Developmental Trajectories of Marijuana Use From Adolescence to Adulthood

Personal Predictors

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Objective: To investigate the relationship between early adolescent personal characteristics and the developmental trajectories of marijuana use extending from early adolescence to adulthood.

Design: This study used a longitudinal design. Data were obtained using structured questionnaires administered by trained interviewers.

Setting: Interviews were conducted in the participants’ homes in upstate New York.

Participants: Participants were drawn from a randomly selected cohort and were studied prospectively since 1975 (T1) at a mean age of 6 years. The follow-up data used for this study were collected at 6 time points when the participants were aged between 14 and 37 years in 1983 (T2), 1985-1986 (T3), 1992 (T4), 1997 (T5), 2002 (T6), and 2005-2006 (T7).

Main Outcome Measures: Developmental trajectories of marijuana use.

Results: Semiparametric group-based modeling and logistic regression analyses were used to analyze the data. The following 5 distinct trajectories of marijuana use were identified: nonusers or experimenters, occasional users, quitters or decreasers, increasing users, and chronic users. Chronic users compared with other groups studied (nonusers or experimenters, occasional users, quitters or decreasers, and increasing users) reported low self-control, externalizing behavior, and an orientation to sensation seeking.

Conclusions: Personal attributes of low self-control, externalizing behavior, and an orientation to sensation seeking have long-term predictive power for distinct trajectories of marijuana use over time. The importance of these findings for prevention and treatment programs is discussed.


In prior research,1-3 marijuana use was associated with several problem behaviors, such as rebelliousness, delinquency, risky sexual behavior, other substance abuse,1 poor school performance, low educational aspirations and expectations,3 and the postponement of marriage and employment.4 With some notable exceptions,5,6 most previous investigations of the psychosocial predictors of marijuana use have been cross-sectional or longitudinal studies that did not specifically examine different trajectories of marijuana use. To our knowledge, the present study is the first to examine personal predictors of the trajectories of marijuana use over an age span of 23 years from early adolescence to adulthood.

Because most prior research has not specifically examined the predictors of trajectories of marijuana use, we assessed 5 personal predictors derived from the literature on the correlates of marijuana use. The significance of intraindividual variables for substance use was emphasized by Tarter,7 who proposed that personal variables are proximally related to substance use and that they serve to mediate the effect of inherited behavioral propensities and social influences on substance use. The first personal predictor examined herein, self-control, includes the ability to regulate cognition, emotion, and behavior.8 Wills and Stoolmiller8 found that limited self-control is related to the rate of increase in substance use. The second personal predictor, externalizing behavior, is a component of neurobehavioral disinhibition,9 a disturbance of the prefrontal cortex reflected in affective, behavioral, and cognitive impairments. Tarter et al9 found that these impairments were predictive of the early onset of substance use disorders. The externalizing behavioral problems investigated herein include rebelliousness, less responsibility, tolerance of deviance, and delinquent and aggressive behaviors. The third predictor we included is a measure assessing the individual’s orientation to sensation seeking. Sensation seeking or novelty seeking is defined as an attraction toward the experience of novel situations and stimuli.10,11 Cloninger12 theorized that a high level of novelty seeking has a biological basis and is associated with increased exploratory pursuit of stimuli.
such as substance use. Higher levels of sensation seeking have been associated with membership in an early-onset substance use trajectory group compared with late-onset and nonuser groups. The fourth personal predictor we included is internalizing behavior, which is generally accepted as referring to overlapping symptoms of depression and anxiety. According to the self-medication theory of Khantzian, individuals use drugs to deal with internal distress. Higher levels of depressive symptoms have been found to prospectively predict membership in different trajectories of marijuana use through adolescence. The fifth personal predictor we included is a measure of educational expectations and aspirations, as Schulenberg et al found that high school grades and high expectations of college completion were associated with subsequent trajectories of little or no marijuana use. From a cognitive perspective, adolescents with high aspirations or expectations may be more likely to think of the consequences of substance use on their lives. From a sociological perspective, those with a low educational orientation may be more likely to associate with substance-using peers and to use drugs themselves.

