Distinguishing Subpopulations of Marijuana Users with Latent Profile Analysis

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Abstract

Background—Although marijuana is the most commonly used illicit drug in the United States, little is known about the effects of typical marijuana use patterns and whether there are distinct subgroups of marijuana users.

Methods—The present study used latent profile analysis to determine the number of distinct subgroups of marijuana users in a large sample of college students ($n = 2,129$ past month marijuana users across 11 universities). We also examined how these distinct groups differ on several putative risk/protective factors (e.g., personality traits, perceptions of marijuana, and motives for using marijuana).

Results—Using the Lo-Mendell-Rubin Likelihood Ratio Test, we identified four latent classes with the largest class consisting of infrequent marijuana users, and three other classes demonstrating increasingly frequent use and more negative consequences with the most severe class being the smallest class. We found the largest between-class differences (i.e., distinctions across classes) to be on identification with being a marijuana user and use of protective behavioral strategies (PBS), such that the heavier user classes showed higher identification with marijuana users and lower use of PBS.

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Conclusions—Our findings demonstrate that college student marijuana users are a heterogeneous group with different profiles of risk/protective factors and that those who use cannabis a few times per month are different from those who are near-daily or daily users. Our findings also serve as a call to action for the field to consider examining identification with being a marijuana user and the use of PBS in future marijuana studies.

Keywords

Marijuana Use; Negative Marijuana Consequences; Protective Behavioral Strategies; Social Norms; Identity; Latent Profile Analysis; Person-Centered Analysis

1. Introduction

Increasing evidence suggests that heavy, chronic, and early onset marijuana use has a wide range of long-term negative consequences including cannabis use disorder (CUD), cognitive impairment, lower achievement, and poor educational outcomes (Volkow et al., 2014). With the trend towards decriminalization and legalization of marijuana use across the country (Pacula et al., 2015), the availability of marijuana, and perhaps use of marijuana is likely to increase. Given this landscape, it is important to identify risk factors associated with heavy and problematic (i.e., associated with negative consequences) marijuana use (Simons et al., 2012). Although data from large epidemiological studies (e.g., Monitoring the Future, Johnston et al., 2015; National Survey of Substance Use and Health, Center for Behavioral Health Statistics and Quality, 2015) demonstrate that chronic marijuana use is associated with various psychosocial and medical problems, many questions still remain. For example, much less is known about the effects of typical marijuana use patterns and whether there are distinct subgroups of marijuana users.

Although variable-centered analyses (e.g., multiple regression, structural equation modeling) predominate the marijuana literature, they are limited in that they tend to focus on the unique associations between marijuana use and associated outcomes as well as only comparing users to non-users. Further, variable-centered approaches assume that all participants have been sampled from a single population (i.e., population homogeneity assumption; Collins and Lanza, 2010). The limitations of variable-centered analyses can be overcome through the use of person-centered analyses. Person-centered analyses can identify subpopulations, or subgroups, of individuals who share particular attributes. For example, there has been a plethora of person-centered research identifying distinct subpopulations of users for various drugs including: tobacco (Sutfin et al., 2009), MDMA/ecstasy (Carlson et al., 2005), alcohol (Reboussin et al., 2006), and opioids (Monga et al., 2007).

There have been several studies utilizing person-centered analyses in the examination of marijuana users among adolescents (Eassey et al., 2015; Hix-Small et al., 2004; Windle and Wiesner, 2004) and emerging/young adults (Arria et al., 2016; Brook et al., 2011; Brown et al., 2004; Caldeira et al., 2012; Ellickson et al., 2004; Jackson et al., 2008; Juon et al., 2011; Schulenberg et al., 2005; Tait et al., 2011). Using group-based trajectory approaches, these studies typically identified 3 to 5 groups of marijuana users: abstainers, increasing users, daily users, and, in some cases, experimental and decreasing users. Further, researchers were

able to identify several variables that were predictive of these distinct marijuana users, some acting as risk and some as protective factors. For example, Eassey and colleagues (2015) found that for each trajectory group, parental disapproval of substance use and associating with non-using peers demonstrated significant protective effects on the frequency of marijuana use. Less exposure to peer pressure was associated with lower frequency of marijuana use for the increasing and chronic trajectory groups, whereas school attachment had a protective effect for only those in the chronic use trajectory group. As most of these previous studies have come from large, longitudinal epidemiological studies, they have a strength in being from nationally representative samples that capture change over time (i.e., trajectories) of these marijuana users.

