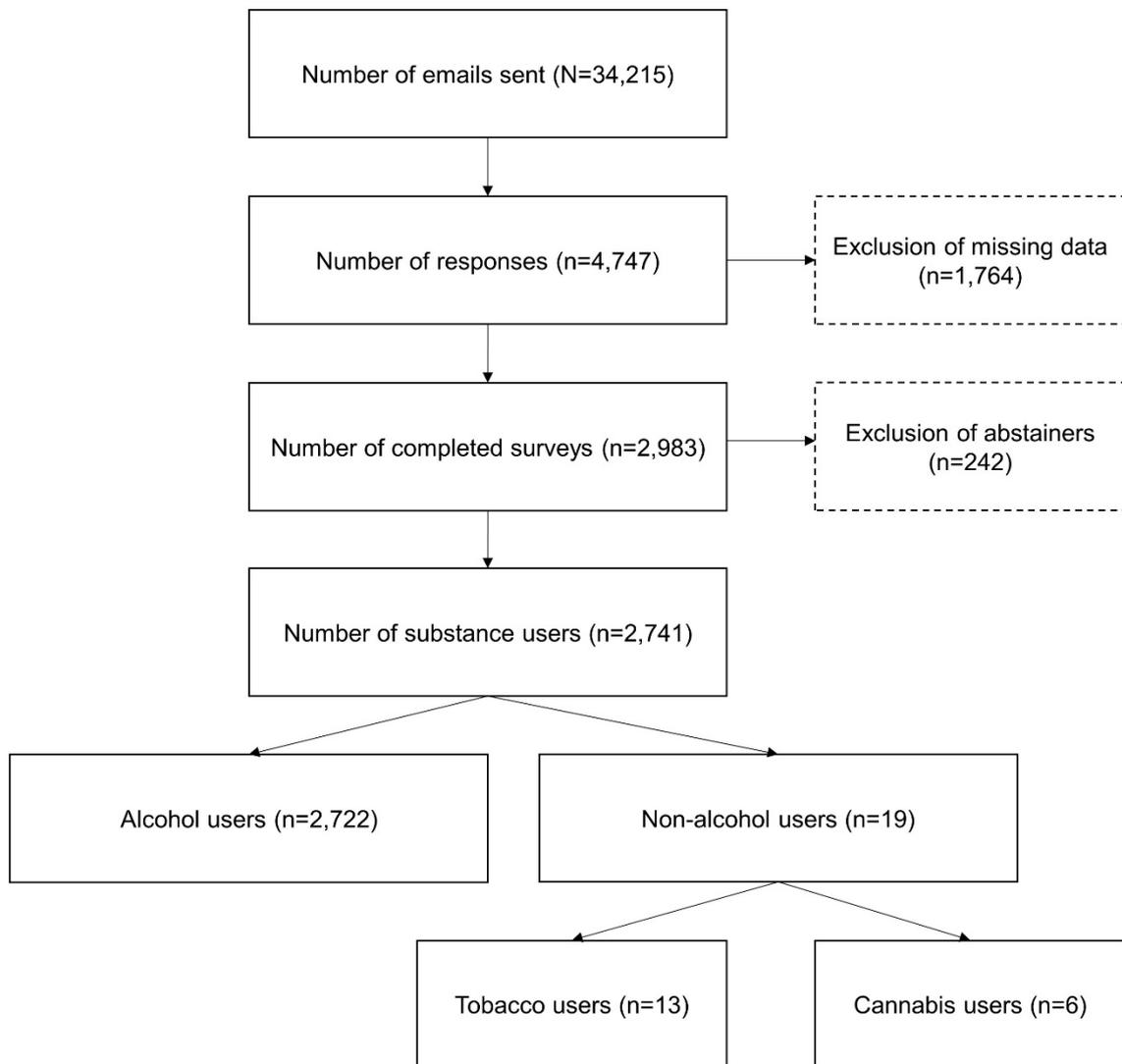
Figure 1. Flowchart of data processing and inclusion.