In summary, the present longitudinal study uses a growth mixture model to identify rates and direction of change in marijuana use among different subgroups assessed at 6 time points from early adolescence to adulthood. Based on previous research, we hypothesized that there will be several trajectories of marijuana use, including a group of chronic users, a group of nonusers, and a group of quitters. For personal and behavioral predictors of trajectories of marijuana use, we hypothesized that most personal risk factors (eg, externalizing behavior, internalizing behavior, and orientation to sensation seeking) and lower scores on personal protective factors (eg, low self-control and low educational expectations and aspirations) are associated with (1) being chronic users of marijuana vs members of other trajectory groups and (2) being members of other trajectory groups vs nonusers or experimenters.

METHODS

Participants and Procedure

Participants were drawn from a randomly selected cohort studied prospectively since 1975 (T1) at a mean (SD) age of 6.2 (2.8) years. The original sample was representative of the population of children in the 1970s in upstate New York for sex, race/ethnicity, family intactness, family income, and educational status. Six follow-up waves of data were collected in the participants’ homes. The mean (SD) ages of the participants for the various waves were 14.1 (2.8) years in 1983 (T2), 16.3 (2.8) years in 1985-1986 (T3), 22.3 (2.8) years in 1992 (T4), 27.0 (2.8) years in 1997 (T5), 31.9 (2.8) years in 2002 (T6), and 36.6 (2.8) years in 2005-2006 (T7). The trajectory analyses for the present study were based on 806 subjects who participated in the study at 2 time points or more from T2 through T7. Eleven subjects who participated in the study at only 1 time point were excluded from the present analyses. There were no appreciable differences for sex and race/ethnicity between those who were included and those who were excluded from the study. The sample used in the present study was 94.6% white and 49.1% female. Written informed consent was obtained from mothers of the participants in 1975, from the participants and their mothers at T2 through T4, and from the participants only at T5 through T7. The Institutional Review Board of the New York University School of Medicine approved this study. A certificate of confidentiality was issued by the National Institutes of Health. Additional information regarding the study methods, including interview procedures, is available in a prior publication.

MEASURES

Marijuana Use

At each time wave (T2-T7), questions about marijuana use (adapted from the Monitoring the Future national survey) were included. To measure the lifetime quantity and frequency of marijuana use from childhood to the mid-30s, the questions at each time wave asked about the frequency of marijuana use during the period from the last time wave through the current time wave. Specifically, the questions asked about the frequency and quantity of marijuana use in childhood and early adolescence for T2 (before and at T2), during the past 2 years in adolescence for T3 (T2-T3), during the past 5 years in the early 20s for T4 (T3-T4), during the past 5 years in the late 20s for T5 (T4-T5), during the past 5 years in the late 20s and early 30s for T6 (T5-T6), and during the past 5 years in the mid-30s for T7 (T6-T7). The marijuana use measure at each time point had a scale coded as none (score, 0), a few times a year or less (score, 1), once a month (score, 2), several times a month (score, 3), once a week (score, 4), several times a week (score, 5), and daily (score, 6).

Early Adolescent Personal Attributes

For early adolescent (mean age, 14 years) personal attributes, we included a measure of self-control (7 items, α = .62 [eg, “I generally rely on careful reasoning in making up my mind,” and “I feel like losing my temper at people.”]), a measure of orientation to sensation seeking (5 items, α = .52 [eg, “I like ‘wild’ uninhibited parties.”]), and a measure of educational expectations and aspirations (2 items [eg, “How far do you hope you will go in school?”], α = .91). In addition, we included a measure of externalizing behavior (α = .81) that consisted of the following: (1) 8 items assessing tolerance of deviance (eg, “How wrong do you think it is to fake an excuse from home?”), (2) 8 items assessing rebellion (eg, “When rules and regulations get in the way, I sometimes ignore them.”), (3) 6 items assessing responsibility (eg, “If I get too much change in a store, I always give it back.”), (4) 3 items assessing aggression (eg, “I often make people angry by teasing them.”), and (5) 5 items assessing delinquency (eg, “How often have you gotten into a serious fight at school?”). We also included a measure of early adolescent internalizing behavior (α = .79) that consisted of the following: (1) 5 items assessing depression (eg, “Over the last few years, how much were you bothered by feeling low in energy or slowed down?”), (2) 4 items assessing anxiety (eg, “Over the last few years, how much were you bothered by feeling anxious?”), and (3) 6 items assessing interpersonal difficulties (eg, “Over the last few years, how much were you bothered by feeling easily annoyed or fearful?”). These measures have been found to predict drug use, delinquency, and psychopathological conditions.