The studies mentioned above predominately used a single indicator of marijuana frequency as the key indicator for their distinct classes, while ignoring other key variables, such as experiences of marijuana-related negative consequences. From a public health perspective, experience of marijuana-related negative consequences is arguably the most important measure to include, yet none of these studies had a direct measure of marijuana-related negative consequences. By including experiences of marijuana-related negative consequences as an indicator, researchers may be able to further distinguish marijuana users beyond just frequency of use (e.g., a subclass of moderate marijuana users without problems). Such knowledge gains can help improve upon existing treatment of CUD (Davis et al., 2015) as well as policies surrounding the regulation of marijuana use (Room, 2014).

According to the National Survey of Substance Use and Health (NSDUH), the peak period of marijuana use occurs between the ages 18 and 25 years old (Center for Behavioral Health Statistics and Quality, 2015), which is also the age of most college students in the United States (Kena et al., 2015). Thus, college students are an important group to study with regards to examining if there is heterogeneity among marijuana users based on not only frequency of use but also experiences of marijuana-related problems.

1.1 Purpose of Study

The purpose of the present study was to identify subpopulations of marijuana users defined by both marijuana use frequency and experiences of marijuana-related negative consequences. Specifically, we used latent profile analysis to determine the number of distinct subgroups of marijuana users in a large sample of college student past month marijuana users collected from 11 different universities. Latent profile analysis is a person-centered statistical technique that assumes that the pattern of means on observed variables can be accounted for by the existence of distinct latent classes, or distinct classes of individuals in terms of their level of marijuana involvement. One of the strengths of latent profile analysis relative to other person-centered approaches (e.g., cluster analysis) is that latent class membership is considered to be probabilistic and the size of classes is taken in account when assigning probabilistic class membership. Although we had no *a priori* hypotheses regarding how many latent classes we would find, we expected that there would be at least one latent class of low frequency, marijuana users and one latent class of heavy, problematic users. To determine the most salient factors that distinguished lower vs. higher marijuana involvement classes, we examined how these distinct classes differed on a host of

risk and protective factors that have been linked to marijuana use, such as personality traits (Cyders et al., 2007; Galbraith and Conner, 2015; Whiteside and Lynam, 2001; Woicik et al., 2009), perceptions of marijuana use (Napper et al., 2015; Swaim, 2003), motives for using marijuana use (Simons et al., 1998), use of protective behavioral strategies (Pedersen et al., 2016), and difficulties in emotion regulation (Gratz and Roemer, 2004).

2. Method

2.1. Participants and Procedure

College students ($n = 8,141$) were recruited from Psychology Department Participant Pools at 11 participating universities in 11 different states (Washington, California, Wyoming, Colorado, New Mexico, North Dakota, Kansas, Texas, New York, Virginia, Alabama) in the United States between Fall 2015 and Spring 2016. Participants read an informed consent prior to completing the main survey online (~45-60 minutes to complete), and were awarded research participation credit. This research was approved by the institutional review board at each participating university. Additional information about this sample is reported elsewhere (Pearson et al., 2016). For the present study and given our primary concern of identifying the heterogeneity among current marijuana users, our analyses were restricted to participants who reported using marijuana in the past month (n = 2,129). Among current marijuana users, the majority of participants identified as being either White, non-Hispanic ($n = 1,285$; 60.4%), or of Hispanic/Latino ethnicity ($n = 390$; 18.3%), were female ($n = 1,260$; 59.2%), and reported a mean age of 19.95 (SD=3.66) years.

2.2. Measures

2.2.1. Marijuana Involvement Indicators—To determine lifetime marijuana user status, we asked, "In your lifetime, have you ever used marijuana in any form?" If participants responded with "yes," they were branched to two additional questions: 1) "Approximately how many days in your lifetime have you used marijuana?", and 2) "On how many days during the last 30 days did you use marijuana?" If participants responded with 1 or greater to this second question, they were then asked the remainder of the marijuana-related questions.