2.2. Measures

The online survey was implemented through LimeSurvey software and assessed sociodemographic (i.e. age, gender, mother tongue) and academic (i.e. attendance, study years, diploma, grade) variables, substance use (tobacco, alcohol, cannabis, ecstasy, cocaine, heroin; see supplementary Table for reliability coefficients), motives in association with substance use, impulsivity (UPPS-P; Billieux et al., 2012), and trait

anxiety (State-Trait Anxiety Inventory, STAI; Bruchon-Schweitzer & Paulhan, 1993).

Also, we assessed self-esteem through a unique item (i.e., "I have a good self-esteem"), on a Likert scale from 0 "not at all" to 5 "absolutely" (Robins et al., 2001).

Regarding consumption motives, we used the short form questionnaire developed by Kuntsche and Kuntsche (2009) for all substances (i.e. "if you think about all the times you have drunk alcohol or taken psychoactive substances, how many times did you do it…"). The consumption motives assessment investigated social (e.g., "because it helps you enjoy a party"), enhancement (e.g., "because you like the feeling"), conformity (e.g., "to fit in with a group you like"), and coping (e.g., "to cheer up when you are in a bad mood") motives. The short-form of this questionnaire showed comparable factor structure and similar concurrent validity to the original form (Cooper, 1994). This questionnaire also had a good internal consistency in the current sample (see supplementary Table). All the participants included (66.8% women) were between 19 and 35 years old ($M = 20.79$; $SD = 2.83$) and were fluent French speakers. Although young adults are usually defined between 18 and 30 years old (e.g., Lipperman-Kreda et al., 2018), we included all participants in this study[4]. Indeed, including all respondents allowed us to better cover substance use, psychological profiles, and personal characteristics.

2.2.1. Substance Use Evaluation

Tobacco consumption was assessed using the Fagerström Test for Nicotine Dependence (FTND; Heatherton et al., 1991), a 6-item test evaluating cigarette consumption and dependence (score range: 0-10). Scores below 4 indicate no

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[4] Analyses have been conducted in a subsample of participants between 18 and 30 years old and results were similar. We kept the whole sample for a better representation of the population.

dependence, scores between 4 and 5 indicate low dependence, whereas scores between 6 and 7 reflect moderate dependence, and scores higher than 7 high dependence.

Alcohol consumption was assessed by the Alcohol Use Disorders Identification Test (AUDIT; Gache et al., 2005), measuring the severity of alcohol consumption and alcohol use disorders using a 10-item Likert scale (score range: 0-40). AUDIT scores higher than 7 reflect hazardous consumption whereas scores beyond 19 indicate potential severe alcohol use disorder. Complementary items were also used to explore specific binge drinking habits, namely the consumption speed (i.e. number of alcohol doses consumed in one hour; an alcohol dose containing 10 gr of pure ethanol in France), the number of drunkenness episodes during the last 6 months, and the percentage of alcohol consumption episodes leading to drunkenness in the last six months. A binge drinking score (Townshend & Duka, 2002) was computed using the following formula: [(4x consumption speed) + drunkenness frequency + (0.2 x drunkenness percentage)] to consider participants who drank heavily but irregularly.

Finally, cannabis, ecstasy, cocaine, and heroin consumption were evaluated through the Cannabis Abuse Screening Test (CAST; Legleye et al., 2007) adapted for each substance (score range: 0-24). This questionnaire evaluated consumption frequency and harmfulness (i.e., the prevalence of non-recreational use, memory disorders, inability to reduce or stop using the substance, and problems related to consumption). CAST scores beyond 2 reflect a harmful consumption. This test presented acceptable to very good internal consistencies (see supplementary Table).

