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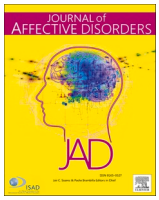

Research paper

The highs and lows: Cannabis use and positive valence bipolar mood and emotion processes in emerging adults

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ABSTRACT

Growing work underscores the importance of understanding disturbances in positive valence or emotional processes in psychopathology. Despite evidence that substance use disorders, such as cannabis misuse, are associated with positive emotion processes, few studies have examined associations between cannabis use and clinically relevant disorders that centrally feature positive emotions (such as bipolar spectrum disorders) and associated positive emotion processes. The present study investigates associations between self-reported cannabis use and bipolar spectrum disorder (BSD) risk and mood severity, as well as three well-studied positive valence processes (i.e., positive emotion experience, reward responsiveness, and positive emotion valuation). Emerging adult college students who endorsed cannabis use (N = 968) were recruited from nine North American universities. Higher self-reported BSD risk was associated with greater cannabis-related interference with daily life, but not cannabis use frequency or difficulty stopping. Furthermore, higher positive emotion experience was associated with lower cannabis frequency, interference with life, and difficulty stopping. Greater reward responsiveness was associated with decreased cannabis interference in daily life. These findings highlight the importance of clinically relevant and basic positive emotion-relevant processes in understanding cannabis use.

1. Introduction

Positive emotions are central to well-being and goal regulation (e.g., Fredrickson, 1998; Shiota et al., 2017). However, when positive emotion processes go awry, they can contribute to distress and symptom severity in affective disorders (e.g., Carl et al., 2013; Gruber et al., 2019). Despite this, few studies have examined their role in substance use disorders, particularly cannabis misuse, with most research focusing on negative emotion outcomes (e.g., Kedzior and Laeber, 2014; Lev-Ran et al., 2014). An important next step is to examine how cannabis use intersects with disorders like bipolar spectrum disorders (BSDs), often described as the 'poster child' for positive emotion disturbances (e.g., Gruber, 2011; Gruber et al., 2019; Johnson et al., 2007). This step is critical given bipolar mood disorders and cannabis use frequently co-occur and

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worsen clinical prognosis (Tourjman et al., 2023). Investigating bipolar disorders during the emerging adulthood period (ages 18–25) is critical given it is a developmental stage marked by heightened emotional reactivity and increased risk-taking, alongside greater autonomy and access to substances such as cannabis, making it a peak period for its co-occurrence with mood and substance use problems (Arnett, 2000; Twenge et al., 2019; Fontanella et al., 2021). The present investigation examines cannabis use in relation to bipolar mood dimensions and key positive emotion processes implicated in bipolar disorders, (e.g., Alloy et al., 2016; Johnson et al., 2005), including positive emotion experience (frequency and intensity of recent positive emotions), reward responsiveness (the degree of excitement when obtaining rewards), and positive emotion valuation (the extent to which individuals strive for and prioritize feeling happy). Doing so provides an important entry point to examine the landscape of cannabis use and positive valence processes.

1.1. Cannabis use and bipolar spectrum disorders

Cannabis contains psychoactive compounds, primarily delta-9-tetrahydrocannabinol (THC; Riboulet-Zemouli, 2020), that affect mood and cognition (Lee et al., 2017; Broyd et al., 2016). Cannabis is the most widely used illicit substance worldwide, with rates rising rapidly over the past decade (United Nations, 2021). Its use is linked to increased mental health risks and healthcare burdens, including cannabis-impaired driving, cannabis use disorder (CUD), and higher rates of hospitalizations (Fischer et al., 2018; Hines et al., 2020; Perisetti et al., 2020). Cannabis is strongly associated with disorders characterized by negative emotions, such as anxiety and depression (Kedzior and Laeber, 2014; Lev-Ran et al., 2014; Ouellette et al., 2019); however, less is known about disorders characterized by disturbances in positive emotion, such as bipolar spectrum disorders (BSDs). Understanding cannabis use and how it co-occurs with BSDs is an important next step.

BSDs involve periods of mania or hypomania (elevated mood, increased energy, risk-taking) and typically depression (sad mood, anhedonia, appetite/sleep changes; American Psychiatric Association, 2022). Difficulties with positive emotion processes define BSDs. Indeed, individuals with, or at risk for, BSDs report greater *positive emotion experience* across various emotion-relevant stimuli (e.g., Dutra et al., 2014; Green et al., 2007; Gruber, 2011). People with BSDs experience greater *reward responsiveness*, including heightened activation of reward-related neural systems (e.g., Caseras et al., 2013; Dutra et al., 2015; Nusslock and Alloy, 2017). Finally, people with BSDs also struggle to manage intense positive emotions (Dodd et al., 2020; Giovanelli et al., 2013; Gruber, 2011; Villanueva et al., 2023). Furthermore, individuals with BSDs report increased *positive emotion valuation*, defined as striving for, and concern about, positive emotion states (e.g., Ford et al., 2015). These findings underscore the significance of positive emotions and BSDs and their potential role in cannabis use.

