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A latent class analysis of poly-marijuana use among young adults

Melissa J. Krauss[a],*, Biva Rajbhandari[a], Shaina J. Sowles[a], Edward L. Spitznagel[b],
Patricia Cavazos-Rehg[a]

[a] Department of Psychiatry, Washington University School of Medicine, St. Louis, MO, United States
[b] Department of Mathematics, Washington University School of Medicine, St. Louis, MO, United States

HIGHLIGHTS

- Alternative marijuana products (concentrates, edibles) have seen a surge in use.
- Latent class analysis of past month marijuana users based on use patterns and driving after use
- Four distinguishable classes of marijuana users were found.
- Class that used plant-based marijuana plus concentrates tended to use heavily and drive after use.
- Poly-marijuana user groups were associated with residence in legalized states.

ARTICLE INFO

ABSTRACT

Introduction: With more states legalizing marijuana use, the marijuana industry has grown, introducing a variety of marijuana products. Our study explores the use of multiple marijuana products (poly-marijuana use) and the characteristics associated with this behavior.

Methods: Past-month marijuana users aged 18–34 years were surveyed online via an existing online panel (n = 2444). Participants answered questions about past-month use of three types of marijuana (plant-based, concentrates, edibles), marijuana use patterns, and driving after use. Latent class analysis was used to identify subgroups of marijuana users.

Results: Four classes of marijuana users were identified: Light plant users, who used only plant-based products infrequently and were unlikely to drive after use (32%); Heavy plant users, who used mainly plant-based products frequently, multiple times per day, and were likely to drive after use (37%); Plant and concentrates users, who used plant-based products heavily and concentrates at least infrequently, used multiple times per day, and were likely to drive after use (20%); Light plant and edibles users, who used both products infrequently and were unlikely to drive after use (10%). Those in legal marijuana states were more likely to belong to the poly-marijuana groups.

Discussion: Our findings reflect the increase in popularity of new marijuana products in legal states and suggest that heavy user groups, including concentrates users, are associated with driving after use. As various forms of marijuana use increases, monitoring and surveillance of the use of multiple types of marijuana will be important for determining potential varying impacts on physiological and social consequences.

1. Introduction

Social perception of marijuana has become more lenient in the United States in the past decade. As of the 2016 election, 28 states had passed laws legalizing medicinal use, and eight states had passed measures legalizing recreational use (NORML, 2017; Procon.org, 2016). These more lenient policies reflect the general public's perception that marijuana use is not harmful (Johnston, O'Malley, Bachman, Schulenber, & Miech, 2014; Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2014). In fact, over half of Americans (52%) now favor legalizing marijuana for recreational use (Pew Research Center, 2013).

As policies have evolved, the marijuana consumer market has grown along with the availability and demand for a variety of marijuana products. Traditional, plant-based products (dried and crushed marijuana flowers) are usually smoked (Schauer, King, Bunnell,

Promoff, & McAfee, 2016), and average around 13% THC (tetra-hydrocannabinol; the main psychoactive component of marijuana) (US Department of Justice Drug Enforcement Administration [DEA], 2014). Novel, highly concentrated forms of marijuana, sometimes containing up to 70–90% THC, have been growing in popularity (Colorado Department of Revenue, 2014; Marijuana Business Daily, 2016). Marijuana concentrates (hereafter concentrates) are a processed form of marijuana whereby solvents (e.g., butane) are passed through the dried marijuana plant. The resulting oils or wax substances are then vaporized and inhaled (Schauer et al., 2016). Because of the high THC concentrations, concentrates users are more likely to experience intense effects following use (e.g., loss of consciousness) (Stogner & Miller, 2015). Edibles, or marijuana infused in food, have also surged in use (Colorado Department of Revenue, 2014; Marijuana Business Daily, 2016) and have a delayed onset and longer duration of effects compared to smoked marijuana (Williams, 2016). Epidemiological surveys of substance use do not yet ask young adults about use of multiple forms of marijuana, and surveillance of these behaviors is timely.

While combustible plant-based marijuana is the most commonly ingested form (Oregon Public Health Division, 2016; Schauer et al., 2016), frequent users are more likely to use more than one form of marijuana (i.e. poly-marijuana user) (Oregon Public Health Division, 2016). As the public experiments with multiple marijuana forms, there is a need for additional research examining the characteristics of different types of users. As such, in the present study, we take the first step towards delineating marijuana user profiles in the context of poly-marijuana use, employing latent class analysis to describe subgroups of marijuana users based on types of marijuana used and associated risky behaviors.

