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Marijuana Motivations Across Adolescence: Impacts on Use and Consequences

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Abstract

Background—Motivational models for marijuana use have focused on reasons to use marijuana, but rarely consider motives to abstain.

Objectives—We examined how both adolescent marijuana abstinence motives and use motives contribute to marijuana use and problems at the end of emerging adulthood.

Methods—434 community recruited youth who had not initiated marijuana use at baseline were followed from adolescence (at ages 12, 15, and 18 years) into emerging adulthood (age 25 years). Motives to abstain and to use marijuana, marijuana consumption, and marijuana-related problems were assessed across time.

Results—Endorsing more motives to abstain from marijuana across adolescence predicted less marijuana use in emerging adulthood and fewer marijuana-related problems when controlling for past motives to abstain and marijuana-related behavior. Positive reinforcement use motives related to increased marijuana consumption and problems, and negative reinforcement motives predicted problems when controlling for past marijuana use motives and behaviors. Expansion motives during adolescence related to lower marijuana use in emerging adulthood. When considered together, motives to abstain buffered the effect of negative reinforcement motives on outcomes at age 25 for youth endorsing a greater number of abstinence motives.

Conclusions/Implications—Given these findings, inclusion of both motives to use and abstain is warranted within comprehensive models of marijuana use decision making and may provide important markers for prevention and intervention specialists.

Keywords

marijuana motives; abstinence motives; adolescence; marijuana

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Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

According to recent Monitoring the Future (MTF) results, over a third of high school seniors have tried marijuana at least once (36%), while 12.7% of 8th graders have initiated marijuana use (Johnston, O'Malley, Meich, Bachman, & Schulenberg, 2014). Although teenage marijuana users generally believe that marijuana is not harmful to their health (Brook, Balka, & Whiteman, 1999; Danseco, Kingery, & Coggeshall, 1999; Johnston et al., 2014), studies of early-onset marijuana use suggest differently. Early marijuana use has been associated with low academic intentions (Ellickson, Tucker, Klein, & Saner, 2004), poor executive functioning (Gruber, Sagar, Dahlgren, Racine, & Lukas, 2012), reduced verbal IQ (Pope et al., 2003), future abuse of opioids (Fiellin, Tetrault, Becker, Fiellin, & Hoff, 2013), and difficulties transitioning into adult social roles (Brook, Adams, Balka, & Johnson, 2002). Habitual marijuana users who initiated weekly use before, compared to after, age 18 had lower IQ scores at age 38 (Meier et al., 2012), and clinical features of marijuana dependence were twice as prevalent in adolescent-onset users than in adult-onset users (Chen & Anthony, 2003). Understanding the mechanisms that underlie marijuana-related decision making is central to the development of appropriate prevention and intervention strategies.

Marijuana-related motivations, or reasons to use or abstain from use, are one explanatory mechanism associated with marijuana engagement. Motives for alcohol and other drug use are important cognitive predictors of alcohol and other drug engagement, distinct from substance use expectancies (i.e., learned associations between behavior and outcomes held in memory) and attitudes, or broad-based beliefs about use (Ajzen, 1985; Kuntche, Knibble, Gmel, & Engles, 2005). In longitudinal work with high school seniors from 1976 to 1990 in the MTF study, increased frequency of marijuana use was associated with using to get high, increase drug effects, gain insights, cope with negative mood states, and alleviate tension as well as with reasons associated with compulsive use ("hooked" or "get through the day;" Patrick, Schulenberg, O'Malley, Johnston, & Bachman, 2011, p. 112). In late adolescence, endorsing reasons to use that reflected seeking acceptance by peers and reducing negative consequences associated with other drug use predicted marijuana use disorder at age 35 (Patrick et al., 2011), suggesting that marijuana use motives during adolescence may have long-term effects on later drug-related outcomes.

Like alcohol consumption, marijuana use is often associated with both social facilitation and stress reduction (Newcomb, Chou, Bentler, & Huba, 1988; Patrick et al., 2011; Simons, Correia, & Carey, 2000), justifying the application of social and coping motives to marijuana use. Simons, Correia, Carey, and Borsari (1998) adapted Cooper's (1994) 4-factor model for alcohol use motives to marijuana use. In their 5-factor model, enhancement and social motivations are considered positive reinforcement reasons for engaging in marijuana use. These motives capture a participant's desire to use marijuana to feel "high" or to facilitate group interactions, respectively. Conversely, coping and conformity motives are considered negative reinforcement motivations to use. Coping motives identify pain relief and stress reduction as the primary reasons for use, and conformity motives capture the desire to use marijuana to fit in with a social group or to avoid social rejection. Expansion motives, which were not included in Cooper's model for alcohol use, attempt to capture the specific psychedelic properties of marijuana, typified by the broadening of experiential awareness (Newcomb et al., 1988; Simons et al., 1998).