2.3. Data analysis

Descriptive analyses were first performed to explore the prevalence of substance use in the whole sample. A data clustering technique was then used to identify subgroups among this sample (including all people who had already use any substance). As previously performed (Hair et al., 2010; Billieux et al., 2015; Lannoy et al., 2017), we conducted data grouping through a combination of hierarchical (using Ward's method with a squared Euclidean distance measure) and non-hierarchical (i.e., K-means analysis) methods. We designated the psychological variables selected for the cluster analysis according to established risk factors for substance use, i.e., impulsivity (urgency, lack of premeditation, lack of perseverance, sensation seeking) and motives (enhancement, social, conformity, coping). All the variables selected were Z-scored to ensure that they had the same metric properties. To avoid multicollinearity (Hair et al., 2010), we also merged positive and negative urgency facets of impulsivity (correlation: $r = .52$, $p < .001$) into an "urgency" factor, in line with previous recommendations (Billieux et al., 2015). Finally, subgroups were compared based on external correlates (i.e., age, gender, academic years, academic attendance, anxiety, self-esteem, and substance use), post-hoc tests were corrected for multiple comparisons with Bonferroni procedure when appropriated. Regarding substance use comparisons, we explored: (1) the prevalence of each substance use in the different subgroups by binary evaluations (yes/no) and (2) the substance use in each cluster, thanks to continuous scores. We investigated polysubstance consumption by computing the percentage of individuals using two substances (i.e., tobacco and cannabis) or all substances (i.e., tobacco, alcohol, cannabis, ecstasy, cocaine) in each cluster. As nearly all students drank alcohol, we did not explore polysubstance use in link with alcohol consumption.

3. Results

3.1. Descriptive analysis

Descriptive analyses showed that 42.1% of students smoke tobacco, 99.3% drink alcohol, 24.4% smoke cannabis, 4.9% consume ecstasy, 1.9% consume cocaine, and 0.2% consume heroin.

3.2. Cluster Analysis

We performed cluster analysis on the whole sample, and results indicated an optimal four-factor solution (Figure 2). The four clusters encompassed 33.9%, 31.8%, 21.1%, and 13.2% of the sample. Analyses of variance confirmed the differences between clusters regarding impulsivity and consumption motives. Comparisons based on external correlates strongly supported the reliability of these subgroups (Table 1). First, results showed that Cluster 1 was characterized by low impulsivity and consumption motives, Cluster 2 by high values of enhancement and social motives as well as average scores for sensation seeking and lack of perseverance, Cluster 3 by extreme conformity motives, elevated drinking motives, as well as intense urgency, and Cluster 4 by globally intense impulsivity (urgency, lack of perseverance, sensation seeking, lack of premeditation) and high motives (coping, enhancement, social). Second, the main finding observed in the cluster comparisons was that substance use significantly differed between clusters, with an increased prevalence in Cluster 4. The fourth cluster encompassed individuals presenting larger consumption of all substances, increased dangerousness, but also polysubstance use (Figure 3). Although the sample showed a higher prevalence of women, gender ratio differed between clusters and was more balanced in Cluster 2 compared to the others. Regarding university years, results showed that participants in Cluster 1 were more

1 advanced in their academic background (i.e., higher prevalence of master's and Ph.D.

2 students) whereas participants of Cluster 4 were rather in their first university years.

3 Finally, concerning psychopathological factors, findings highlighted that individuals of

4 Cluster 1 reported higher self-esteem and individuals of Cluster 2 had lower anxiety.

5 Members of Clusters 3 and 4 showed higher anxiety and lower self-esteem.

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Figure 2.