Cannabis use and BSDs are highly comorbid, with lifetime cannabis use reported in 52%–71% of individuals with BSDs (Tourjman et al., 2023) and approximately 36% meeting criteria for CUD (Preuss et al., 2023). The presence of cannabis use is linked with earlier BSD onset, higher suicide risk, greater manic symptom severity, and poorer functioning (Maggu et al., 2023; Henquet et al., 2006; Bartoli et al., 2019; Pinto et al., 2019; van Rossum et al., 2009), whereas other studies find that cannabis use does not impede and may even enhance decision-making in BSDs (Miranda et al., 2025). When the comorbidity of BSD and CUD is present, the psychiatric hospitalization risk increases by over 50% (Patel et al., 2022). Some studies suggest cannabis may trigger and elevate risk for both mania and depression (Arjmand et al., 2019; Jefsen et al., 2023), whereas other studies report associations between cannabis use and greater mood episode duration (i.e., manic and depressive; Baethge et al., 2008; Strakowski et al., 2000). One experience-sampling study found that cannabis use in people with bipolar disorder type I statistically predicted increases in positive (but not negative) affect and greater mood (manic and depressive) symptoms (Tyler et al., 2015). These findings highlight the need for further research on how cannabis use interacts with mood severity and positive emotion processes.

1.2. Cannabis use and positive emotion processes

Few studies have assessed positive emotions and cannabis use (e.g., Fredrickson, 2001; Shiota et al., 2017). However, several studies suggest that positive emotions, central to BSDs (Gruber, 2011), may play an important role. For example, Buckner et al. (2015) found that individuals reported higher positive emotion on cannabis use days compared to non-use days. Similarly, Chakroun et al. (2010) found that self-reported happiness was associated with greater cannabis use in healthy young adults, whereas reduced cannabis use was associated with increased depressed and anxious mood. Sznitman et al. (2022) also reported that higher positive emotion was associated with greater cannabis use intentions and remained elevated after use. These findings suggest that elevated positive emotion may drive cannabis use. A related line of work suggests that cannabis use may be linked to diminished reward responsiveness despite elevated experience of positive emotions. Long-term cannabis use is associated with lower self-reported reward responsiveness (Wright et al., 2016). Neuroimaging studies have found reduced activation in reward-related brain regions during reward anticipation (van Hell et al., 2010; Luijten et al., 2017) and blunted responses in the nucleus accumbens with increased cannabis use (Martz et al., 2016). These findings suggest that cannabis may initially enhance, but ultimately blunt, reward sensitivity. In other words, occasional or initial cannabis use may be associated with elevated positive affect and mood symptoms in individuals with BSD (Tyler et al., 2015), but heavier or more sustained use has been associated with blunted reward responding (Martz et al., 2016).

1.3. The present investigation

Disturbances in positive emotion systems increasingly are recognized as integral across various psychopathologies, including substance use and mood disorders (e.g., Gruber et al., 2019; Hechtman et al., 2013). However, few studies have examined how positive emotion processes intersect with both cannabis use and BSDs. The present investigation sought to address this gap with the following aims:

Aim 1: Associations between BSDs and self-reported cannabis use. We predicted that higher BSD risk scores would be associated with more problematic cannabis use, including frequency, interference, and difficulty stopping (Aim 1a). We predicted that these associations would hold when controlling for current mania and depression mood symptoms (Aim 1b). Finally, we predicted that higher self-reported mania, but not depression, symptoms would be associated with more problematic cannabis use (Aim 1c).

Aim 2: Associations between positive emotional processes and self-reported cannabis use. We predicted that cannabis use would be associated with higher positive emotion experience (Aim 2a), lower reward responsiveness (Aim 2b), and higher positive emotion valuation (Aim 2c).

Exploratory Aim 3: Moderation between BSD risk and symptoms with cannabis use. We explored whether positive emotion processes moderated any significant associations between BSD risk and cannabis use observed from Aim 1.

2. Method

2.1. Participants

An initial sample of $N = 1921$ emerging adults between 18 and 25 years of age completed a baseline remote survey as part of a larger study

on mental health. Participants were currently enrolled college students recruited from nine North American universities during the 2019–2020 academic year prior to the COVID-19 initial outbreak in March 2020 (Young et al., 2025). All recruiting sites received ethical approval to conduct this research, including the University of Colorado Boulder, Northwestern University, New York University, San Francisco State University, Temple University, University of Georgia, University of British Columbia Vancouver, University of California Berkeley, and University of California Irvine. From this initial sample, we included participants who reported using cannabis at least once in their lives given our a priori interest in cannabis use and answered no more than 2 attention checks incorrectly, resulting in a final sample of $N = 968$. This restriction ensured analyses reflected meaningful variability in cannabis use patterns and consequences. See participant characteristics in Supplementary Table S1.

2.2. Measures

The primary study measures assessed cannabis use, BSD risk and symptoms, and positive emotion processes. Descriptives for all measures are in Table S2.

2.2.1. Cannabis Use

Cannabis use was measured using an adapted 5-item version of the Cannabis Use Problems Identification Test (CUPIT; Bashford et al., 2010). This measure assesses the presence, frequency, interference, and difficulty of stopping cannabis use. The first item assessed cannabis use ("Have you ever used cannabis?") rated 1 (Yes) or 0 (No), and the second item queried age of onset ("How old were you the first time you used cannabis?"). Three additional CUPIT individual items assess the frequency of cannabis use (CUPIT3: "On how many days have you used cannabis over the past three months (90 days)?"), cannabis use life interference (CUPIT4: "Did your use of cannabis ever interfere with or get in the way of your work at school, your job, or your home life?"), and difficulty stopping cannabis use (CUPIT5: "How difficult do you think you would find it to stop using or go without cannabis altogether?"). We computed a CUPIT composite score as the mean across these latter three items; however, given the composite had low internal consistency ($\alpha = 0.47$), we did not use the composite score in our main analyses. Instead, we focused on the three individual CUPIT items (frequency, interference, and difficulty stopping).