Marijuana use frequency was determined using a more high-definition measure patterned from the Daily Drinking Questionnaire (DDQ; Collins et al., 1985). Specifically, each day of the week was broken down into 6 4-hour blocks of time (12a-4a, 4a-8a, 8a-12p, etc.), and participants were asked to report at which times they used marijuana during a "typical week" and their "heaviest use week" in the past 30 days. From this measure, we created two marijuana use frequency estimates by summing the total number of time blocks for which they reported using during the typical and heaviest use weeks (hypothetical ranges: 0-42). The initial measure has shown adequate reliability and validity in previous research (Dvorak and Day, 2014; Williams et al., 2000). The measure of "heaviest" week has not been used in prior research, but was modeled after measures of heavy weekly alcohol use.

Adapted from the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006), the 50-item Marijuana Consequences Questionnaire (MACQ; Simons et al., 2012) assesses eight domains of marijuana negative consequences: social-interpersonal

consequences (6 items), impaired control (6 items), negative self-perception (5 items), self-care (9 items), risk behaviors (8 items), academic/occupational consequences (5 items), physical dependence (4 items), and blackout use (7 items). Participants were asked whether they experienced each of these negative consequences due to their marijuana use in the past month. Participants responded to dichotomously coded responses (0=*no*, 1=*yes*). In the present study, we used a total score as an indicator of problematic marijuana use. The bivariate correlations and descriptive statistics of marijuana involvement indicators are shown in Table 1.

2.2.2. Auxiliary variables—We assessed a wide range of auxiliary variables. All of these measures have strong psychometric properties and have been validated in college study/ young adult populations. Additional psychometric information regarding these measures for the whole sample can be obtained elsewhere (Pearson et al., 2016).

We assessed several individual difference variables. Using the 59-item UPPS-P (Cyders et al., 2007; Whiteside and Lynam, 2001), we assessed five impulsivity-like traits: premeditation (i.e., tendency to think before acting), perseverance (i.e., tendency to follow through on tasks or plans), sensation seeking (i.e., tendency to seek out novel or exciting experiences), negative urgency (i.e., tendency to behave impulsively especially when experiencing negative affect), and positive urgency (i.e., tendency to behave impulsively when experiencing positive affect). Using the 23-item Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009), we assessed four personality traits known to be associated with risk of substance use: hopelessness (i.e., depressed mood), impulsivity (i.e., tendency to react to internal/external influences without consideration of possible consequences to oneself or others), sensation seeking, and anxiety sensitivity (i.e., tendency to fear arousal-related bodily sensations such as rapid breathing, perspiration, and elevated heart). Using the 15-item Sensation Seeking Personality Trait Questionnaire (SSPTQ; Conner, 2015), we examined specific facets of sensation seeking: risk seeking and experience seeking. Using the 36-item Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer, 2004), we examined six facets of emotion regulation: nonacceptance of emotional responses, difficulty engaging in goal-direct behavior, impulsive control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, lack of emotional clarity.

We also assessed several marijuana-related variables. Marijuana descriptive norms, or perceptions of how frequently others use marijuana, was assessed using the same marijuana use frequency measures to assess one's marijuana use but in reference to the "typical college student" (hypothetical range: 0-42). Marijuana injunctive norms, or perceptions of how much others approve of marijuana use, was assessed using a 9 item measure that assesses three behaviors ("using marijuana," "using marijuana to get high," and "using marijuana daily") for three reference groups ("Your best friends," "Typical college students," and "Your parents"). Internalization of the college marijuana culture, or the degree to which one perceives marijuana use to be integral to the college experience, was assessed using the 8-item Perceived Importance of Marijuana to the College Experience (PIMCES; Pearson et al., 2016). Reasons for using marijuana (social, coping, enhancement, conformity, and expansion) was assessed using the 25-item Marijuana Motives Questionnaire (MMQ; Simons et al., 1998). Identification with being a marijuana user was assessed using a 5-item

measure adapted from the Smoker Self-Concept Scale (Shadel and Mermelstein, 1996). Utilization of protective behavioral strategies, or behavioral strategies aimed at reducing marijuana use, intoxication, and/or related harms, was assessed using the 29-item Protective Behavioral Strategies-Marijuana (PBSM; Pedersen et al., 2016).