We examine young adult marijuana users across the U.S. to examine whether residence in a legal marijuana state is associated with specific marijuana use subgroups. Given that the legal marijuana industry is one the fastest growing industries in the U.S. and emerging evidence suggesting an influx of novel marijuana products (ArcView Market Research, 2017), we use the availability proneness theory of drug abuse to guide our study. The availability proneness theory stresses the relationship between increased accessibility and likelihood for substance use among prone individuals (Smart, 1980). We hypothesize that poly-marijuana users will be more likely to live in legal marijuana states given the increase in accessibility of these products (ArcView Market Research, 2017; Borodovsky, Crosier, Lee, Sargent, & Budney, 2016; Lamy et al., 2016; National Institute on Drug Abuse, 2016; Zhang, Zheng, Zeng, & Leischow, 2016). We also hypothesize that a cluster of our participants will be prone to problematic behaviors such as driving after use, heavy use, and/or poly-marijuana use. In consideration that the risk of a vehicle crash increases progressively with the dose and frequency of marijuana use (Li, Brady, & Chen, 2013; Li et al., 2012), our study that considers driving following use across different types of marijuana users represents a novel and timely area of study.

2. Methods

2.1. Participants

An online survey was conducted with members of SurveyMonkey® Audience, a proprietary panel of participants recruited from over 30 million people who complete SurveyMonkey surveys. SurveyMonkey asks people who complete a survey whether they would like to be a member of the online panel. Panel participants are offered donations to a charity or entry in sweepstakes in exchange for surveys taken. Detailed background information is stored in a profile for each Audience member. SurveyMonkey maintains high quality responses by limiting the number of surveys that can be taken per week and using incentives that are not based on monetary rewards. SurveyMonkey also runs panel benchmarking surveys to ensure that the demographic characteristics are similar to that of the U.S. population.

The survey was conducted in June–September of 2015. For the present study, participants were 18–34 years old, lived in the United States, and reported using marijuana in the past month. Marijuana use is not part of an Audience member's profile; thus, SurveyMonkey targeted our age group of U.S. residents with an invitation to the survey, both by email invitation and by "routing" people who visit their website to take a survey for which they qualify. Eligibility items were used to ensure the respondent was in the age group of interest and met marijuana use criteria. We restricted our study to past month marijuana users to focus on current marijuana use behaviors (in the past 30 days) among non-sporadic users. Each participant provided informed consent online, and the Washington University Institutional Review Board reviewed and approved this study.

Because SurveyMonkey Audience is not nationally representative, we applied weights to our survey data so that marginal totals of our survey matched that of past-month marijuana users in the 2014 National Survey on Drug Use and Health (NSDUH) on age, gender, and race/ethnicity. The NSDUH, sponsored by the Substance Abuse and Mental Health Services Administration, is conducted annually in the U.S. and provides national data on substance use and mental health (United States Department of Health and Human Services et al., 2014). Weights were applied using a raking technique with the SAS rake and trim macro (Abt Associates, n.d.). The weights were then normalized so that the sum of the weights equaled the sample size of our survey data (n = 2444).

2.2. Marijuana use behaviors (used as latent class indicators)

In addition to traditional plant/flower-based marijuana, we assessed use of two increasingly popular forms of marijuana: edibles and concentrates (Loflin & Earleywine, 2014; Schauer et al., 2016). The survey queried past-month use of these three types of marijuana with the following three parallel questions: "How many days did you _____ in the past 30 days?": a) "smoke marijuana in its plant or bud form", b) "dab marijuana concentrates/extracts" (concentrates were defined as including shatter, wax, oil, and any other THC-concentrated form of marijuana), and c) "consume marijuana edibles." Responses included 0 days, 1–2 days, 3–5 days, 6–9 days, 10–19 days, 20–29 days, and 30 days. Responses were recoded into no use (0 days) and relatively equal frequency categories of use (1–9 days, 10–19 days, and 20–30 days).

To identify what may be considered 'problematic' or 'risky' marijuana use behaviors, we assessed whether participants normally used marijuana multiple times per day with the item "On a typical day when you use marijuana, how many times a day do you use (i.e., number of sessions)?". We dichotomized responses to reflect those who used multiple times (i.e., at least twice) per day versus those who only used once per day. We also used an item modified from the Cannabis Use Disorders Identification Test (CUDIT) (Adamon & Sellman, 2003) inquiring "How often are you "high" for 6 or more hours?" Response options were dichotomized to contrast those who were "high" for 6 or more hours at least once a month versus those who were not. Finally, we also assessed the risky behavior of driving after marijuana use with an item from Monitoring the Future: "During the last two weeks, how many times have you driven a car, truck or motorcycle after smoking marijuana?" (Johnston, Bachman, O'Malley, Schulenberg, & Miech, 2015). Responses were dichotomized to represent any engagement in this behavior versus not at all in the last two weeks.

2.3. Potential predictors of marijuana use classes

Guided by the availability proneness theory of drug abuse (Smart, 1980) we believed that those living in legal marijuana states would be more likely to use multiple product types. Legal status of marijuana at the time of the survey was coded based on the participant's state of residence. Prior research indicates that medical users tend to use more