2.2.2. BSD mood risk

BSD mood risk was measured using the validated short form of the Hypomanic Personality Scale (HPS-20; Meads and Bentall, 2008; Sperry et al., 2015). This 20-item self-report scale uses true-false items to measure episodic changes in mood (e.g., "I often feel excited and happy for no apparent reason"), behavior (e.g., "I do most of my work during brief periods of intense inspiration"), and energy (e.g., "There are times when I am so restless that it is impossible for me to sit still"). Higher scores on the HPS-20 indicate a greater risk for future manic and/or hypomanic episodes. Internal consistency for the HPS-20 in the present study was good ($\alpha = 0.75$). Given no clinical cutoffs have been formally established, when examining the relative proportion of participants who scored in higher clinical ranges, we followed parallel clinical cutoff guidelines from the full version of the HPS-48 (e.g., Eckblad and Chapman, 1986), which commonly use a standard score of 1.82 or higher. In the present study, 4.29% of participants scored above this standard score cutoff consistent with previous studies in young adults (e.g., Gruber et al., 2008).

2.2.3. BSD mood symptoms

Current BSD-relevant mood symptoms of mania and depression were measured using the DSM5 Cross-Cutting Symptom Measure for depression (DSM5-CCSM: Depression) and mania (DSM5-CCSM: Mania; Narrow et al., 2013), consistent with previous studies in emerging adults (e.g., Ibonie et al., 2025; Jopling et al., 2025; Villanueva et al., 2025; Young et al., 2025). The depression domain included two items rated on a 0 (not at all) to 4 (nearly every day) scale rating how much the individual has been bothered by depression symptoms over the past two weeks, for example: "Little interest or pleasure in doing things?". The mania domain items also included two items rating how much the individual has been bothered by mania symptoms using the same 0 (not at all) to 4 (nearly every day) scale over the past two weeks, for example: "Sleeping less than usual, but still have a lot of energy?". We note that in the current study, over half (59.18%) of participants scored above the depression item screener cutoff score of 2 or greater, and over half (52.6%) scored above the mania domain item cutoff score of 2 or greater.

Following scoring guidelines, these scores were supplemented with a continuous measure of mania severity using the Altman Self-Rating Mania Scale (ASRM; Altman et al., 1997). The ASRM consists of five items that assess symptoms of mania over the past week, including elevated mood, self-confidence, need for sleep, speech, and increased activity level. Each item is rated on a 5-point scale ranging from 0 to 4, with higher summed scores indicating greater symptom severity. Internal consistency for the ASRM was good in the present study ($\alpha = 0.70$). In this sample, over half (53.56%) of people scored above a clinical threshold total score of six or higher (Altman et al., 1997) on the ASRM.

2.2.4. Positive emotion processes

We measured three well-studied positive emotion processes linked to BSDs, including (1) positive emotion experience, (2) reward responsiveness, and (3) positive emotion valuation. For *positive emotion experience*, we used the modified Differential Emotions Scale (mDES; Fredrickson et al., 2003), consisting of nine positive and nine negative emotion items rated on a Likert scale from 1 (not at all) to 5 (extremely). From this, a positive affect subscale score (mDES-PA) and negative affect subscale score (mDES-NA) was computed as the mean across individual positive (or negative) emotion items, with higher scores indicating greater positive (or negative) emotion experience in the last week. Internal consistency was strong for mDES-PA ($\alpha = 0.89$) and mDES-NA ($\alpha = 0.86$) subscales.

Reward responsiveness was measured using the Behavioral Activation System Reward Responsiveness Subscale (BAS-RR; Carver and White, 1994), which contains five items rated on a 1 (very true for me) to 4 (very false for me) scale. Sample items include: "When I get something I want, I feel excited and energized." Following scoring guidelines, reverse-scored individual items such that higher scores indicate more reward responsiveness. Internal consistency for the BAS-RR subscale was strong in the present study ($\alpha = 0.80$).

Positive emotion valuation was measured using the Valuing Happiness Questionnaire (VHQ; Mauss et al., 2011). The VHQ includes seven items rated on a 1 (strongly disagree) to 7 (strongly agree) scale, with higher total scores indicating greater valuing of happiness. The VHQ includes two subscales measuring concern about happiness (e.g., "If I don't feel happy, maybe there is something wrong with me") and aspiring for happiness (e.g., "I would like to be happier than I generally am"). Internal consistency was strong for the VHQ total score ($\alpha = 0.81$) and concern about happiness subscale ($\alpha = 0.81$), but was lower for the aspiring for happiness subscale ($\alpha = 0.64$).

2.3. Procedures

The procedures consisted of four main parts. First, participants contacted the study team to complete the survey at one of the university recruiting sites. Second, participants completed a 60-min baseline Qualtrics survey that included informed consent, demographic information, the present study measures, and other measures not part of the current investigation (see Table S3 in Supplementary materials). Finally, participants were compensated for their participation at their respective

sites.