3. Results

3.1. Class Solution

To determine the number of latent classes in our sample based on marijuana use indicators, we used the Lo-Mendell-Rubin Adjusted Likelihood Ratio Test (Lo et al., 2001; Vuong, 1989), which compares whether a k class solution fits better than a $k-1$ class solution. The Likelihood Ratio Test suggests that a 2-class solution fit significantly better than a 1-class solution ($p < .001$), a 3-class solution fit significantly better than a 2-class solution ($p < .001$), and a 4-class solution fit significantly better than a 3-class solution ($p = .011$); however, a 5-class solution did not fit significantly better than a 4-class solution ($p = .685$). Therefore, we settled on a 4-class solution. Table 2 reports commonly used fit statistics for 1 through 6 class solutions. Importantly, our relative entropy was .957, indicating that about 19 out of 20 subjects were correctly classified in the appropriate latent class, which is excellent classification quality (>.80 is considered 'high', Clark and Muthen, 2009).

Figure 1 depicts the pattern of means across the 4 latent classes. Class 1 was the largest class, with 68.6% of the sample ($n = 1,461.13$), reported using 3 to 4 days per month on average ($M = 3.69$), 2 to 3 times during typical and heaviest use weeks ($M = 2.42, 2.64$), and experienced about 6 negative consequences from marijuana use ($M = 6.24$). Class 2 was the next largest class, with 19.46% of the sample ($n = 414.34$), reported using about 20 days per month ($M = 20.24$), using 8 to 11 times during typical and heaviest use weeks, and experienced nearly 11 negative consequences from marijuana use. Class 3 was the next largest class, with 8.31% of the sample ($n = 176.81$), reported using about 25 days per month, 17 to 23 times during typical and heaviest use weeks, and experienced nearly 14 negative consequences from marijuana use. Class 4 was the smallest class, with 3.61% of the sample ($n = 76.73$), reported using 27 to 28 days per month, 29 to 33 times during typical and heaviest use weeks, and experienced nearly 15 negative consequences from their marijuana use.

3.2. Equality of Means

Based on our 4-class solution, we tested the equality of means across latent classes on various marijuana-related variables using pseudo-class-based multiple imputations (Asparouhov and Muthén, 2007). Rather than assigning individuals to the latent class where their membership has the highest probability and conducting traditional techniques like analysis of variance (ANOVA), this method accounts for the probabilistic nature of class membership, and both global and pairwise comparisons can be conducted using Wald tests. Results are summarized in Table 3 and 4. To provide sociodemographics of these classes, we examined age (means) and gender (percentage of female) differences in each class. Within these classes, Class 1 had a significantly lower age group ($M = 19.76$) of individuals compared to Class 3 and 4 (see Table 3). Among gender, about 67% of the individuals in

Class 1 were female which was significantly higher than Class 2 (55%), Class 3 (50%), and Class 4 (37%). To maximize interpretability of mean differences, all variables were converted to z-scores (see Table 4) and a mean difference of one indicates a one-standard deviation difference.

On impulsivity-like traits, Class 1 had slightly higher levels of Premeditation and Perseverance compared to Class 2, but no differences were found on sensation seeking, negative urgency, or positive urgency. On the SURPS personality traits, Class 2 had higher levels of hopelessness than Class 1, and Classes 3 and 4 had lower levels of anxiety sensitivity than Class 1, but no differences were found on sensation seeking or impulsivity. Based on the SSPTQ that decomposes sensation seeking, Class 1 showed lower levels of risk seeking compared to Class 2, but no differences on experience seeking. There were no significant between-class differences on any of the facets of emotion regulation.

On measures of marijuana descriptive norms (typical and heaviest), we found a gradient pattern such that norms were lowest in Class 1, significantly higher in Class 2, and significantly higher in Classes 3 and 4, which did not significantly differ from each other. We observed this same pattern for marijuana injunctive norms for one's best friends and one's parents, but did not find any significant differences for marijuana injunctive norms for typical college students. For the PIMCES, Class 1 reported the lowest internalization of college marijuana culture followed by Class 2, which did not significantly different from Class 3, but was significantly lower than Class 4, which did not significantly differ from Class 3.