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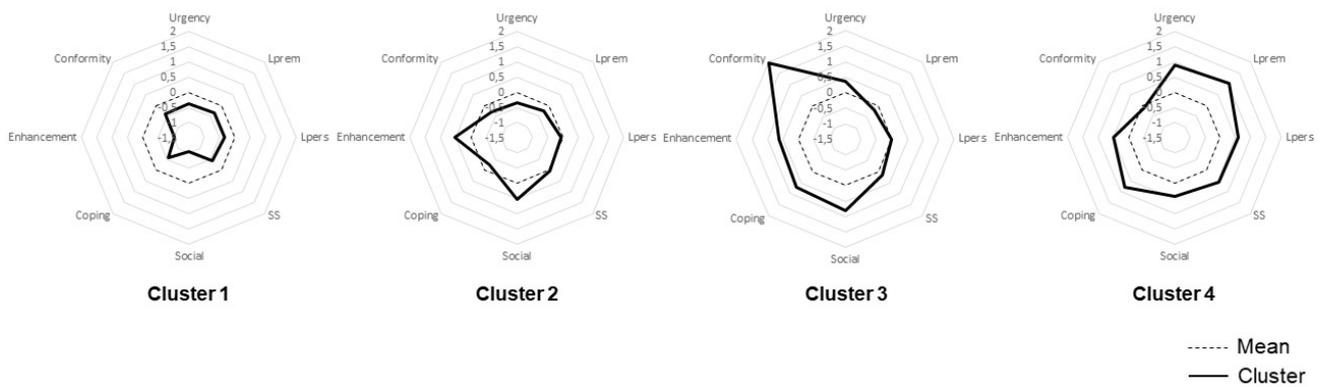
8 **Figure 2**. Subgroups of college students determined by cluster analysis

9 according to impulsivity facets (urgency, lack of premeditation [Lprem], lack

10 of perseverance [Lpers], sensation seeking [SS]) and consumption motives

11 (social, enhancement, conformity, coping).

Figure 3.

Prevalence of substance and polysubstance use
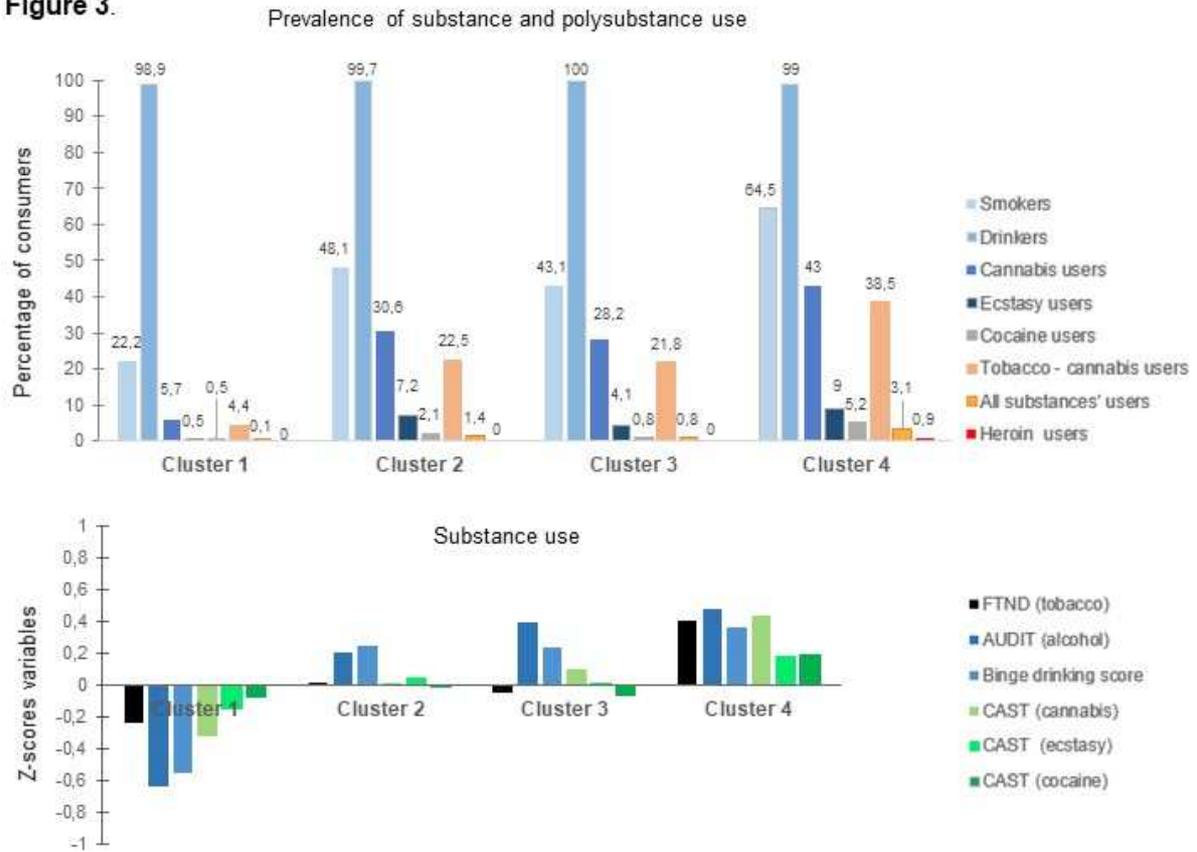
Figure 3. Substance use in the four clusters. Figure 3a represents the prevalence of substance use in each cluster (i.e. tobacco, alcohol, cannabis, ecstasy, cocaine, heroin), the percentage of individuals consuming both tobacco and cannabis or all substances. Figure 3b illustrates substance use in each cluster, in reference to validated tools (Fagerström Test for Nicotine Dependence [FTND], Alcohol Use Disorder Identification Test [AUDIT], Cannabis Abuse Screening Test [CAST] for cannabis, ecstasy, cocaine, and heroin consumption). Scores presented in the Y axis are standardized in order to reliably compare the different tests.