Control Variables

Demographic characteristics assessed included sex, age, and socioeconomic status. The latter included items such as family income and highest level of parental education at T2.
STATISTICAL ANALYSIS

Using commercially available software (Mplus; Muthén & Muthén, Los Angeles, California),27 we conducted growth mixture model analyses to identify the developmental trajectories of marijuana use. We treated the dependent variable (marijuana use at each time point) as a censored normal variable. We applied the full-information maximum likelihood approach28 for the missing data in the analysis. We set each of the trajectory polynomials to be cubic. We used the minimum Bayesian information criterion (BIC) to determine the number of trajectory groups (G). We did not consider groups with less than 5% of the sample because some investigators29 have cautioned against overextrac-
tion of latent classes owing to the presence of nonnormal data. After extracting latent classes, we assigned each participant to the trajectory group with the largest Bayesian posterior probability. For each of the trajectory groups, we created an indicator variable that had a value of 1 if the participant had the largest Bayesian posterior probability for that group and a value of 0 otherwise. The observed trajectory for a group was the mean of marijuana use at each time point for participants assigned to the group (Figure and Table 1).

We computed the mean (SD) for each of the personal and behavioral factors by each of the trajectory groups. We then performed multivariate logistic regression analyses to separately examine the associations between each of the personal and behavioral factors and the participants’ trajectory group memberships. For example, in the 5 logistic regressions of G1 vs G5, we set the G5 group as the reference group. The dependent variable was an indicator variable of being G1 users. The independent variable was 1 of 5 T2 personal factors (ie, self-control, externalizing behavior, orientation to sensation seeking, internalizing behavior, and educational expectations and aspirations), and the control variables consisted of sex, age, family income, and parental educational level. To facilitate interpretation of the adjusted odd ratios, the independent variables were converted to standardized scores. Therefore, the odds ratios associated with these variables were computed for 1 SD of change.

RESULTS

TRAJECTORIES OF MARIJUANA USE

The mean (SD) of the marijuana use scores at each time point were 0.56 (1.19), 0.75 (1.35), 1.00 (1.37), 0.94 (1.43), 0.72 (1.37), and 0.60 (1.23) for T2 to T7, respectively. The percentage of marijuana users peaked at T4 (mean age, 22 years).

We calculated solutions for the 3-group trajectory (likelihood value, −4982; BIC, 10 098), the 4-group trajectory (likelihood value, −4937; BIC, 10 042), the 5-group trajectory (likelihood value, −4883; BIC, 9967), and the 6-group trajectory (likelihood value, −4843; BIC, 9921). Although the BIC for the 6-group trajectory was lower than that for the 5-group trajectory, we did not consider the 6-group solution because there was 1 trajectory group with less than 3% of the sample. Participants were then assigned to the marijuana trajectory group that best depicted their marijuana use over time. The mean classification probabilities for group membership ranged from .81 to .88, which indicate a satisfactory classification.

The Figure shows the 5 observed marijuana use trajectories. Table 1 gives the mean (SD) marijuana use (T2–T7) by the 5 trajectory groups.

RISK AND PROTECTIVE FACTORS AS PREDICTORS OF TRAJECTORY GROUP MEMBERSHIP

Table 2 gives the mean (SD) for each of the T2 risk and protective factors by the 5 marijuana use trajectory groups. Table 3 gives the results from the separate logistic regression analyses. Compared with the nonusers or experimenters, observations among the other trajectory groups were as follows: (1) low self-control and more externalizing behavior were significantly associated with an increased likelihood of being a member of each of the marijuana use trajectory groups (ie, chronic users, quitters or decreasers, increasing users, or occasional users), (2) greater orientation to sensation seeking and more internalizing behavior were significantly associated with an increased likelihood of being a chronic user or a quitter or decreaser, and (3) low educational expectations and aspirations were associated with an increased likelihood of being a chronic user. We also noted that all personal and behavioral factors significantly distinguished chronic users from nonusers or experimenters. In addition, low self-control, more externalizing behavior, and greater orientation to sensation seeking were significantly associated with an increased likelihood of being a chronic user as opposed to being a quitter or de-