Most of the research on marijuana motives has been conducted with college students, although a few key studies have effectively mapped the basic pattern of motivations for marijuana use among teens. In adolescence, enhancement, expansion, and social motives account for a significant amount of the variance associated with problematic marijuana use (Chabrol, Ducongé, Casas, Roura, & Carey, 2005; Zvolensky et al., 2007). In a study of French adolescents, Chabrol and colleagues (2005) found that greater enhancement motives were associated with increased marijuana use in boys, while expansion motives had a greater influence on girls. In a momentary sampling study of adolescent and emerging adult marijuana users, motives associated with positive reinforcement (social, enhancement, and expansion motives) were more frequently endorsed than motives relating to negative reinforcement (coping and conformity motives). However, positive reinforcement motives were unrelated to the dose consumed, subjective feelings of being “high,” or the duration of use episodes, when other predictors were considered (Shrier, Walls, Rhoads, & Blood, 2013). In high-risk adolescent marijuana users, coping motives related strongly to adverse consequences of marijuana use across time when other motives, psychopathological symptoms, and demographics were considered (Fox, Towe, Stephens, Walker, & Roffman, 2001). Social, enhancement, expansion, and coping motives were related to increased marijuana use frequency (Bonn-Miller, Zvolensky, & Bernstein, 2007; Simons et al., 1998) and problems in emerging adults (Buckner, Bonn-Miller, Zvolensky, & Schmidt, 2007; Simons, Gaher, Correia, Hansen, & Christopher, 2005), and use of marijuana for positive reinforcement appears to continue into adulthood (Lee, Neighbors, & Woods, 2007; Simons et al., 2000).

Limited research has addressed adolescents’ motivations to abstain from marijuana. As longitudinal research suggests that lifetime abstainers have higher educational achievement, better overall health, and better life satisfaction at age 29 than those with any lifetime marijuana use (Ellickson, Martino & Collins, 2004), better understanding of how reasons to abstain relate to long-term outcomes could lead to improved prevention programming. In addition, motivationally based prevention and intervention strategies often focus on highlighting discrepancies between approach and avoidance motivational states for youth (Swan et al., 2008). Little is known, however, about the function of cognitions relating to abstinence from marijuana across time, especially among adolescents.

The most frequently cited reasons for quitting or abstaining from marijuana use among adolescents are concerns about psychological and physical damage (Terry-McElrath, O’Malley, & Johnston, 2008), as well as lack of interest in the effects of the drug (Fountain et al., 1999). High-risk adolescents (i.e., those evidencing behavioral, emotional, or substance use problems) cite avoidance of legal and employment consequences as their primary reasons to stop using marijuana (Weiner, Sussman, McCuller, & Lichtman, 1999). In a study of college-aged marijuana abstainers, highly influential reasons for abstinence included, “It does not fit the image I have of myself,” “I don’t need it to have a good time,” and “I don’t see benefits of using it” (Rosenburg et al., 2012, p. 98). The assumption of adult social roles (e.g., having children, getting married, launching a new career) is commonly associated with cessation from marijuana use (Chen & Kandel, 1998; Hammer & Vaglum, 1990).

This investigation expands on previous longitudinal work discussed above by Patrick et al. (2011), which examined the effects of marijuana use motives in late adolescence on problematic use in adulthood. We examine the effects of both motives to use and abstain from marijuana on marijuana use, both quantity and frequency, and marijuana-related problems across the period from early adolescence through emerging adulthood. We explore whether motives to use and to abstain assessed during adolescence will interact to predict later marijuana use and related problems, which has been found for alcohol motives in the adolescent alcohol literature (Anderson, Grunwald, Bekman, Brown, & Grant, 2011). As motivational enhancement strategies have grown in popularity for use in youth substance abuse programming (Naar-King & Suarez, 2011), investigating the interplay of motives to abstain and motives to use across adolescent development helps to illuminate decisional balance processes in youth substance use decision making. Results of this study could have important implications for designing motivational-based interventions for adolescents.

METHODS

Participants and Design

The Rutgers Health and Human Development Project (HHDP) used a prospective longitudinal design to examine the development, predictors, and consequences of substance use from adolescence into adulthood. From 1979–1981, adolescents were identified through a random dial telephone survey, based on population density in New Jersey, reaching 95% of all households in the targeted geographic area (16 of 21 counties). A quota sampling procedure was used to identify youth based on sex and age for the accelerated cohort design (ages 12, 15, and 18 at baseline). This investigation focuses on the 475 adolescents who were 12 years old at study initiation (wave 1, 1979–1981) and followed at ages 15 (wave 2, 1982–1984), 18 (wave 3, 1985–1987), and 25 (wave 4, 1992–1994); 91% of the original sample was re-interviewed at wave 4. Eligibility requirements included birth between 1967 and 1969, fluency in English, having no diagnosed mental impairment or serious physical impairment, and not living in a corrective or rehabilitative institution, including alcohol and drug treatment facilities, at baseline (Horwitz, White, & Howell-White, 1996).

For this investigation, participants were limited to 434 youth (91%) who reported no lifetime marijuana use at wave 1 but who may or may not have initiated use after the first wave of assessment. The sample was approximately half girls (48%), primarily Caucasian (90%), and is best characterized as working- and middle-class metropolitan dwellers. Follow-up rates were wave 2: $n = 424$; wave 3: $n = 426$; wave 4: $n = 405$.