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Table 1. Descriptive Statistics and Mean Comparisons between Clusters

Variables	Cluster 1 (*n* = 930)	Cluster 2 (*n* = 872)	Cluster 3 (*n* = 362)	Cluster 4 (*n* = 577)	*F* / *khi2*	*Comparisons*
Cluster profiles [mean (SD)]						
Impulsivity						
Urgency	8.93 (2.15)	9.04 (1.83)	10.67 (2.11)	11.89 (1.89)	336.30*	C4>C3>C2=C1
Lack of premeditation	6.71 (1.86)	6.94 (1.69)	7.09 (1.86)	9.66 (2.01)	355.51*	C4>C3>C2=C1
Lack of perseverance	6.57 (2.14)	7.24 (2.23)	7.36 (2.41)	8.77 (2.51)	111.52*	C4>C3>C2=C1
Sensation seeking	8.69 (2.76)	10.07 (2.73)	10.45 (2.84)	11.58 (2.56)	139.14*	C4>C3=C2>C1
Consumption motives						
Social motives	5.23 (1.94)	10.59 (2.12)	11.57 (2.03)	10.18 (2.65)	1307.26*	C3>C2>C4>C1
Enhancement motives	4.71 (1.71)	9.91 (2.29)	10.25 (2.53)	9.85 (2.74)	1108.75*	C3=C4=C2>C1
Conformity motives	3.50 (1.10)	3.69 (1.07)	8.61 (2.20)	4.13 (1.48)	1361.13*	C3>C4>C2<C1
Coping motives	3.89 (1.68)	4.82 (2.11)	7.61 (3.22)	7.88 (3.02)	452.71*	C4=C3>C2>C1
External correlates [mean (SD)]						
Age	21.40 (3.49)	20.63 (2.39)	20.37 (2.28)	20.29 (2.38)	24.28*	C1>C2=C3=C4
Age range	19 - 35	19 - 35	19 - 35	19 - 35		
Gender (% of women)	75.6	54.4	64.1	73.1	104.93*	C1>C4>C3>C2
Academic year					98.08*	
First year (%)	30.4	29.2	13.7	26.7		
Second year (%)	28.3	36.3	12.5	22.9		
Third year (%)	36.4	32.2	14.4	17		