3. Results

The main study analyses were pre-registered on the Open Science Framework (https://osf.io/ag39d).[1]

3.1. Preliminary analyses: data distribution and quality check

We note that the preliminary analyses were not included in our original pre-registration data analysis plan, though they are standard practice in the field. Specifically, we first examined for potential outliers (i.e., +/− three SDs) among our primary variables and 0.61% was Winsorized accordingly (i.e., assigned the next highest or lowest value at or below three SDs). We note that a somewhat higher proportion of Winsorized data came from the two cannabis use items assessing interference (2.07% of data Winsorized) and difficulty stopping cannabis use (2.58% of data Winsorized). Second, we examined skewness and kurtosis indices following standard cutoffs (i.e., skewness ±2 and kurtosis ±7; Hair and Alamer, 2022) and found that cannabis interference (skewness statistic = 2.29) and difficulty stopping cannabis (skewness statistic = 2.11) were positively skewed, and hence, were log-transformed. Third, we computed preliminary bivariate correlations among our main variables, which were correlated in the expected directions (see Table S4).

3.2. Main analyses

3.2.1. Aim 1: BSD risk, current mood symptoms, and cannabis use

To examine associations between BSD risk and cannabis use, we used a hierarchical linear regression with Block 1 including common study covariates (e.g., age, sex, study site). Current covariates were included because both age and sex are known to influence cannabis use (Khan et al., 2013; Guxens et al., 2007). Additionally, given that legalization and attitudes towards cannabis vary by state-level policy (Philbin et al., 2019), we included study site as a fixed-effect covariate, represented by eight dummy-coded variables (one per site, with one reference site). Block 2 with BSD risk (measured using the HPS-20). The HPS-20 was associated with greater cannabis life interference (β=0.085, (931) = 2.59, 95%CI[0.0006, 0.003], p=0.010) but was not associated with cannabis use frequency (p=0.116) or difficulty stopping cannabis use (p=0.977; Table 1).

We next examined whether these associations held when accounting for current mood symptoms. Specifically, Block 1 included the same study covariates; Block 2 included current depression and hypomania/mania mood symptoms (DSM5-CCSM: Depression, DSM5-CCSM: Mania, ASRM), and Block 3 included BSD risk (HPS-20). No significant associations between HPS-20 and cannabis use frequency (p=0.149), interference (p=0.116), and difficulty stopping (p=0.510) remained significant when current mood symptoms were accounted for (Table 2).

Finally, we examined associations between current mood symptoms and cannabis use specifically. As before, Block 1 included the same study covariates, and Block 2 included current mood symptoms (i.e., DSM5-CCSM: Depression, DSM5-CCSM: Mania, ASRM). As seen in Table 3, DSM5-CCSM: Depression scores were associated with higher cannabis life interference (β=0.073, (939) = 2.03, 95%CI[0.0001, 0.014], p=0.042). No other significant associations emerged.

3.2.2. Aim 2: positive emotion processes and cannabis use

The second aim examined associations between positive emotion processes (positive emotion experience, reward responsiveness, and positive emotion valuation) and cannabis use. For positive emotion experience (Aim 2a), we conducted three separate hierarchical linear regression analyses with cannabis use frequency, cannabis life interference, and difficulty stopping cannabis use as the outcome measures. Block 1 included standard covariates (e.g., age, sex, study site), and Block 2 included positive emotion experience (mDES-PA) and negative emotion experience (mDES-NA). As seen in Table 4, greater mDES-PA scores were associated with lower frequency of cannabis use (β= − 0.083, (905) = −2.425, 95%CI[−0.497, −0.057], p = 0.015) and lower cannabis life interference (β= − 0.080, t(905) = −2.28, 95%CI[−0.014, −0.001], p = 0.023) scores. Higher mDES-NA scores were significantly associated with higher cannabis interference (β=0.075, (905) = 2.162, p=0.031).

For reward responsiveness (Aim 2b), BAS-RR scores were associated with decreased cannabis life interference (β= − 0.071, (847) = 2.01, 95%CI[0.0001, 0.014], p=0.046; Table 5). In other words, participants who had higher reward responsiveness had lower cannabis-related life interference. BAS-RR scores were not associated with cannabis use frequency (p=0.248) or difficulty stopping (p=0.910).

For positive emotion valuation (Aim 2c), the VHQ total score was significantly associated with frequency and difficulty stopping. As seen in Table 6, the VHQ total score was associated with greater cannabis use frequency (β=0.067, (937) = 2.13, 95%CI[0.005, 0.130], p = .033) and greater difficulty stopping (β=0.074, t(860) = 1.96, 95%CI[0.001, 0.020], p = .029). Given these significant results, we conducted post-hoc analyses to determine whether either of the two VHQ subscales may have been driving these effects. Results suggested that the VHQ aspiring for happiness subscale was not associated with any cannabis items (Table S5), but the VHQ concerns about happiness subscale was significantly associated with greater cannabis use frequency (β=0.107, t(937) = 3.37, 95%CI[0.044, 0.169], p < .001), and greater difficulty stopping cannabis use (β=0.126, t(860) = 3.73, 95%CI[0.008, 0.027], p < .001; Table S6).