This study was approved through the Rutgers University IRB. At the beginning of the study, parents provided written informed consent and youth provided assent. Once participants were 18 years of age, they provided written consent. At each assessment period, participants spent an average of 4 h completing standardized self-report questionnaires on their substance use and other behaviors since the last assessment. For a complete description of study sample procedures, see Pandina, Labouvie, and White (1984).

MEASURES

Motives to Use or Abstain

Participants indicated if any one of a series of motives to use marijuana or to abstain from use influenced their decisions (or would influence their decisions) to use marijuana (no = 0; yes = 1). Scores on these dimensions represent the total number of motives endorsed within each content domain. At wave 1, all participants included in this analysis reported on motives to abstain. At waves 2 and 3, abstainers/stoppers reported on reasons they abstain and users reported on reasons they might abstain (i.e., concerns). As there were no users included in these analyses at wave 1, at later waves, abstainers reported on reasons they might consider using and users reported on reasons why they use marijuana. There was some variability in the item sets assessed across time; items retained for this analysis were 10 items for abstention and 28 items for use present at all time periods.

As the literature does not provide a commonly used measure of motives to abstain from marijuana, we conducted an exploratory factor analysis to determine an appropriate scale structure for the available items using Stata 12.0 (StataCorp, 2011). A single factor best captured the data. We summed 10-items, which included content related to the avoidance of negative consequences (e.g., trouble with the police or getting sick) and interference with activities or life goals (e.g., studying, job, sports). Reliability estimates (Cronbach's α) for the scale ranged from .82 (age 12) to .88 (age 18), and scores ranged from 0 to 10.

Because this investigation predated the advent of the Simons and colleagues' (1998) 5-factor model for marijuana use motives, items included did not cover the entirety of their content domains. Therefore, we matched items to the existing coding strategy used by Anderson, Briggs, and White (2013) for alcohol, using a positive reinforcement (social and enhancement motivations; *n* [of items] = 11; α = .86 [wave 2] and .92 [wave 3]) and negative reinforcement framework (coping and conformity motivations; *n* = 17; α = .87 [wave 2] and .90 [wave 3]), with the inclusion of the expansion domain from Simon's analysis (*n* = 7; α = .65 [wave 2] and .77 [wave 3]. This strategy of combining motivational scales along the dimensions of positive and negative reinforcement has been supported within the alcohol literature (Carey & Correia, 1997). Sample items for the positive reinforcement scale included, "to relate better to people" and "to feel independent and powerful." Negative reinforcement items included, "to help me when I'm depressed" and "my friends expect me to." Given arguments for expansion as a substance-specifc motivational frame for marijuana use (Simons et al., 1998) and the availability of items capturing this dimension, we generated a separate subscale for these items. Items characteristic of this scale included, "to get better insight into myself" and "to expand my awareness and understanding of things."

Confrmatory factor analysis demonstrated adequate fit for these three motive subscales (positive reinforcement, negative reinforcement, and expansion) modeled together at wave 2 (χ^2 [df = 24] = 233.48, $p < .0001$; CFI = 0.97; RMSEA = .08 [CI: 0.07–0.09]) and wave 3 (χ^2 [df = 24] = 243.82, $p < .0001$; CFI = 0.98; RMSEA = .08 [CI: 0.07–0.09]).

Marijuana Quantity and Frequency

Participants were asked to report on their marijuana frequency (number of times used) since the last assessment (past 3 years). Scores were reported such that 0 = 0 times, 1 = 1–2 times, 2 = 3–9 times, 3 = 10–19 times, 4 = 20–39 times, 5 = 40–69 times, 6 = 70–99 times, 7 = 100–299 times, 8 = 300–599 times, 9 = 600–999 times, 10 = 1,000 or more times at all waves. Participants were also asked the typical quantity of marijuana they used on use occasions over the past 3 years. Responses were recorded on a 10-point scale from 0 (none), 1 (a few drags on a joint), 2 (1 joint), 3 (2–3 joints), 4 (4–5 joints), 5 (6–7 joints), 6 (8–9 joints), 7 (10–15 joints; $^{1}_{2}$ ounce), 8 (16–25 joints; 1 ounce), and 9 (more than 1 ounce). These two variables were treated as continuous for analysis and log transformed prior to analysis due to non-normality.

Marijuana Problem Index (MRAPI)

Problems related to marijuana use were measured by the MRAPI, a modified version of the Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989), validated by previous research (Simons et al., 1998). The shortened version (White, Labouvie, & Papadaratsakis, 2005) consists of 18 items assessing potential consequences due to marijuana use. Examples include feeling dependent on marijuana, increased tolerance, neglecting work or home duties, and increased tension in social relationships. At follow-up, participants rated the frequency of experiencing each item on a Likert scale ranging from 0 (never) to 3 (more than five times) in the past three years. MRAPI scores showed variability across time, ranging from 0 to 54 at wave 2 (M = 1.25; SD = 4.94), 0 to 32 at wave 3 (M = 2.01; SD = 4.51), and 0 to 31 at wave 4 (M = 1.03; SD = 3.68). Again, scores were log transformed prior to analysis.