Figure. Developmental trajectories of marijuana use from adolescence to age 37 years. Marijuana use score refers to the following: none (score, 0), a few times a year or less (score, 1), once a month (score, 2), several times a month (score, 3), once a week (score, 4), several times a week (score, 5), and daily (score, 6). Time wave refers to the following: age 14.1 years (T2), age 16.3 years (T3), age 22.3 years (T4), age 27.0 years (T5), age 31.9 years (T6), and age 36.6 years (T7).

The trajectory groups were chronic users (10.7%), quitters or decreasers (22.9%), increasing users (5.7%), occasional users (20.6%), and nonusers or experimenters (40.1%). As summarized in the Figure and in Table 1, chronic users started early, achieved the maximum level of use on a weekly basis in late adolescence, and then tapered off gradually to a lower level. Quitters or decreasers started early and then tapered off from late adolescence or emerging adulthood into adulthood. Increasing users started late, increased use from late adolescence or emerging adulthood to the early 30s (several times a week or daily), and then stayed at that level through the mid-30s. Occasional users started late and used marijuana less than on a monthly basis.
More externalizing behavior was significantly associated with an increased likelihood of being a chronic user as opposed to being an increasing user. Low self-control, more externalizing behavior, greater orientation to sensation seeking, and low educational expectations and aspirations were significantly associated with an increased likelihood of being a chronic user as opposed to being an occasional user. Bonferroni correction was applied to these comparisons. There were more significant results than expected by chance, and the results were consistent with the hypotheses. We did not hypothesize how the remaining groups would differ from one another. Nevertheless, we found that more externalizing behavior significantly differentiated a quitter or decreaser from an occasional user or an increasing user. Low educational expectations and aspirations were associated with an increased likelihood of being a quitter or decreaser as opposed to being an occasional user.

**Table 1. Marijuana Use From T2 to T7 by Trajectory Group**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chronic Users</th>
<th>Quitters or Decreasers</th>
<th>Increasing Users</th>
<th>Occasional Users</th>
<th>Nonusers or Experimenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>At T2</td>
<td>2.43 (2.04)</td>
<td>1.13 (1.17)</td>
<td>0.10 (0.37)</td>
<td>0</td>
<td>0.08 (0.30)</td>
</tr>
<tr>
<td>At T3</td>
<td>3.57 (1.42)</td>
<td>1.32 (1.14)</td>
<td>0.37 (0.58)</td>
<td>0.14 (0.38)</td>
<td>0</td>
</tr>
<tr>
<td>At T4</td>
<td>3.13 (1.76)</td>
<td>0.08 (0.83)</td>
<td>2.35 (1.69)</td>
<td>1.29 (1.25)</td>
<td>0.21 (0.43)</td>
</tr>
<tr>
<td>At T5</td>
<td>2.83 (1.69)</td>
<td>0.34 (0.56)</td>
<td>3.24 (1.83)</td>
<td>1.43 (1.34)</td>
<td>0.20 (0.46)</td>
</tr>
<tr>
<td>At T6</td>
<td>1.93 (1.73)</td>
<td>0.22 (0.44)</td>
<td>4.43 (1.50)</td>
<td>1.01 (0.99)</td>
<td>0</td>
</tr>
<tr>
<td>At T7</td>
<td>1.55 (1.66)</td>
<td>0.21 (0.47)</td>
<td>4.29 (1.19)</td>
<td>0.91 (0.81)</td>
<td>0</td>
</tr>
</tbody>
</table>

*a Marijuana use score refers to the following: none (score, 0), a few times a year or less (score, 1), once a month (score, 2), several times a month (score, 3), once a week (score, 4), several times a week (score, 5), and daily (score, 6).*