3.3. Exploratory analyses

3.3.1. Aim 3: moderation between BSD risk and symptoms with cannabis use

Our pre-registration specified that moderation analyses would be conducted for any significant associations that emerged between BSD risk and cannabis use. We conducted a hierarchical linear regression analysis with standard covariates in Block 1 (e.g., age, sex, study site), BSD risk (HPS-20) in Block 2, and positive emotion processes (positive emotion experience, reward responsiveness, and positive emotion valuation) in Block 3, and interaction terms between BSD risk and each of the three positive emotion processes (mDES-PA, BAS-RR, VHQ total) in Block 4. All variables were standardized prior to the main analyses. However, no significant moderation effects were found.

We also conducted post-hoc analyses taking into consideration the influence of alcohol use using a single alcohol item from DSM-5 CCSM ("Drinking at least 4 drinks of any kind of alcohol in a single day?") in Block 1 of the regression model to ensure the effects observed were specific to cannabis use. All main findings remained significant for every model except for several effects from Aim 1 and 2, which became non-significant, including depression symptoms (DSM-5 CCSM: Depression; p = .057), negative affect (mDES-NA; p = .060), and reward responsiveness (BAS-RR; p = .067). See Supplementary materials Tables S7–S14.

4. Discussion

Emerging research underscores the importance of understanding disruptions in positive valence systems, particularly as they relate to substance use and mood disorders. The present study examined associations between cannabis use and both clinically relevant positive

[1] We note that the main analyses reported in the manuscript were run after the relevant Winsorizing and log transformations for skewness were applied as described above. For results for the main study analyses run without checking data for outliers, skewness, etc. see the **supplementary materials**.

Table 1
Regression analyses for BD risk score (HPS-20) with cannabis use (Aim 1a).

Predictor	CUPIT item 3: Frequency of use			CUPIT item 4: Interference with life			CUPIT item 5: Difficulty stopping use		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Block 1	0.028	**0.028***		0.009	**0.009***		0.009	**0.009***	
Age			−0.023			0.001			−0.043
Sex			**−0.121****			**−0.079***			−0.057
Study site			**1 = 0.265****; 2 = 0.010; 3 = 0.022; 4 = −0.006; **5 = 0.173****; **6 = 0.109***; 7 = 0.045; **8 = 0.124***			1 = 0.086; 2 = 0.055; 3 = 0.054; 4 = −0.012; **5 = 0.090***; 6 = 0.008; 7 = 0.007; 8 = 0.032			**1 = 0.155***; 2 = 0.063; 3 = 0.042; **5 = 0.131***; **6 = 0.097***; 7 = 0.002; 8 = 0.092
Block 2	0.030	0.003		0.016	**0.007***		0.010	0.001	
HPS-20			0.050			**0.085***			0.030

Note: CUPIT = Cannabis Use Problems Identification Test; HPS-20 = Hypomanic Personality Scale; β = standardized beta coefficients (individual beta values are from Model 2); study site: 1 = University of Colorado, Boulder; 2 = University of California, Berkeley; 3 = University of California, Irvine; 4 = University of Georgia; 5 = San Francisco State University; 6 = Temple University; 7 = Northwestern University; 8 = New York University.
* $p < .05$.
** $p < .01$.

Table 2
Regression analyses for BD risk score (HPS-20) with cannabis use after accounting for current symptoms (Aim 1b).

Predictor	CUPIT item 3: Frequency of use			CUPIT item 4: Interference with life			CUPIT item 5: Difficulty stopping use		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Block 1	0.029	**0.029****		0.010	**0.010***		0.009	0.009	
Age			−0.025			−0.001			−0.044
Sex			**−0.130****			**−0.083***			−0.066
Study site			**1 = 0.276****; 2 = 0.012; 3 = 0.021; 4 = 0.001; **5 = 0.162****; **6 = 0.112***; 7 = 0.051; **8 = 0.110***			1 = 0.091; 2 = 0.058; 3 = 0.053; 4 = −0.009; **5 = 0.085***; 6 = 0.013; 7 = 0.010; 8 = 0.037			**1 = 0.169***; 2 = 0.066; 3 = 0.042; **5 = 0.129***; **6 = 0.099***; 7 = 0.008; 8 = 0.088
Block 2	0.036	0.007		0.019	**0.010***		0.016	0.007	
DSM5-Dep			0.033			0.066			0.066
DSM5-Mania			0.007			0.040			−0.017
ASRM			−0.053			0.014			−0.019
Block 3	0.038	0.003		0.022	0.003+		0.017	0.001	
HPS-20			0.049			0.055			0.024

Note: CUPIT = Cannabis Use Problems Identification Test; HPS-20 = Hypomanic Personality Scale; DSM5:Dep = DSM-5 Level 1 Cross-Cutting Measure for Depression Domain; DSM5-Mania = DSM-5 Level 1 Cross-Cutting Measure for Mania Domain; ASRM = Altman Self-Rating Mania Scale; β = standardized beta coefficients (individual beta values are from Model 3); study site: 1 = University of Colorado, Boulder; 2 = University of California, Berkeley; 3 = University of California, Irvine; 4 = University of Georgia; 5 = San Francisco State University; 6 = Temple University; 7 = Northwestern University; 8 = New York University.
* $p < .05$.
** $p < .01$.

Table 3
Regression analyses for current mood symptom scores with cannabis use (Aim 1c).