Analytic Plan—A multistage approach was used to examine how motives to abstain and to use marijuana assessed in adolescence influenced marijuana use and related problems in emerging adulthood among youth who had not initiated marijuana use prior to age 12. For abstinence motives, we focused on motives to abstain among nonusers at age 12, and those who had or had not initiated marijuana use at ages 15 and 18 to predict marijuana use and problems at age 25. This strategy accounted for abstinence motivation (or concerns) prior to the onset of use and across early periods of initiation. For motives to use at age 15 and 18, we focused on both users, whose marijuana-related cognitions may be more differentiated as a function of direct experience (Dunn & Goldman, 1998), and nonusers (reasons that they might use) to predict use and problems at age 25. Finally, we examined the interaction effects of motives to use and abstain at ages 15 and 18 (when both users and nonusers provided ratings of these potentially competing motives for using and not using marijuana) on marijuana use and related problems in emerging adulthood.

Using Stata 12.0 (StataCorp, 2011), generalized estimating equations (GEE) were conducted to examine the prediction of marijuana quantity (MJQ), marijuana frequency (MJF), and MRAPI scores at age 25, accounting for the influence of the time varying predictors of motives to abstain from (ages 12, 15, 18) and to use (ages 15, 18) marijuana, controlling for MJQ, MJF, and MRAPI scores across time (one covariate per analysis, e.g., MJQ across time when MJQ was the outcome variable). MJQ, MJF, and MRAPI scores were included as

time-varying covariates to assure that the cross-time influence of motives was not an artifact of motives' concurrent associations with marijuana use or problems at each wave (Littlefield, Sher, & Wood, 2010). Sex (0 = female; 1 = male) was included in the models as a covariate due to bivariate relations with outcomes. Given the unequal time periods between assessments, we chose an unstructured matrix for the within-subjects effects and used robust standard errors in estimation (Allison, 2012). Significant interactions were probed using the *margins* command (StataCorp, 2011). A small proportion of the data was missing on the outcome variables of interest across time (1.8–2.3% per scale waves 1–3; 6.8% on outcome variables at wave 4). In Stata, missing data on the predictor variables are removed in a pairwise manner at each wave, allowing for inclusion of almost the entire sample within each regression.

RESULTS

Table 1 provides information on the sample marijuana use characteristics, problem scores, and descriptive statistics for predictors at each wave of assessment. The percentage of the sample endorsing recent use of marijuana peaked around age 18, with over half of the sample indicating use of marijuana since the last assessment. Problem severity, as indexed by the MRAPI, was relatively low across time but evidenced variability across participants. In Table 2, we show the results of the GEE analyses for motives to abstain. Motives to abstain from marijuana assessed at ages 12, 15, and 18 signifcantly predicted MJQ and MJF at age 25, with more motives for abstention from ages 12 to 18 predicting less marijuana engagement at age 25. The effect of MJQ and MJF (i.e., marijuana use indices at each previous wave) on current marijuana use at age 25 was also significant. For marijuana quantity, young men were more likely to endorse greater consumption than women. A similar pattern emerged for MRAPI scores with more abstinence motives in adolescence predicting fewer marijuana-related problems in emerging adulthood. Again, past problems significantly predicted later MRAPI scores.

Table 3 presents the parameter estimates for the model including motives to use. Motives for positive reinforcement from marijuana assessed in mid to late adolescence predicted greater quantity and frequency of use and use-related problems in emerging adulthood. Interestingly, endorsement of expansion motives in adolescence related to less frequent consumption and decreased quantity per occasion at age 25. Negative reinforcement motives were associated with increased marijuana-related problems only. In terms of covariates, past use frequency predicted more frequent marijuana use at age 25, while past MRAPI scores inversely predicted problems later on. Consistent with models for motives to abstain, young men, compared to women, reported greater quantity across time.

Given that participants reported on both motives to use and to abstain at waves 2 and 3, we examined whether motivations to use and to abstain in mid to late adolescence (ages 15 and 18) predicted later marijuana use (quantity and frequency) and problems in emerging adulthood (Table 4). We tested the main effects of motive type (motives to abstain, positive and negative reinforcement use motives, expansion motives) and the interaction of motives to use and to abstain (i.e., abstain × positive motives to use, abstain × negative motives to use, abstain × expansion). There was a significant interaction effect of negative

reinforcement motives for use and motives to abstain on frequency of marijuana use at age 25. Examination of the simple slopes of negative reinforcement motives on use frequency at each level of motives to abstain indicated that motives to abstain buffered the effects of negative reinforcement motives for youth endorsing more than five motives to abstain (Figure 1a). Motives to abstain also moderated the influence of negative reinforcement motives on marijuana-related problems at age 25, with the buffering effect only occurring for youth with the greatest number of motives to abstain (7–10 reasons; Figure 1b). Figure 1 presents the interaction of motives to abstain with negative reinforcement motives at varying levels of abstinence motive endorsement; motives to abstain from marijuana had greater buffering effects against negative reinforcement motives when predicting marijuana frequency than for marijuana-related problems. Positive reinforcement motives, past use, and past problems emerged as significant main effects in the analyses. Interaction effects were not statistically significant in the prediction of the quantity of marijuana at age 25; positive reinforcement motives, being male, and higher past quantity predicted greater quantity of at age 25, while motives to abstain inversely predicted this outcome.