Fourth year (%)	38.2	33.5	14	14.3	
Fifth year (%)	45.1	32.2	12.4	10.3	
PhD students (%)	57.1	31.9	5.5	5.5	
Academic attendance (%)	88.19 (20.52)	83.68 (21.23)	82.70 (24.24)	78.52 (22.54)	24.39*	C1>C2=C3>C4
Anxiety	45.16 (11.51)	42.88 (11.86)	49.51 (12.45)	50.62 (12.95)	59.20*	C4=C3>C1>C2
Self-esteem	3.10 (1.26)	3.34 (1.18)	2.65 (1.30)	2.62 (1.37)	50.05*	C1>C2>C3=C4
Tobacco consumption (FTND)	0.31 (1.11)	0.68 (1.46)	0.60 (1.41)	1.28 (1.99)	51.60*	C4>C2=C3>C1
Alcohol consumption (AUDIT)	3.51 (2.84)	7.99 (4.95)	9.00 (5.60)	9.45 (6.02)	255.10*	C4=C3>C2>C1
Binge drinking score	8.34 (9.53)	26.66 (20.36)	26.66 (21.84)	29.36 (23.08)	223.78*	C4>C3=C2>C1
Cannabis consumption (CAST)	0.08 (0.61)	1.01 (2.59)	1.28 (3.44)	2.24 (4.18)	75.79*	C4>C3=C2>C1
Ecstasy consumption (adapted CAST)	0.01 (0.12)	0.15 (0.89)	0.12 (0.77)	0.25 (1.10)	13.07*	C4>C3=C2>C1
Cocaine consumption (adapted CAST)	0.00 (0.03)	0.03 (0.34)	0.01 (0.11)	0.14 (1.06)	9.32*	C4>C3=C2=C1

1   *Note.* FTND = Fagerström Test for Nicotine Dependence; AUDIT = Alcohol Use Disorder Identification Test; CAST = Cannabis Abuse Screening
2   Test. Cluster comparisons for the heroin CAST score were not performed as heroin users (n=5) are regrouped in Cluster 4. Differences between
3   clusters are shown by corrected Bonferroni post hoc tests (excepted for gender and academic years). *p < 0.001.

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4. Discussion

The current study aimed to identify the existence of distinct psychological profiles of substance users among college students. The current findings support the existence of distinct psychological profiles and highlight four subgroups characterized by specific impulsivity facets and consumption motives. These profiles differ regarding the intensity and frequency of substance use, anxiety, and self-esteem. Moreover, while the current results highlight distinct profiles of substance users and identify those at risk for excessive use, these profiles were not characterized by a large variation regarding the type of substance consumed. This finding appears in contrast with previous studies investigating heterogeneity in social and environmental variables (Schilling et al., 2017; Stanley & Swaim, 2018). Regarding psychological factors, our results demonstrate specific characteristics related to multiple consumptions rather than profiles of alcohol or drug users.

First of all, consistent with previous studies showing that substance users have higher impulsivity and consumption motives than no-substance users (Charles et al., 2016; Dow and Kelly, 2013), the current research reveals that Cluster 1 is composed of young people with light substance use, as well as impulsivity and motives scores below the mean of the whole sample. Indeed, these students report a preserved self-regulation (reduced impulsivity), a lack of desire to consume drugs, but also good self-esteem and low anxiety. Moreover, this cluster is characterized by a stronger prevalence of women and older students, which widely supports the influence of gender and age on substance use (Degenhardt et al., 2008).

Regarding the subgroups of people using substances, Cluster 2 is characterized by important enhancement and social motives. Accordingly, we postulate that this cluster includes people with a classical "student profile" who use

1   substances for pleasure and sensations in social and festive contexts. Indeed, it has

2   been shown that emerging adulthood is associated with increased autonomy and

3   freedom, leading to new experiences such as substance use (see Stone et al., 2012,

4   for a review). The university environment can further facilitate this freedom and can

5   lead young people to explore new experiences. This proposal is reinforced by the

6   apparent preservation of psychological well-being in this subgroup (good self-esteem,

7   academic attendance, and low anxiety), supporting that substance use would be

8   mainly contextual and not related to psychological difficulties. Therefore, we expect

9   that most students in this cluster would evolve towards a low-risk profile with studies'

