Drug and Alcohol Dependence 191 (2018) 223–233

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Affect and cannabis use in daily life: a review and recommendations for future research

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ARTICLE INFO

Keywords:
Cannabis
Marijuana
Ecological momentary assessment
Negative affect
Positive affect

ABSTRACT

Background: Although cannabis is often used for the purposes of relieving negative affective states such as anxiety and depression, the associations between cannabis use and affect in daily life are unclear. Ecological momentary assessment (EMA) has been used to study these associations in individuals' natural environments, providing more ecological validity, minimizing retrospective bias, and allowing for the analysis of within-individual processes over time. This review focuses on studies that utilized EMA to examine daily-life associations of cannabis use and negative and positive affective states.

Methods: We review the findings of the 19 articles that met inclusion criteria, including clinical and community samples.

Results: Results provide equivocal evidence regarding relations between cannabis use and affect for community samples. Findings are mixed for clinical samples as well, but more consistent patterns emerge for general negative affect (NA) and anger/hostility at the momentary level; cannabis use may be more likely following increased NA and lead to decreases in NA and anger/hostility in psychiatric populations.

Conclusions: Findings support a negative reinforcement hypothesis for clinical samples in terms of general NA and anger/hostility. However, discrepancies among studies point to a need to thoroughly characterize samples, consider motives for and expectancies of use, improve quantification of cannabis use, and consider co-use with other substances. Additional design recommendations are also offered for future studies.

1. Introduction

Cannabis is a commonly used drug in the United States and worldwide, with many individuals specifically using cannabis for mood regulation purposes. Furthermore, cannabis use has been associated with psychiatric disorders characterized by affective problems, cross-sectionally (e.g., Cougle et al., 2015; Metrik et al., 2016) and longitudinally (especially heavy cannabis use; Lev-Ran et al., 2014). The idea of using cannabis to alleviate negative mood states goes back hundreds of years (Lee, 2012; NASEM, 2017) and, indeed, a common reason endorsed for cannabis use today is to relieve symptoms of depression and anxiety (Osborn et al., 2015; Walsh et al., 2017). For example, among medical cannabis patients, relief of anxiety and depression are the most common reasons besides pain relief for seeking cannabis (Bonn-Miller et al., 2014; Davis et al., 2016; Metrik et al., 2018; Reinarman et al., 2011; Walsh et al., 2017). Anxiety and depression are also among the most commonly endorsed motives for cannabis use among individuals who use cannabis recreationally (Osborn et al., 2015). This is particularly concerning because of the high comorbidity of cannabis use disorder and mood and anxiety disorders, indicating potential contributions of negative mood states to cannabis use or vice versa (Agosti et al., 2002; Chen et al., 2002; Conway et al., 2006; Cougle et al., 2015; Kevorkian et al., 2015; Lev-Ran et al., 2014; Metrik et al., 2016; Stinson et al., 2006).

Consistent with the *affective-motivational model of drug addiction* (Baker et al., 2004), individuals with affective psychopathology are particularly likely to rely on cannabis use to acutely reduce situational negative affect (Haney et al., 1999; McDonald et al., 2003; Metrik et al., 2011; Phan et al., 2008) or to attenuate withdrawal symptoms (Budney et al., 2003). Using cannabis, for this reason, may thus be negatively reinforcing for individuals who are particularly sensitive to uncomfortable psychological states (Farris et al., 2016).

Cannabis may also be used to heighten positive affect and become positively reinforcing (Cooper and Haney, 2008). However, positive

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https://doi.org/10.1016/j.drugalcdep.2018.07.001
Received 20 April 2018; Received in revised form 7 July 2018; Accepted 9 July 2018
Available online 15 August 2018
0376-8716/

subjective effects are most relevant in the initiation and progression to regular drug use, while negative reinforcement becomes increasingly salient at higher and more frequent levels of use (Robinson and Berridge, 2003). As drug dependence develops, long-term neuroadaptations in the brain occur that underlie the progression from positive to negative reinforcement once the withdrawal/negative affect stage of the addiction cycle sets in (Koob and Volkow, 2010). Therefore, positive reinforcement effects might be more salient for individuals who use cannabis recreationally and are not dependent, while negative reinforcement might be most evident for individuals who are dependent.

Cannabis is a pharmacologically complex drug that can acutely produce both positive and negative subjective effects. Although there are many active constituents in cannabis, the two cannabinoids that have been isolated and studied the most are Δ9-tetrahydrocannabinol (THC) and cannabidiol (CBD). THC is the psychoactive and major mood-altering constituent in cannabis, and THC content in cannabis plants has risen dramatically over the last few decades, from ~3–5% to up to ~25% today (Mehmedic et al., 2010). Importantly, research suggests a dose-dependent effect of THC on depression and anxiety; lower doses tend to have anti-depressant and anxiolytic effects, whereas higher doses may induce depression and anxiety (Mechoulam and Parker, 2013; Metrik et al., 2011, 2016; Morgan et al., 2012; Niesink and van Laar, 2013). Discrepancies between reported uses of cannabis and its potential effects suggest a need for newer approaches to evaluate under what conditions cannabis alleviates or exacerbates negative mood states and psychiatric symptoms.