DISCUSSION

To our knowledge, this is the first prospective examination of the interplay of both motives to use and to abstain from marijuana on marijuana use and related problems assessed from the onset of adolescence through emerging adulthood. These findings support previous research on alcohol use motives (Kuntsche, Knibbe, Gmel, & Engels, 2005; Kuntsche, Knibbe, Gmel, & Engels 2006; White, 1987) and marijuana use motives (Bonn-Miller et al., 2007; Patrick et al., 2011; Simons et al., 1998; Zvolensky et al., 2007), indicating that positive and negative reinforcement motives for marijuana use are related to increased consumption and use-related problems. These findings support consistency in the function of substance-related motivation in the processes underlying engagement with alcohol and other drugs (Simons et al., 1998). With the addition of expansion motives, a marijuana-specific motivational set (Simons et al., 1998), an intriguing pattern emerged: more expansion motives across middle adolescence were related to lower marijuana use in emerging adulthood when motives to use were considered alone. This finding might suggest that using marijuana for reasons associated with expansion of consciousness may not be sufficient to maintain marijuana use across time or engender problematic use. Interestingly, Patrick et al. (2011) found positive prospective relations between reasons to use associated with gaining insight, a component of expansion motives, at age 18, and marijuana use at age 35; however, gaining insight was not a predictor of later marijuana use dependence. Contradictions between these two prospective studies may relate to the different operationalization of expansion reasons or to differences in the age of assessment. Further research using the current operationalization of expansion motives (i.e., Simons et al., 1998) is needed to better understand these influences across adolescence into young adulthood. While past research and, to some extent, our own investigation have highlighted the importance of motives associated with the pharmacological actions of the marijuana use (McCabe, Boyd, Cranford, & Teter, 2009), the broader categorization of positive vs. negative reinforcement seemingly provides a stable framework by which to understand motives for alcohol and other drug-related behaviors.

Few studies have targeted abstinence motives when considering alcohol and other drug processes in adolescents (Anderson et al., 2011, 2013; Bekman et al., 2011; Fountain et al., 1999; Terry-McElrath et al., 2008). This investigation describes how motives to abstain from marijuana, assessed prior to marijuana use initiation and throughout adolescence, impact marijuana use and problems at the end of emerging adulthood. As anticipated, more motives to abstain from marijuana early in adolescence predicted less engagement with marijuana in emerging adulthood and fewer marijuana-related problems, when accounting for marijuana use and marijuana-related behaviors across time. While our operationalization of motivation here focused on the number of motives endorsed within a certain domain, other research has focused on the intensity of endorsement of sets of motives (e.g., Cooper, 1994). It is unknown how differing operationalizations of motives (i.e., count vs. intensity) might impact the interpretation of relations between motives and use across time. However, we were able to correlate the number of motives endorsed with average intensity of endorsement at wave 3 when both types of data were available. Correlations for all four motive subscales were significant ($p < .00001$). Nevertheless, the association between count and intensity measures should be examined in future research.

Given the factor structure of the available items, we did not model the influence of different subdomains of abstention motives in this investigation. Past work in this sample has suggested that these youth do have differentiated motives to abstain from alcohol use at ages 15, 18, and 25 (Anderson et al., 2013). As we were unable to examine such differentiation here, a limitation of this work, future longitudinal research on how individual subdomains of abstinence motives predict marijuana use and problems is needed. Nevertheless, the findings suggest that youth who have more reasons for not using marijuana during adolescence are less likely to use marijuana at high levels and to develop problems with marijuana later. Thus, interventions that increase and reinforce reasons for not using marijuana may not only reduce early initiation but may reduce later excessive and problematic use (Swan et al., 2008).

Consistent with earlier cross-sectional work on alcohol-related cognitions (Anderson et al., 2011), motives to abstain moderated the relation between use motives, in this case, negative reinforcement motives, and the frequency of marijuana consumption. In contrast to the findings of Anderson et al. (2011), in the present study, higher levels of motives to abstain from marijuana also buffered the impact of negative reinforcement motives on problems. To better understand the dynamic relations between these classes of motives, more longitudinal work is needed. While theoretical and empirical work supports the integration of both types of motives in models of adolescent alcohol-related decision making (Anderson et al., 2013; Bekman et al., 2011), prospective work in this area with adolescents has been limited. A challenge to understanding the interplay of motives to use and abstain on initiation and maintenance of alcohol and other drug use behavior is whether it is appropriate to assess motives to use in individuals who have not had direct experience with alcohol or other drugs. This issue is particularly salient when examining earlier stages of engagement, or for drugs with lower base rates of use, as it may be problematic to introduce naïve individuals to the potentially appealing effects of substance use.