10   progress or at the beginning of their professional life. This assumption is in line with

11   existing longitudinal studies showing that leaving University is related to a decrease of

12   substance use in people with low-risk profiles (e.g., Gómez et al., 2017). However, it

13   is worth noting that these individuals also report high scores for the use of all

14   substances and elevated binge drinking. These consumption habits may have

15   deleterious consequences at short-term but also in the long-term (e.g., cognitive and

16   cerebral impairments; Mahmood et al., 2013; McNamee et al., 2008). Prevention

17   actions modifying the potential misperception that substance use is normative and

18   informing about the negative consequences (Botvin & Griffin, 2007; Onrust et al.,

19   2018) should thus be carried out among individuals in this cluster.

20   Cluster 3 is mainly defined by important conformity, together with enhancement,

21   social, and coping motives, as well as high urgency scores. Other impulsivity facets,

22   although slightly more elevated than in clusters 1 and 2, are close to the average of

23   the whole sample. This cluster characterizes a part of substance users who particularly

24   use alcohol and drug to avoid being excluded by others (Studer et al., 2016).

25   Subsequent analyses also showed that college students in this subgroup have

important levels of anxiety and low self-esteem. Therefore, this third subgroup is comparable to the second in terms of substance use but present lower psychological well-being. Due to its mean impulsivity scores (lack of premeditation, lack of perseverance, sensation seeking), this cluster contrasts with the current literature emphasizing the crucial role of impulsivity in substance use (e.g., Charles et al., 2016; Loree et al., 2015). These results show that people with low personal risk factors to use substances may still have significant substance consumption and poor well-being. This finding is, however, in accordance with previous studies showing the unique predictive value of consumption motives (Dow and Kelly, 2013) and underlines the dangerousness related to negative reinforcement motives (e.g., Cooper, 1994; Dow and Kelly, 2013; Mezquita et al., 2011). It constitutes a main insight of the present study as it highlights a currently under-reported category of college students. Indeed, in this subgroup, we observe a relationship between substance use, peer pressure (conformity), and stress (coping), possibly related to the university environment (e.g., the burden to success in a high social environment). This subgroup emphasizes the need for prevention programs improving the ability to refuse drugs and to resist peer influence (Botvin and Griffin, 2007; Helmer et al., 2016).

Finally, Cluster 4 encompasses another part of substance users and show a "classical profile" of heavy consumers, characterized by elevated impulsivity and consumption motives (coping, enhancement, social), low self-esteem, low academic attendance, and high anxiety. This psychological profile is in line with previous studies, showing a strong influence of impulsivity and emotional motives in substance use (e.g., Barahmand et al., 2016; Cooper et al., 2003; Lammers et al., 2013) as well as a significant relationship with anxiety (e.g., Tavolacci et al., 2013). Accordingly, we postulate that participants in this subgroup use substances to increase positive affects

1　(enhancement, social, urgency, sensation seeking) or decrease negative ones

2　(coping, urgency), while reporting low perseverance and few considerations of the

3　long-term consequences. The hazardousness of this profile is observed through

4　elevated substance use and a higher prevalence of polysubstance use. Previous

5　studies showed that polysubstance use is related to increased mental illness and

6　violent/high-risk behaviors compared to unique substance use (Connor et al., 2014;

7　Morley et al., 2015). This result thus reinforces the negative health and social

8　outcomes of this cluster. The possible consequences of such a psychological profile

9　of substance users should be underlined. As students in this subgroup present the

10　typical risk profile for substance abuse and dependence, they are at risk of evolving

11　towards severe substance use disorders after their university years. Prevention and

12　intervention programs are critical for this subgroup and might focus on improving

13　personal skills (e.g., emotion regulation, perseverance, premeditation), cognitive

14　restructuring (Botvin and Griffin, 2007; Chambers et al., 2016), or cognitive stimulation

15　(Sampedro-Piquero et al., 2018) to avoid such transition towards established addictive

16　disorders.