On marijuana motives, Class 1 showed significantly lower social motives, coping motives, enhancement motives, and expansion motives compares to Classes 2, 3, and 4, which did not significantly differ from each other. No differences were found on conformity motives. On marijuana identification, all classes were significantly different from all other classes such that the heavier user classes showed higher identification with marijuana users. The exact opposite pattern was observed with marijuana protective behavioral strategies such that heavier user classes were associated with lower use of protective behavioral strategies.

4. Discussion

The marijuana literature is limited by the fact that much research is focused on comparing users to non-users. This standard practice unwittingly assumes that marijuana users are a homogenous population. The present study put this assumption to the test by using latent profile analysis to determine if there are distinct types of marijuana user classes defined by indicators of marijuana frequency and experiences of negative consequences. In support of previous person-centered research finding heterogeneity in marijuana use among adolescents (Eassey et al., 2015; Hix-Small et al., 2004; Windle and Wiesner, 2004), we identified four latent classes with the largest class consisting of infrequent marijuana users, and three other classes demonstrating increasingly frequent use and more negative consequences with the most severe class being the smallest class.

Across several personality traits, we observed small yet statistically significant differences between the two largest classes (Class 1 and Class 2) such that the more frequent marijuana user class demonstrated a riskier profile (e.g., higher on impulsivity-like traits and risk seeking) than the infrequent marijuana user class; however, these traits largely failed to distinguish between the three higher frequency marijuana user classes. However, moving from the least frequent/least negative consequences class (Class 1) to the most frequent/most negative consequences class (Class 4), we found the largest differences (i.e., distinction across classes) to be on identification with being a marijuana user and use of protective behavioral strategies. Specifically, we found roughly half a standard deviation difference between classes on both of these outcomes (see Table 4).

Social Identity Theory (Hogg et al., 2004) posits that identity is defined by the groups with which an individual identifies and that much of human behavior is influenced by the norms of such groups. Thus, one would expect that higher identification with being a marijuana user would be associated with marijuana-related outcomes. Consistent with previous research (Neighbors et al., 2013), we found an increase in frequency of marijuana use and marijuana negative consequences across the classes to be monotonically associated with increased identification with being a marijuana user.

Reviews of the alcohol literature demonstrate that use of alcohol protective behavioral strategies (i.e., strategies used before, during, or after drinking to reduce use, intoxication, and/or harm) are associated with decreased alcohol use and alcohol-related negative consequences (Pearson, 2013; Prince et al., 2013). Stemming from a similar harm reduction perspective, Pedersen et al. (2016) recently developed a measure of marijuana protective behavioral strategies, which we found to strongly distinguish between the user classes such that the more problematic user classes reported lower use of these strategies. Therefore, building off of the only published study to date examining marijuana protective behavioral strategies (Pedersen et al., 2016), the present study provides additional evidence that this construct is an important protective factor.

From a clinical perspective, the present study highlights that it is unlikely that a one-size-fits-all approach to preventions/interventions targeting marijuana use will be successful. Specifically, we identified users with distinct use profiles who also demonstrated differences on a wide range of traits that may be relevant to the theoretical model guiding specific intervention strategies. For example, previous research suggests that marijuana descriptive norms predicts marijuana use only among individuals who identify strongly with marijuana users and weakly with typical college students (Neighbors et al., 2013). Thus, personalized feedback may be effective for individuals with this pattern of pre-existing social identity (e.g., Class 4) but not for individuals who do not strongly identify with marijuana users (e.g., Class 1).

4.1. Limitations

Several important limitations of the present study must be noted. First, the cross-sectional, non-experimental study design prevents us from making causal inferences. Longitudinal and experimental designs are needed to make such inferences. Second, we did not actively ensure that we obtained a nationally representative sample so we cannot be sure whether our