Interestingly, past marijuana problems predicted fewer such problems in emerging adulthood when controlling for the impact of motives assessed in adolescence (age 15 and 18: marijuana use motives and the interaction model), suggesting that youth may have been incentivized to change their problematic use patterns. However, marijuana-related problems predicted more problems in emerging adulthood when controlling for the effects of abstinence motives alone. This could be a function of the differing periods of assessment for motives to abstain (ages 12, 15, 18 vs. ages 15 and 18). More longitudinal research is needed to determine whether this finding is sample specific or relates to important developmental processes in the period from early to middle adolescence.

This investigation had a number of strengths, including: our use of a relatively large sample of youth assessed across a developmentally sensitive period for the initiation of marijuana use; use of a prospective, longitudinal design; explicit accounting for time-varying covariation in the estimates of predictors, and outcomes in our models; and the ability to evaluate both motives for use and for abstention. These strengths are tempered by limitations. While the HHDP provides an incredibly rich source of prospective data, the cohort assessed was in adolescence during the 1980s. The mid 1980s evidenced rising evaluations of risk associated with marijuana use and concurrently declining rates of marijuana use, as reported by high school seniors in the U.S. on MTF surveys (Johnston et al., 2014). Since 2000, youth in the U.S. have evidenced lowered perceptions of risk associated with marijuana use and increased rates of use. While the mechanisms underlying these shifts are unclear, it is likely that changing social norms relating to marijuana use and changes in the legal status of marijuana in certain states have had an impact (Johnston et al., 2014). As such, we must use caution in extrapolating our interpretations from these data to current adolescents and emerging adults as direct comparisons of marijuana-related motives across cohorts are unavailable. Unfortunately, similar cohort limitations affect other longitudinal marijuana research pertaining to motives within this area (Patrick et al., 2011). In addition, our sample was predominantly Caucasian, consistent with demographic patterns in New Jersey at that time. Also, the use of unvalidated motives measures limits generalizability to other investigations in this area. In sum, prospective longitudinal work in this area is clearly needed using a diverse sample of today's youth, mirroring this unique study by including both types of motives.

In light of recent findings regarding the developmentally sensitive nature of negative consequences associated with marijuana engagement beginning in adolescence (Chen & Anthony, 2003; Meier et al., 2012) and recent state laws making marijuana use legal in certain states in the U.S. (Walsh, 2013), data-driven prevention and intervention programming for adolescent marijuana use is imperative. Recent cross-sectional research suggests that motives to use and to abstain from marijuana differentially impact intentions to cut down and to stop or quit marijuana use among mid-adolescents (Dash & Anderson, 2014). As our results indicate, a better understanding of the interplay of motives to use and to abstain may inform developmentally appropriate prevention and intervention strategies for youth (Metrick, Frissell, McCarthy, D'Amico, & Brown, 2003) and perhaps provide appropriate targets for selective prevention programming for teens (Conrod, Castellanos-Ryan, & Strang, 2012; Swan et al., 2008).

GLOSSARY

Conformity motives	reasons to use alcohol or other drugs based upon the desire to use to fit in with a social group or to avoid social rejection
Coping motives	reasons to use alcohol or other drugs that identify pain relief and stress reduction as the primary reasons for use
Enhancement motives	reason to use alcohol or other drugs based on a desire to feel "high."
Expansion motives	reasons to use related to the specific psychedelic properties of marijuana, exemplified by the broadening of experiential awareness
Marijuana-related motivations	reasons to use or abstain from marijuana use
Negative reinforcement motives	a set of motivations related to decreasing negative experiences, specifically coping or conformity reasons
Positive reinforcement motives	a set of motivations related to increasing positive experiences, specifically enhancement and social motivations
Social motivations	reasons to use alcohol or other drugs associated with facilitating group interactions

Biographies

Kristen G. Anderson, Ph.D., is the Principal Investigator of the Adolescent Health Research Program and Associate Professor and Chair of Psychology at Reed College. Her area of expertise is the developmental psychopathology of addictive behaviors from late childhood through emerging adulthood. Dr. Anderson has specialized in the development of cognitive assessments of youth substance use decision-making, longitudinal modeling of process-oriented data, and the integration of personality and social-cognitive models of substance use initiation and maintenance.

Miranda Sitney, B.A., graduated from Reed College in 2012 with a degree in psychology. She is currently a research assistant for the Mind Research Network in Madison, Wisconsin. Her current projects involve identifying protective and risk factors for youths with callous and unemotional traits in juvenile detention settings. She is planning to attend graduate school in Clinical Psychology in the upcoming year.

Helene R. White, Ph.D., is a Distinguished Professor at Rutgers, the State University of New Jersey with a joint appointment at the Center of Alcohol Studies and in the Sociology Department. Her research focuses on the etiology, development, and consequences of substance use and comorbid problem behaviors in both community and high-risk samples. In addition, she is engaged in research on the development and evaluation of substance use prevention programs for college students.