**Table 2. Personal Predictors at T2 by Trajectory Group**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chronic Users</th>
<th>Quitters or Decreasers</th>
<th>Increasing Users</th>
<th>Occasional Users</th>
<th>Nonusers or Experimenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>High self-control</td>
<td>−0.48 (1.03)</td>
<td>−0.21 (0.93)</td>
<td>−0.22 (1.19)</td>
<td>0.07 (1.00)</td>
<td>0.24 (0.93)</td>
</tr>
<tr>
<td>Externalizing behavior</td>
<td>1.09 (0.91)</td>
<td>0.51 (0.92)</td>
<td>−0.10 (0.93)</td>
<td>−0.29 (0.82)</td>
<td>−0.42 (0.80)</td>
</tr>
<tr>
<td>Orientation to sensation seeking</td>
<td>0.28 (0.63)</td>
<td>−0.04 (0.80)</td>
<td>0.19 (1.23)</td>
<td>0.14 (1.07)</td>
<td>−0.15 (1.08)</td>
</tr>
<tr>
<td>Internalizing behavior</td>
<td>0.03 (0.94)</td>
<td>0.16 (1.03)</td>
<td>0.13 (1.10)</td>
<td>−0.01 (1.01)</td>
<td>−0.11 (0.97)</td>
</tr>
<tr>
<td>High educational expectations and aspirations</td>
<td>−0.30 (1.01)</td>
<td>−0.12 (1.02)</td>
<td>0.07 (0.94)</td>
<td>0.18 (0.91)</td>
<td>0.04 (1.02)</td>
</tr>
</tbody>
</table>

*a Each personal predictor was standardized across the whole sample. Data are given as mean (SD).*

**Table 3. Logistic Regression Analysis of Risk and Protective Personal and Behavioral Factors Associated With Trajectory Groups Over Time**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>High Self-control</th>
<th>Externalizing Behavior</th>
<th>Orientation to Sensation Seeking</th>
<th>Internalizing Behavior</th>
<th>High Educational Expectations and Aspirations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic users vs nonusers or experimenters</td>
<td>0.35 (0.25-0.49)</td>
<td>6.13 (3.95-9.52)</td>
<td>2.18 (1.65-2.88)</td>
<td>1.41 (1.06-1.88)</td>
<td>0.72 (0.54-0.97)</td>
</tr>
<tr>
<td>Chronic users vs occasional users</td>
<td>0.52 (0.35-0.77)</td>
<td>3.52 (2.10-5.87)</td>
<td>1.62 (1.11-2.38)</td>
<td>1.05 (0.72-1.54)</td>
<td>0.51 (0.34-0.76)</td>
</tr>
<tr>
<td>Chronic users vs increasing users</td>
<td>0.83 (0.54-1.26)</td>
<td>2.82 (1.60-4.94)</td>
<td>1.61 (0.99-2.62)</td>
<td>0.87 (0.55-1.38)</td>
<td>0.72 (0.44-1.15)</td>
</tr>
<tr>
<td>Chronic users vs quitters or decreasers</td>
<td>0.67 (0.50-0.91)</td>
<td>1.93 (1.41-2.63)</td>
<td>1.78 (1.23-2.58)</td>
<td>0.90 (0.68-1.19)</td>
<td>0.87 (0.66-1.02)</td>
</tr>
<tr>
<td>Quitters or decreasers vs nonusers or experimenters</td>
<td>0.53 (0.42-0.67)</td>
<td>3.02 (2.28-4.00)</td>
<td>1.62 (1.31-2.01)</td>
<td>1.54 (1.24-1.91)</td>
<td>0.82 (0.66-1.16)</td>
</tr>
<tr>
<td>Quitters or decreasers vs occasional users</td>
<td>0.75 (0.56-1.02)</td>
<td>1.81 (1.27-2.58)</td>
<td>1.16 (0.86-1.58)</td>
<td>1.34 (0.99-1.79)</td>
<td>0.63 (0.46-0.87)</td>
</tr>
<tr>
<td>Quitters or decreasers vs increasing users</td>
<td>1.08 (0.73-1.60)</td>
<td>1.75 (1.10-2.80)</td>
<td>1.17 (0.79-1.74)</td>
<td>1.12 (0.76-1.63)</td>
<td>0.80 (0.52-1.24)</td>
</tr>
<tr>
<td>Increasing users vs nonusers or experimenters</td>
<td>0.54 (0.38-0.76)</td>
<td>1.68 (1.12-2.53)</td>
<td>1.22 (0.91-1.63)</td>
<td>1.35 (0.99-1.86)</td>
<td>1.04 (0.73-1.47)</td>
</tr>
<tr>
<td>Increasing users vs occasional users</td>
<td>0.78 (0.56-1.09)</td>
<td>1.08 (0.70-1.67)</td>
<td>1.13 (0.81-1.59)</td>
<td>1.20 (0.87-1.65)</td>
<td>0.88 (0.59-1.30)</td>
</tr>
<tr>
<td>Occasional users vs nonusers or experimenters</td>
<td>0.78 (0.63-0.96)</td>
<td>1.54 (1.19-2.02)</td>
<td>1.15 (0.95-1.39)</td>
<td>1.12 (0.92-1.37)</td>
<td>1.16 (0.93-1.45)</td>
</tr>
</tbody>
</table>