results generalize to the population of college students in the United States. By collecting data from Psychology department participant pools, psychology pools are likely overrepresented, and we know that women were overrepresented relative to the college student population as a whole. Collecting a larger, more representative sample, and using sampling weights are ways that future studies could attempt to improve the likelihood that findings generalize to this population. Third, by collecting a college sample, it is unknown whether our results would generalize to non-college attending individuals. Fourth, we did not assess presence, likelihood, symptoms, or severity of a CUD or other alcohol/substance use. Future studies examining CUD symptoms could improve our description of the distinct user classes. For example, we expect that Classes and 3 and 4 have substantially more individuals with a CUD compared to Classes 1 and 2; however, we were unable to test this hypothesis with the current data. Fifth, although we extracted four classes, other class solutions are viable. For example, when we extracted five and six class solutions, we found additional classes that exhibited a moderate frequency of marijuana use and a moderate experience of consequences. Therefore, there are limitations with regards to determining exactly how many classes exist in the population, and these results should be considered preliminary until replicated. Relatedly, although we had multiple indicators of marijuana use frequency, we may be able to better distinguish between types of marijuana users if we had included measures of quantity of marijuana use, level of subjective intoxication from marijuana use, and estimates of the potency of marijuana used. Future studies with a more comprehensive assessment of marijuana use indicators are likely to find different class solutions that may lead to making finer-grained distinctions between user types. For example, although Class 1 experienced the fewest amount of consequences, these additional indicators may identify additional heterogeneity among infrequent marijuana users, including individuals experiencing no, few, or more negative consequences.

4.2. Conclusions

Using latent profile analysis, the present study demonstrates that college student marijuana users are a heterogeneous group. Not only can this heterogeneity be distinguished by a careful examination of marijuana use involvement (including marijuana use frequency and marijuana negative consequences), but we can also examine the risk/protective factors that are associated with being a particular type of marijuana user. Interestingly, our largest class of individuals were infrequent marijuana users who did not appear to experience many negative consequences from their use. Three additional classes reported more problematic use patterns that were associated with experiencing increased negative consequences. Taken together, our results suggests that those who use cannabis a few times per month are different from those who are near-daily or daily users. Further, our examination of factors that distinguished between user classes revealed the relative importance of two constructs that are not well-researched in the marijuana field: identification with being a marijuana user and the use of protective behavioral strategies. Given the growing number of studies supporting alcohol protective behavioral strategies in intervention contexts (Barnett et al., 2007; Larimer et al., 2007; Murphy et al., 2012), we suggest that similar attempts to address these harm-reducing strategies in preventative interventions. Therefore, we hope our findings serve as a call to action for the field to consider examining these constructs in future studies and to move away from only examining users vs. non-users.

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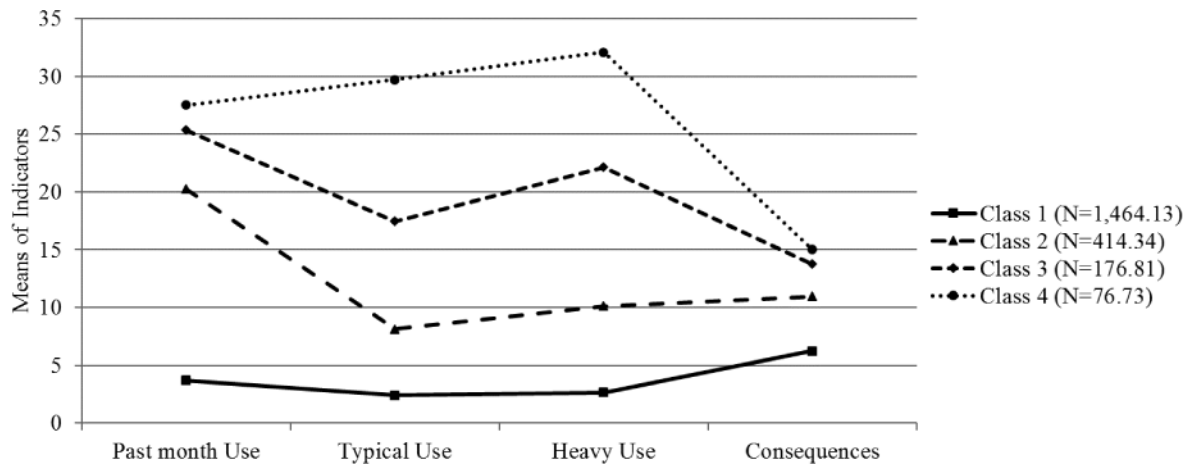
Figure 1.
Depiction of the four latent classes defined by the pattern of means on past month marijuana use (mean days), marijuana use in a typical week (times used in terms of 6 4-hour blocks of time), marijuana use on heaviest use week (times used in terms of 6 4-hour blocks of time), and marijuana-related negative consequences (mean frequency of negative consequences experienced in the past month).