Predictor	CUPIT item 3: Frequency of use			CUPIT item 4: Interference with life			CUPIT item 5: Difficulty stopping use		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Block 1	0.030	**0.030****		0.010	**0.010***		0.010	**0.010***	
Age			−0.021			−0.003			−0.049
Sex			**−0.136****			**−0.086***			−0.072
Study site			**1 = 0.271****; 2 = 0.010; 3 = 0.020; 4 = −0.001; **5 = 0.159****; **6 = 0.112***; 7 = 0.041; **8 = 0.113***			1 = 0.088; 2 = 0.056; 3 = 0.052; 4 = -0.010; **5 = 0.083***; 6 = 0.004; 7 = 0.004; 8 = 0.038			**1 = 0.168***; 2 = 0.065; 3 = 0.041; **5 = 0.128***; **6 = 0.094***; 7 = 0.004; 8 = 0.086
Block 2	0.038	0.007+		0.020	**0.010***		0.016	0.006	
DSM5: Dep			0.030			**0.073***			0.064
DSM5: Mania			0.018			0.052			−0.014
ASRM			−0.048			0.025			−0.031

Note: CUPIT = Cannabis Use Problems Identification Test; HPS-20 = Hypomanic Personality Scale; DSM5:Dep = DSM-5 Level 1 Cross-Cutting Measure for Depression Domain; DSM5-Mania = DSM-5 Level 1 Cross-Cutting Measure for Mania Domain; ASRM = Altman Self-Rating Mania Scale; β = standardized beta coefficients (individual beta values are from Model 2); study site: 1 = University of Colorado, Boulder; 2 = University of California, Berkeley; 3 = University of California, Irvine; 4 = University of Georgia; 5 = San Francisco State University; 6 = Temple University; 7 = Northwestern University; 8 = New York University.
* $p < .05$.
** $p < .01$.

emotion processes (i.e., BSD risk) and well-studied positive emotion processes (i.e., positive emotion experience, reward responsiveness, and positive emotion valuation) in a large, multi-site sample of emerging adults in North America. Of import, the participants were all emerging adults who endorsed using cannabis at least once in their lifetime. The findings suggest important associations of both BSD risk and positive

Table 4
Regression analyses for emotion experience (mDES-PA, mDES-NA) scores with cannabis use (Aim 2a).

Predictor	CUPIT item 3: Frequency of use			CUPIT item 4: Interference with life			CUPIT item 5: Difficulty stopping use		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Block 1	0.032	**0.032****		0.012	**0.012***		0.012	**0.011***	
Age			−0.019			−0.007			−0.044
Sex			**−0.129****			**−0.094***			**−0.081***
Study site			**1 = 0.264****; 3 = 0.025; 4 = 0.001; **5 = 0.167****; **6 = 0.101***; 7 = 0.036; **8 = 0.118***			1 = 0.097; 3 = 0.054; 4 = −0.002; **5 = 0.087***; 6 = −0.034; 7 = 0.007; 8 = 0.031			**1 = 0.160***; 3 = 0.044; **5 = 0.133***; 6 = 0.082; 7 = 0.001; 8 = 0.084
Block 2	0.042	**0.010***		0.024	**0.012***		0.018	0.006	
mDES-PA			**−0.083***			**−0.080***			−0.065
mDES-NA			−0.033			**0.075***			0.000

Note: CUPIT = Cannabis Use Problems Identification Test; mDES-PA = modified Differential Emotions Scale - Positive Affect subscale; mDES-NA = modified Differential Emotions Scale - Negative Affect subscale; β = standardized beta coefficients (individual beta values are from Model 2); study site: 1 = University of Colorado, Boulder; 2 = University of California, Berkeley; 3 = University of California, Irvine; 4 = University of Georgia; 5 = San Francisco State University; 6 = Temple University; 7 = Northwestern University; 8 = New York University.
* $p < .05$.
** $p < .01$.

Table 5
Regression analyses for reward responsiveness (BAS-RR) total score with cannabis use (Aim 2b).

Predictor	CUPIT item 3: Frequency of use			CUPIT item 4: Interference with life			CUPIT item 5: Difficulty stopping use		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Block 1	0.033	**0.033****		0.008	0.008		0.010	0.010	
Age			0.010			0.019			0.046
Sex			**0.111****			0.061			0.042
Study site			**1 = −0.270****; 2 = −0.007; 3 = -0.023; 4 = −0.000; **5 = −0.188****; **6 = −0.105***; 7 = −0.048			1 = −0.096; 2 = −0.052; 3 = −0.057; 4 = −0.002; **5 = −0.090***; 6 = 0.014; 7 = −0.016			**1 = −0.160***; 2 = −0.064; 3 = −0.045; **5 = −0.144***; **6 = −0.090***; 7 = −0.009
Block 2	0.035	0.002		0.012	**0.005***		0.011	0.001	
BAS-RR			−0.040			**−0.071***			−0.032

Note: CUPIT = Cannabis Use Problems Identification Test; BAS-RR = Behavioral Activation System - Reward Responsiveness Subscale; β = standardized beta coefficients (individual beta values are from Model 2); study site: 1 = University of Colorado, Boulder; 2 = University of California, Berkeley; 3 = University of California, Irvine; 4 = University of Georgia; 5 = San Francisco State University; 6 = Temple University; 7 = Northwestern University; 8 = New York University.
* $p < .05$.
** $p < .01$.

Table 6
Regression analyses for positive emotion valuation (VHQ) total scores with cannabis use (Aim 2c).