Research on the effects of cannabis on affect outside the laboratory can provide a more ecologically valid depiction of the way individuals use cannabis and how it affects their emotional state in concert with other daily-life cues. Ecological momentary assessment (EMA; Stone and Shiffman, 1994) is an important research tool that minimizes retrospective biases while gathering ecologically valid data from daily life. EMA (1) is idiographic, allowing for the examination of individual processes like affect or emotion; (2) involves collecting data in real-world environments, increasing the ecological validity of findings; (3) focuses on individuals' current/recent states or behaviors, and collects multiple assessments of each over time, typically several times per day; and (4) can be event-based (initiated by the individual based on instructions), time-based, randomly-prompted, or combinations of these (Trull and Ebner-Priemer, 2013). In addition, EMA data can be analyzed at different levels, allowing for more precision in identifying associations. For example, in studies that include multiple assessments each day, for multiple days, analyses can reveal *momentary effects* (concurrent associations at the moment), *day effects* (average-day score associations), and *person-level effects* (average score across all assessment occasions). Simultaneously entering predictors at multiple levels of analysis can help determine whether momentary or day-level predictors provide meaningful information above and beyond trait-like person-level predictors. Therefore, EMA can provide a fine-grained and ecologically valid picture of the associations between cannabis use and affect.

We review existing EMA studies of the associations between cannabis use and negative affect (NA), positive affect (PA), and a range of subtypes of NA that are related to psychiatric symptoms. In addition, because both theory (e.g., Robinson and Berridge, 1993; Berridge and Robinson, 2016) and research suggest that mood-altering effects of cannabis may depend on the nature of the sample (clinical versus non-clinical; e.g., Haney and Evins, 2016), we organize study results based on whether participants were sampled from the community (and thus, presumably, not endorsing clinical levels of mood and anxiety symptoms or other forms of psychopathology as a whole) or from clinical samples comprised of those with significant levels of psychopathology. Although associations between cannabis use and affect might vary depending on the chronicity of cannabis use and/or presence of cannabis use disorder, most studies did not clearly describe the samples or analyze data separately by CUD. Thus, we were unable to systematically organize the review by the presence of CUD.

At the momentary level, we hypothesized that across all samples, NA would be elevated prior to cannabis use and lower following cannabis use. We expected PA to be elevated during and following cannabis use, and we expected this to be stronger for community samples. We did not make a hypothesis about momentary PA prior to cannabis use because it is possible that elevated PA would precede use as an anticipatory effect, but it is also possible that low levels of PA would precede use if individuals use cannabis for the purposes of increasing PA. We generally did not expect positive or negative associations between cannabis use and affect at the day level because it is often difficult to establish temporal precedence at this level of analysis. If temporal precedence were adequately established, we would expect the same pattern of findings that we expect at the momentary level. Given that person-level predictors approximate trait-level measures, we expected positive associations between NA and cannabis use across samples, with stronger associations in clinical samples.

2. Methods

We searched the PubMed and PsycInfo databases to identify relevant studies up until December 2017. The search combined the terms *cannabis or marijuana* with the following: *ecological momentary assessment, experience sampling method, ambulatory assessment, ambulatory monitoring, electronic diary, daily diary, daily life, daily lives, and interactive voice response*. Next, manual searches of Google Scholar and ResearchGate were conducted based on authors of articles already identified. Lastly, an additional manual search was completed of abstracts listed on the webpage for the *Society for Ambulatory Assessment*. Studies were included if they used any form of EMA (paper, electronic diary, smartphone) to empirically examine relations between cannabis use and mood/affective states. Specifically, these studies needed to ask participants explicit questions about cannabis use and affective states during the EMA period. In total, 19 articles from 15 separate studies are included in this review.

Table 1 provides an overview of these studies, which are listed alphabetically. The table is organized to highlight: (1) the *nature of the sample* (e.g., psychiatric outpatients, community residents, college students) as well as *% of sample that had current cannabis use disorder (CUD)*; (2) the *number of participants* in each study (N); (3) the *% of each sample that identified as female*; (4) the *mean age* of the sample; (5) the *duration of the EMA study in days*; (6) the *number of EMA assessment per day*; (7) the *compliance rate for prompted or scheduled assessments*; (8) the *nature of the event-contingent assessments if used* (e.g., about to use cannabis); (9) the *measure of cannabis use* (e.g., any, number of joints, number of puffs); (10) the *measure of mood or affect* used in the study; and (11) the *level of analysis* (e.g., momentary, day-, person-level).

3. Results

We organize results from these studies by considering NA and PA separately. Within each affect section, we summarize findings according to sample composition (*community* or *clinical*), given the possibility of different affect-cannabis relations depending on the prominence of emotional dysregulation. Lastly, within each affect-sample section, we organize findings according to the level of analysis (momentary, day, and person).

Note that several studies report NA as an aggregate of more specific negative affective states such as sadness and anger, other studies report a combination of aggregated NA and specific negative affective states, and still, other studies report specific negative affective states without reporting aggregated NA. Of the studies that report specific negative affective states, most focus on anxiety, sadness/depression, and anger/hostility. Thus, in our review, we will include findings regarding these states as well as general NA. Some studies of clinical samples report