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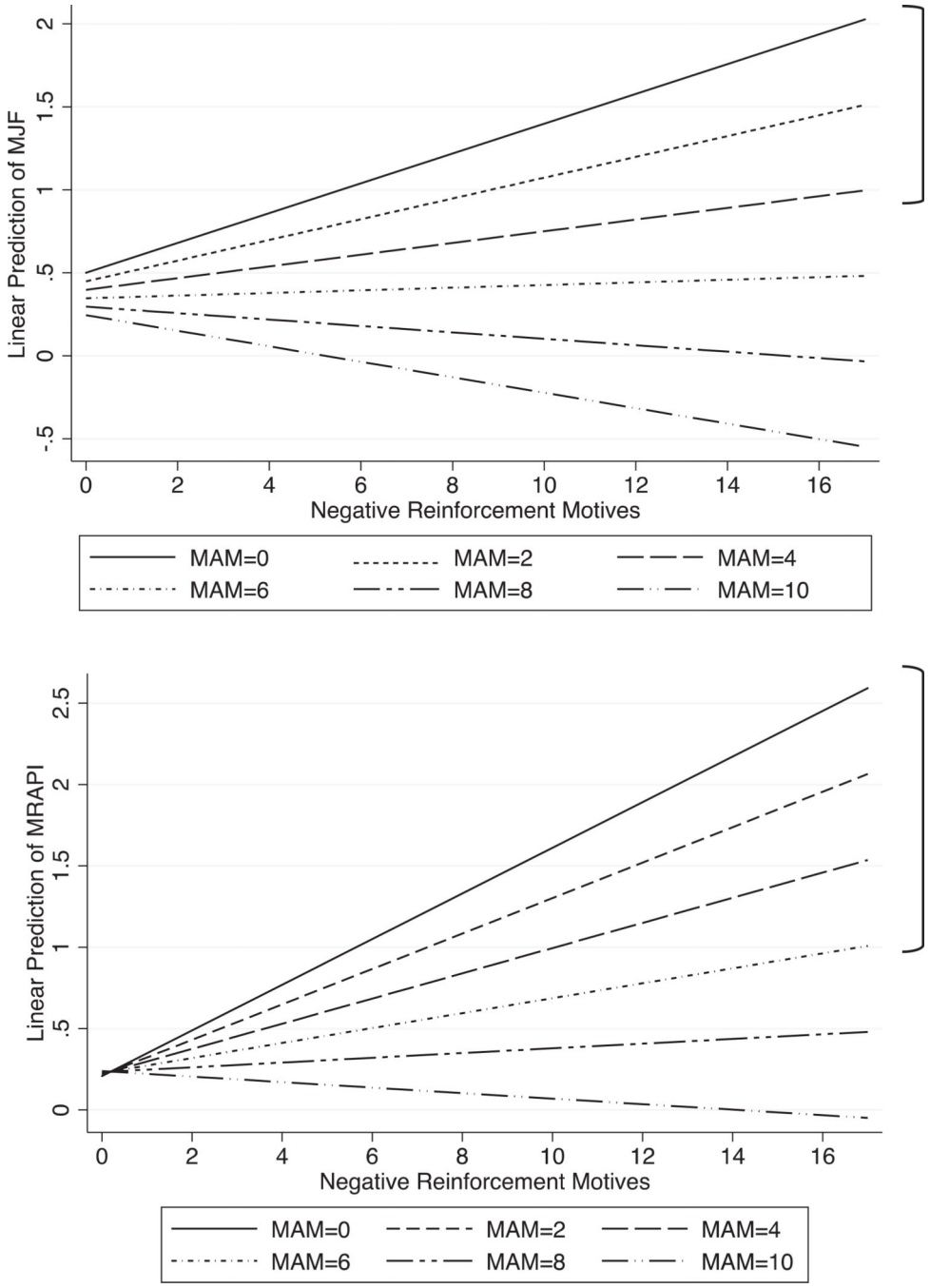

FIGURE 1.

(a) Plot of the simple slopes of negative reinforcement marijuana motives on marijuana frequency at levels of motives to abstain. MAM = Motives to abstain from marijuana. Bracket indicates significant slopes. (b) Plot of simple slopes of negative reinforcement marijuana motives on marijuana problems at levels of motives to abstain. MAM = Motives to abstain from marijuana. Bracket indicates significant slopes.

TABLE 1

Descriptive statistics for marijuana use variables and predictors at each wave

	Age 12			Age 15			Age 18			Age 25		
MJ use*												
MJQ												
None	100%			73.1%			46.4%			64.4%		
Few drags				10.1%			18.4%			16.1%		
1 joint				9.2%			15.8%			12.8%		
2+ joints				7.6%			19.5%			6.7%		
MJF												
None	100%			73.1%			46.2%			64.4%		
1–2 occ				8.0%			6.3%			4.9%		
3–9 occ				6.8%			14.3%			9.6%		
10–39 occ				7.8%			13.9%			9.9%		
40+ occ				4.3%			19.3%			11.1%		
Lifetime use	0%			27%			57%			65%		
Past 3 year use	0%			27%			54%			36%		
	M	SD	Rng	M	SD	Rng	M	SD	Rng	M	SD	Rng
MRAPIS	0.0	0.0	–	1.3	4.9	0–54	2.0	4.5	0–32	1.0	3.7	0–31
Motives												
MAM	4.9	3.0	0 –10	3.7	3.0	0–10	5.0	3.4	0–10			
Pos Reinf				1.3	2.6	0–8	0.6	1.5	0–8			
Neg Reinf				0.5	1.6	0–11	3.2	3.6	0 –11			
Expansion				0.1	0.4	0–4	0.9	1.5	0–7			