Predictor	CUPIT item 3: Frequency of use			CUPIT item 4: Interference with life			CUPIT item 5: Difficulty stopping use		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Block 1	0.028	**0.028****		0.009	**0.009***		0.010	**0.010***	
Age			−0.023			0.002			−0.050
Sex			**−0.126****			**−0.080***			−0.054
Study site			**1 = 0.266****; 2 = 0.012; 3 = 0.021; 4 = −0.006; **5 = 0.166****; **6 = 0.112***; 7 = 0.040; **8 = 0.132***			1 = 0.084; 2 = 0.037; 3 = 0.053; 4 = −0.013; 5 = 0.067; 6 = −0.004; 7 = 0.001; 8 = 0.035			**1 = 0.162***; 2 = 0.067; 3 = 0.042; **5 = 0.124***; **6 = 0.097***; 7 = 0.001; 8 = 0.095
Block 2	0.031	0.003+		0.010	0.000		0.014	**0.004***	
VHQ-total			**0.067***			0.011			**0.074***

Note: CUPIT = Cannabis Use Problems Identification Test; VHQ = Valuing Happiness Questionnaire; β = standardized beta coefficients (individual beta values are from Model 2); study site: 1 = University of Colorado, Boulder; 2 = University of California, Berkeley; 3 = University of California, Irvine; 4 = University of Georgia; 5 = San Francisco State University; 6 = Temple University; 7 = Northwestern University; 8 = New York University.
* $p < .05$.
** $p < .01$.

emotion processes with cannabis use. These findings provide initial insights into the interplay between cannabis use and positive emotion systems and contribute to a growing literature investigating the important comorbidity between cannabis use and disorders of positive emotion systems by including individuals at risk for BSDs.

4.1. Cannabis use and BSDs

Despite well-documented literature highlighting comorbidity between cannabis use and BSD dimensions, few studies have examined more specific facets of cannabis use in association with BSD risk among emerging adults. The present study contributed to this emerging literature by finding a significant association between BSD risk and cannabis

interference with daily functioning specifically, and not general cannabis use frequency or difficulty stopping. In other words, individuals with a greater propensity towards BSD may experience more cannabis-related interference in important life-functioning domains, such as work or home responsibilities. These results align with existing literature showing that cannabis use may impair daily functioning (Preuss et al., 2023; Pinto et al., 2019). Furthermore, this finding suggests that it is not about how much an individual is consuming, but rather if it is getting in the way of important things. Future work is necessary to examine the directionality (or potential bidirectionality) of the observed findings, as it remains unclear the extent to which BSD tendencies contribute to early cannabis interference or are a consequence of sustained cannabis use.

Of note, the association between BSD risk and cannabis interference did not hold when controlling for mood symptoms. This finding suggests that state-level mood symptoms may have a greater influence on cannabis-related impairment than trait BSD risk alone. Specifically, current depressive symptoms were associated with greater cannabis interference, reflecting the potential role of cannabis in contributing to daily life interference during depressive periods in BSDs (Kedzior and Laeber, 2014; Lev-Ran et al., 2014). However, this association did not hold when controlling for alcohol, meaning that the observed relationship between depressive symptoms and cannabis interference may be partially attributable to co-occurring alcohol use rather than a direct effect of cannabis. This possibility is consistent with previous literature linking alcohol use with negative emotionality (Cranford et al., 2011), suggesting that alcohol may independently contribute to mood-related functional impairments. Overall, these findings highlight the importance of considering both trait and state-level factors when assessing cannabis use in individuals at risk for BSDs.

4.2. Cannabis use and positive emotion processes

The majority of studies to date have focused on associations between cannabis use and negative emotion-related outcomes (e.g., Kedzior and Laeber, 2014; Lev-Ran et al., 2014). The present investigation sought to take an initial step towards filling this empirical gap by examining associations between cannabis use and well-studied positive emotion-related outcomes grounded in an affective science approach. Findings suggested that self-reported positive emotion experience was significantly associated with decreased cannabis use frequency and decreased cannabis interference with life. In other words, individuals who experience higher levels of positive emotions may engage in less frequent cannabis use and encounter fewer disruptions in their daily lives due to cannabis. It is important to point out that these effects were valence-specific, as neither negative affect nor reward responsiveness (BAS-RR) remained significantly associated with cannabis interference after accounting for alcohol use. Although initial findings suggested that lower reward responsiveness was linked to greater cannabis interference, these associations did not hold when controlling for alcohol use. Notably, existing theories offer competing predictions about the role of reward responsiveness in substance use. Reward hypersensitivity perspectives suggest that heightened reward sensitivity increases substance use vulnerability (Alloy et al., 2009). In contrast, hyposensitive reward perspectives suggest that reduced reward sensitivity may lead to more depressed or dysphoric mood states that individuals cope with by using substances (e.g., Volkow et al., 2007). The present investigation did not provide direct support for either perspective, highlighting the complexity of reward-related mechanisms in cannabis-specific outcomes.

The relationship between positive emotion experience and cannabis use outcomes remained robust, highlighting its distinct role. This suggests that positive emotions may serve as a protective factor against problematic cannabis use, whereas negative affect and reward-related processes may be more intertwined with alcohol use. This study extends previous research by demonstrating that, while positive affect has been linked to greater use in some contexts (e.g., Buckner et al., 2015; Sznitman et al., 2022), higher levels of positive emotion may also contribute to reduced cannabis frequency and interference. These findings highlight the importance of exploring positive emotions not only as motivators for cannabis use but also as potential buffers against its severity, offering a valuable target for future interventions.