Table 1

Bivariate correlations and descriptive statistics among indicators for marijuana involvement in full sample.

	1	2	3	4	M	SD	Range
1. Past 30-Day Marijuana Use	—				9.57	9.93	0–30
2. Typical Marijuana Use	**.75**	—			5.76	6.92	0–42
3. Heavy Marijuana Use	**.73**	**.86**	—		6.78	8.44	0–42
4. Consequences	**.35**	**.35**	**.35**	—	8.10	7.83	0–50

Note. Significant correlations are bolded for emphasis and were determined by a 99% bias-corrected bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero.

Table 2

Fit statistics for 1 through 6 class solutions for Latent Profile Analysis (LPA).

	Number of Classes					
Fit Statistics	**1**	**2**	**3**	**4**	**5**	**6**
AIC	60030.42	55538.71	53281.74	**52541.65**	52201.57	51730.42
BIC	60075.73	55612.33	53383.68	**52671.91**	52360.15	51917.32
Adjusted BIC	60050.31	55571.03	53326.49	**52598.84**	52271.19	51812.47
Entropy	—	0.951	0.957	**0.957**	0.959	0.939
Smallest n	2,129	518	195	**76**	76	64
LRT	—	$p < .001$	$p < .001$	$p = .011$	$p = .685$	$p = .831$

Note. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion. LRT = Lo-Mendell-Rubin Adjusted Likelihood Ratio Test.

Table 3

Mean comparisons between latent classes on personal beliefs and coping styles.

	Class 1	Class 2	Class 3	Class 4
Demographic Factors				
Age	19.762_a	20.172_{ab}	20.576_b	20.878_b
Percentage of Females	$67\%_a$	$55\%_b$	$50\%_{bc}$	$37\%_c$
Impulsivity-like Traits				
Premeditation	2.881_a	2.824_b	2.861_{ab}	2.842_{ab}
Perseverance	2.913_a	2.842_b	2.872_{ab}	2.836_{ab}
Sensation-Seeking	2.840_a	2.852_a	2.871_a	2.906_a
Negative Urgency	2.370_a	2.409_a	2.373_a	2.403_a
Positive Urgency	2.053_a	2.085_a	2.084_a	2.086_a
SURPS Personality Traits				
Hopelessness	1.869_a	1.927_b	1.881_{ab}	1.920_{ab}
Anxiety Sensitivity	2.545_a	2.504_{ab}	2.438_b	2.405_b
Impulsivity	2.146_a	2.173_a	2.139_a	2.953_a
Sensation-Seeking	2.837_a	2.892_a	2.906_a	2.086_a
Sensation Seeking Facets				
Risk Seeking	2.991_a	3.117_b	3.045_{ab}	3.136_{ab}
Experience Seeking	3.912_a	3.902_a	3.891_a	3.926_a
Emotion Regulation Facets				
Nonacceptance	2.299_a	2.316_a	2.189_a	2.307_a
Goals	2.945_a	2.879_a	2.910_a	2.836_a
Impulse	2.056_a	2.106_a	2.063_a	2.015_a
Aware	2.505_a	2.498_a	2.444_a	2.390_a
Strategies	2.224_a	2.260_a	2.212_a	2.212_a
Clarity	2.360_a	2.406_a	2.368_a	2.287_a
Marijuana-related Perceptions				
Descriptive Norms-Typical	7.911_a	10.070_b	13.340_c	15.545_c
Descriptive Norms-Heaviest	8.345_a	12.093_b	17.372_c	19.647_c
Injunctive Norms-Best Friends	5.032_a	5.785_b	6.099_c	6.243_c
Injunctive Norms-College Students	5.152_a	5.267_a	5.328_a	5.332_a
Injunctive Norms-Parent	2.209_a	2.717_b	3.242_c	3.284_c
Internalized Norms	2.476_a	2.802_b	2.850_{bc}	2.975_c

	Class 1	Class 2	Class 3	Class 4
Motives				
Social Motives	2.577_a	2.826_b	2.901_b	3.056_b
Coping Motives	2.027_a	2.521_b	2.687_b	2.736_b
Enhancement Motives	3.508_a	3.914_b	4.041_b	4.121_b
Conformity Motives	1.491_a	1.482_a	1.415_a	1.360_a
Expansion Motives	2.199_a	2.893_b	3.083_b	3.043_b
Other Factors				
Marijuana User Identification	1.729_a	3.040_b	3.794_c	4.219_d
Protective Behavioral Strategies	4.425_a	3.758_b	3.299_c	2.862_d

Note. Means sharing a subscript in a row indicate means that are not significantly different from each other. For gender, values represent percentage of females within the class.