17　　　Importantly, Clusters 3 and 4 are characterized by psychological problems (high

18　anxiety and low self-esteem), which may no longer reflect recreational substance use.

19　The association between substance use and anxiety is indeed highly prevalent in

20　clinical populations and can be explained by the self-medication hypothesis (for

21　sedatives; alcohol, cannabis) or the neurotoxic effect of substance use (for stimulants;

22　tobacco, cocaine, heroin) (Vorspan et al., 2015). Here, we observed this relationship

23　for individuals presenting the consumption of both sedative and stimulant substances,

24　with a higher prevalence of sedative substances use (i.e. alcohol and cannabis).

25　According to this observation and the age of our sample, we hypothesize that some

1 participants in these clusters use substances as self-medication, which is also

2 consistent with the coping motives and urgency facet observed in these clusters.

3 Moreover, these results can also be related to a recent study showing subgroups

4 characterized by either high self-esteem without psychological problems or low self-

5 esteem with psychological problems (Gierski et al., 2020). Altogether, these results

6 highlight the significant role of anxiety and self-esteem to characterize these

7 subgroups.

8

9 Some limitations should be acknowledged. First, although comparable with

10 previous studies, the response rate in the current research is moderate (13.87%).

11 Second, whereas the consumption motives questionnaire used is in line with previous

12 studies (Cooper et al., 2016) and has good reliability in the current sample, future

13 research should reinforce our results by using substance-specific motive scales. In the

14 same vein, self-esteem was assessed by a single item with a likert scale (Robins et

15 al., 2001). However, given the important role of self-esteem in these findings, this

16 concept should be further explored. Overall, this exploration of distinct psychological

17 profiles among substance users has to be extended through experimental and

18 longitudinal data. It would also be interesting to consider other substances use (e.g.,

19 nicotine-cigarette, methamphetamine, inhalants). Finally, although these results are

20 consistent with previous French studies (e.g., Gierski et al., 2020; Tavolacci et al.,

21 2013), they should be replicated by targeting adults with various ages, socio-economic

22 status and from various countries.

23 As a whole, the current results show distinct psychological profiles of college

24 students and highlight several patterns of combined impulsivity and motivations

25 related to excessive substance use. The associations found between impulsivity facets

1   (urgency, lack of premeditation, sensation seeking) and drinking motives (coping,

2   social, enhancement) in clusters 3 and 4 extend previous results, showing the

3   interaction between these variables to explain excessive/problematic alcohol use

4   (Adams et al., 2012; Jones et al., 2014). In addition, our results highlight the joint role

5   of conformity motives and urgency in Cluster 3. In particular, by indicating profiles of

6   recreational (enhancement and social motives), peer pressure-sensitive (high

7   conformity motives), and hazardous (high impulsivity and consumption motives) users,

8   these findings are in line with previous ones (Lannoy et al., 2017). This study also

9   goes beyond the widely described role of impulsivity by showing that people with good

10   self-regulation also report harmful substance use. Indeed, Cluster 3 highlights that

11   people with good executive abilities may exhibit harmful substance use, mainly

12   explained by a need to comply. These results thus have strong implications to target

13   substance users and implement appropriate prevention and intervention actions. They

14   suggest that prevention of substance use should be adapted according to the

15   psychological characteristics of each profile rather than being conducted in association

16   with the substance consumed.

Declarations of interest

None.

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Supplementary Table. Main variables evaluated in the current study and reliability

coefficients.

Variables	α
Impulsivity	
Urgency	.82
Lack of premeditation	.77
Lack of perseverance	.87
Sensation seeking	.82
Consumption motives	
Social motives	.87
Enhancement motives	.82
Conformity motives	.83
Coping motives	.87
Substance use	
Tobacco consumption (FTND)	.75
Alcohol consumption (AUDIT)	.79
Cannabis consumption (CAST)	.82
Ecstasy consumption (adapted CAST)	.60
Cocaine consumption (adapted CAST)	.79