Results also pointed to significant associations between total scores on the positive emotion valuation scale and greater cannabis use frequency and lower difficulty stopping use. The post-hoc analyses showed that one of the subscales was driving this effect, specifically that concerns about happiness were significantly associated with greater cannabis use frequency and lower difficulty stopping use. This finding suggests that individuals who are preoccupied with maintaining or achieving happiness may use cannabis more frequently, possibly as a strategy to regulate their mood and achieve positive emotional states. Prior research has shown that cannabis use can increase positive affect in the short term (Tyler et al., 2015), which may explain why individuals concerned about happiness may rely on cannabis to boost their mood. However, their ability to stop using cannabis may not be as compromised, possibly because their use is motivated more by mood enhancement rather than dependence. This pattern indicates that while these individuals may turn to cannabis to enhance their mood, they may not experience the same level of difficulty stopping. This could be due to participants in this sample using it more situationally and less habitually or compulsively.

4.3. Limitations and future directions

The present study findings should be carefully interpreted in the context of several study limitations. First, the cross-sectional design of this study precludes us from drawing conclusions about the causal relationships between, or illuminating temporal dynamics among, cannabis use, positive emotion processes, and BSD risk. Future research should employ longitudinal designs to establish the temporal sequence of these associations and to determine whether changes in positive emotion processes predict subsequent cannabis use behaviors at an individual level. Experimental approaches could further establish potential causality between cannabis use and subsequent effects on mood severity and emotion processes.

Second, when addressing outliers, the data showed that the sample had low cannabis use levels overall, with the modal use being less than once a month. This caused higher instances of interference and difficulty stopping to be statistical outliers. After adjusting for these outliers, some findings changed notably, highlighting the impact of the small variance in the CUPIT measures; in other words, only a smaller subsample of participants endorsed higher levels of cannabis use interference and difficulty-stopping scores. This low variance in the cannabis measures is not unexpected, perhaps in a large college population, given they were not specifically recruited for cannabis use, pointing to the need for targeted recruiting and for further research in a sample with higher cannabis use. It also may be the case that we sampled emerging adults before the onset of regular cannabis use, suggesting future longitudinal designs are needed that track young adults throughout their college experience when more frequent use and associated problematic outcomes may increase.

Third, as our multi-site emerging adult sample was recruited remotely utilizing a survey-based design, we were unable to obtain a more in-depth mental health history or validated measures of cognitive functioning or intelligence. Future research is needed to replicate these findings in clinical samples and to explore whether these associations hold across different subtypes of BSDs as well as cannabis use disorders.

Fourth, although the present investigation captured a diverse menu of positive valence processes, the inclusion of broader measures of psychological well-being (e.g., self-esteem or life satisfaction) may have provided additional context for understanding cannabis use in relation to positive emotional functioning.

Taken together, the present study provides important insights into the complex relationship between cannabis use, positive emotion processes, and BSDs. Our findings suggest that what is most important about cannabis use may be how much it interferes with daily functioning in individuals with heightened BSD risk rather than how frequently they use cannabis. We also see that concerns about happiness may exacerbate difficulties with stopping cannabis use. These results underscore the importance of considering both positive and negative emotion processes in understanding cannabis use in mood-disordered populations.

CRediT authorship contribution statement

Luiza Rosa: Writing – review & editing, Writing – original draft, Visualization, Formal analysis, Data curation, Conceptualization. **Gerald Young:** Writing – review & editing, Validation, Formal analysis, Data curation. **Stevi G. Ibonie:** Writing – review & editing, Data curation. **Joelle LeMoult:** Writing – review & editing, Funding acquisition, Data curation. **Iris B. Mauss:** Writing – review & editing, Data curation. **Lauren B. Alloy:** Writing – review & editing, Data curation. **Jessica L. Borelli:** Writing – review & editing, Data curation. **Sarah R. Holley:** Writing - review & editing, Data curation. **Ellen Jopling:** Writing – review & editing, Data curation. **Daniel P. Moriarity:** Writing – review & editing, Data curation. **Robin Nusslock:** Writing – review & editing, Data curation. **Gregory Strauss:** Writing – review & editing, Data curation. **Cynthia M. Villanueva:** Writing – review & editing, Data curation. **Lauren M. Weinstock:** Writing – review & editing, Data curation. **L. Cinnamon Bidwell:** Writing – review & editing, Supervision, Conceptualization. **June Gruber:** Writing – review & editing, Writing – original draft, Supervision, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Human ethics and consent to participate declarations

The study received Institutional Review Board approval from the universities that took part in the study (see methods for specific IRBs). Informed consent was obtained from all individual participants included in the study. University of Colorado Boulder (IRB #18-0483), Northwestern University (#STU00210783), New York University (IRB-FY2019-3541), San Francisco State University (X19-49R3), Temple University (#26117), University of Georgia (PROJECT00000882), University of British Columbia (BREB #H19-01559), University of California Berkeley (IRB # #2019-05-12210), and the University of California Irvine (HS# 2019-5354).

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Declaration of competing interest

The authors declare that they have no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2026.121640.

Data availability

The de-identified dataset and syntax used in the present investigation is available online: https://github.com/GruberPEPLab/BSDandCannabisUse.

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