Table 4

Standardized mean comparisons between latent classes on personal beliefs and coping styles.

	Class 1	Class 2	Class 3	Class 4	Largest Class Difference
Impulsivity-like Traits					
Premeditation	0.035_a	-0.108_b	-0.015_{ab}	-0.059_{ab}	d=0.143
Perseverance	0.052_a	-0.132_b	-0.053_{ab}	-0.147_{ab}	d=0.199
Sensation-Seeking	-0.014_a	0.008_a	0.046_a	0.125_a	d=0.139
Negative Urgency	-0.019_a	0.062_a	-0.014_a	0.054_a	d=0.081
Positive Urgency	-0.019_a	0.040_a	0.040_a	0.050_a	d=0.069
SURPS Personality Traits					
Hopelessness	-0.030_a	0.092_b	-0.001_{ab}	0.072_{ab}	d=0.122
Anxiety Sensitivity	0.046_a	-0.041_{ab}	-0.178_b	-0.250_b	d=0.296
Impulsivity	-0.011_a	0.044_a	-0.027_a	0.038_a	d=0.071
Sensation-Seeking	-0.039_a	0.066_a	0.088_a	0.181_a	d=0.220
Sensation Seeking Facets					
Risk Seeking	-0.054_a	0.145_b	0.030_{ab}	0.177_{ab}	d=0.231
Experience Seeking	0.006_a	-0.013_a	-0.029_a	0.027_a	d=0.056
Emotion Regulation Facets					
Nonacceptance	0.006_a	0.022_a	-0.105_a	0.009_a	d=0.127
Goals	0.021_a	-0.048_a	-0.108_a	-0.101_a	d=0.129
Impulse	-0.011_a	0.050_a	-0.002_a	-0.063_a	d=0.113
Aware	0.014_a	0.003_a	-0.067_a	-0.134_a	d=0.148
Strategies	-0.006_a	0.035_a	-0.020_a	-0.023_a	d=0.058
Clarity	-0.009_a	0.048_a	0.005_a	-0.109_a	d=0.157
Marijuana-related Perceptions					

	Class 1	Class 2	Class 3	Class 4	Largest Class Difference
Descriptive Norms-Typical	-0.144_a	0.128_b	0.536_c	0.812_c	d=0.956
Descriptive Norms-Heaviest	-0.214_a	0.212_b	0.811_c	1.070_c	d=1.284
Injunctive Norms-Best Friends	-0.217_a	0.370_b	0.611_c	0.725_c	d=0.942
Injunctive Norms-College Students	-0.040_a	0.066_a	0.120_a	0.132_a	d=0.172
Injunctive Norms-Parent	-0.154_a	0.192_b	0.563_c	0.597_c	d=0.751
Internalized Norms	-0.183_a	0.346_b	0.426_{bc}	0.632_c	d=0.851
Motives					
Social Motives	-0.090_a	0.156_b	0.224_b	0.380_b	d=0.470
Coping Motives	-0.166_a	0.302_b	0.457_b	0.505_b	d=0.671
Enhancement Motives	-0.147_a	0.270_b	0.392_b	0.482_b	d=0.629
Conformity Motives	0.017_a	0.001_a	-0.082_a	-0.154_a	d=0.171
Expansion Motives	-0.204_a	0.395_b	0.555_b	0.524_b	d=0.728
Other Factors					
Marijuana User Identification	-0.356_a	0.548_b	1.062_c	1.356_d	d=1.712
Protective Behavioral Strategies	0.298_a	-0.412_b	-0.904_c	-1.365_d	d=1.663

Note. Means sharing a subscript in a row indicate means that are not significantly different from each other.