Note: MJQ = marijuana quantity; MJF = marijuana frequency (occ = occasions); MRAPI = marijuana-related problems (probs); MAM = motives to abstain from marijuana; Pos Reinf = positive reinforcement motives to use marijuana; Neg Reinf = negative reinforcement motives to use marijuana; Expansion = expansion motives to use marijuana; Rng = range;

*Use variables have been collapsed into categories to ease interpretation. Rounding of percentages may result in totals > 100.

TABLE 2

Generalized estimating equation models for influence of motives to abstain on marijuana quantity, frequency, and use-related problems at age 25

	Marijuana quantity			Marijuana frequency			Marijuana problems		
	B	**SE**	***p***	**B**	**SE**	***p***	**B**	**SE**	***p***
MAM	−0.02	0.00	<.0001	−0.04	0.01	<.0001	−0.02	0.01	<.0001
Sex	0.04	0.02	.04	0.03	0.03	0.29	0.02	0.03	.60
MJCov	0.07	0.01	<.0001	0.13	0.01	<.0001	0.08	0.01	<.0001
Model	χ^2 (df = 3) = 188.70		<.0001	χ^2 (df = 3) = 302.24		<.0001	χ^2 (df = 3) = 97.59		<.0001

Note: MAM = motives to abstain from marijuana; MJCov = marijuana engagement covariate across time (quantity for quantity, frequency for frequency, and problems for problems); B = unstandardized coefficient; SE = standard error. All outcomes and MJCov were log transformed.

TABLE 3

Generalized estimating equation models for use motives influence on marijuana quantity, frequency, and use-related problems at age 25

	Marijuana quantity			Marijuana frequency			Marijuana problems		
	B	**SE**	***p***	**B**	**SE**	***p***	**B**	**SE**	***p***
Pos Reinf	0.08	0.01	<.0001	0.17	0.02	<.0001	0.13	0.02	<.0001
Neg Reinf	0.00	0.01	.54	−0.00	0.02	.99	0.05	0.02	.04
Expansion	−0.07	0.03	.01	−0.09	0.03	.007	−0.07	0.04	.14
Sex	0.08	0.03	.02	0.06	0.04	.15	0.04	0.05	.40
MJCov	0.02	0.01	.13	0.04	0.01	.003	−0.05	0.02	<.0001
Model	χ^2 (df = 5) = 158.94		<.0001	χ^2 (df = 5) = 321.17		<.0001	χ^2 (df = 5) = 121.75		<.0001

Note: Pos Reinf = positive reinforcement motives to use marijuana; Neg Reinf = negative reinforcement motives to use marijuana; Expansion = expansion motives to use marijuana; MJCov = marijuana engagement covariate across time (quantity for quantity, frequency for frequency, and problems for problems); B = unstandardized coefficient; SE = standard error. All outcomes and MJCov were log transformed.

TABLE 4

Generalized estimating equation models for the interaction of motives to use and abstain on marijuana quantity, frequency, and use-related problems at age 25

	Marijuana quantity			Marijuana frequency			Marijuana problems		
	B	**SE**	***p***	**B**	**SE**	***p***	**B**	**SE**	***p***
Pos Reinf	0.08	0.02	<.0001	0.13	0.03	<.0001	0.09	0.03	.008
Neg Reinf	0.04	0.02	.07	0.09	0.03	.001	0.14	0.03	<.0001
Expansion	−0.08	0.05	.10	−0.07	0.06	.19	−0.03	0.08	.73
MAM	−0.02	0.01	<.0001	−0.03	0.01	<.0001	−0.00	0.01	.89
MAM*PR	−0.00	0.00	.36	−0.00	0.01	.97	0.00	0.01	.67
MAM*NR	−0.00	0.00	.24	−0.01	0.00	.002	−0.02	0.01	.003
MAM*Exp	0.01	0.01	.43	0.00	0.01	.65	−0.00	0.01	.94
Sex	0.07	0.03	.03	0.05	0.04	.23	0.04	0.05	.44
MJCov	0.03	0.01	.007	0.06	0.01	<.0001	−0.05	0.02	.002
Model	χ^2 (df = 9) = 208.23		<.0001	χ^2 (df = 9) = 524.68		<.0001	χ^2 (df = 9) = 179.17		<.0001

Note: MAM = motives to abstain from marijuana; Pos Reinf (PR) = positive reinforcement motives to use marijuana; Neg Reinf (NR) = negative reinforcement motives to use marijuana; Expansion (Exp) = expansion motives to use marijuana; MJQ = marijuana quantity log transformed; MJF = marijuana frequency log transformed; MRAPI = marijuana-related problems log transformed; MJCov = marijuana engagement covariate across time (quantity for quantity, frequency for frequency, and problems for problems); B = unstandardized coefficient; SE = standard error.