*a Data are given as adjusted odds ratio (95% confidence interval). Each independent variable was continuous and standardized. Odds ratios were adjusted for sex, age, family income, and parental educational level.*

b \( p < .001 \) (2-tailed).

c \( p < .05 \)

d \( p < .01 \)

This longitudinal study contributes to the research literature on the development of marijuana use. First, using
latent growth mixture modeling, we identified 5 different trajectories of marijuana use across a wide age range of 14 to 37 years. Second, we examined a broad spectrum of personal attributes associated with each of the trajectories of marijuana use, which were assessed at 6 time points. These personal attributes include major dimensions of self-control, response to societal demands (ie, externalizing behavior), susceptibility to environmental arousal and stimuli (ie, orientation to sensation seeking), and internal distress (ie, anxiety and depression). Third, we controlled for the important background factors (ie, sex, age, family income, and parental educational level) related to the personal attributes or the trajectories of marijuana use. To our knowledge, this is the first longitudinal study to include personal predictors of the trajectories of marijuana use spanning so many important developmental periods.

Using latent growth mixture modeling, 5 trajectory groups were identified over a period extending from age 14 to 37 years, namely, chronic users, quitters or decreasers, increasing users, occasional users, and nonusers or experimenters. The identified trajectories adequately accounted for individual variations in chronic marijuana use. Results of the trajectory group approach used in this study suggest that there was considerable change in an individual’s marijuana use between early adolescence and the 30s. Therefore, our focus on changes in marijuana use over time revealed information that studying absolute levels of marijuana use could not reveal.

Our trajectories cover a longer period than has been used in prior studies assessing marijuana use trajectories. Nevertheless, the trajectories of marijuana use in the present study corresponded broadly, with slight differences in some cases, to the trajectories found by our group in prior work (conducted among a different sample), as well as those observed by other investigators. However, Schulenberg et al identified a “fling” group of individuals demonstrating intermittent heavy use of marijuana (5.7% of their sample).

For the personal risk factors, externalizing behavior (ie, delinquency, more rebelliousness, tolerance of deviance, and aggressive behaviors) reflects difficulty in meeting environmental demands. Greater antisocial behavior (as reflected in externalizing behavior) distinguished the chronic users from all other trajectory groups (ie, quitters or decreasers, increasing users, occasional users, and nonusers or experimenters). Because chronic users display higher levels of marijuana use at an early age, this result is in accord with findings by Tarter et al, who maintain that neurobehavioral disinhibition predicts early onset of substance use disorders. It may be that externalizing personality attributes reflect unconventional values and behaviors, as well as an acceptance of norm-violating activities consistent with marijuana use, and that they serve to weaken internal personal controls against using marijuana (eg, as suggested by Newcomb and McGee). As noted earlier, sensation seeking represents a propensity toward novel experiences, which is consistent with marijuana use experimentation. A propensity toward novel experiences (ie, an orientation to sensation seeking) distinguished chronic users from other trajectory groups except for increasing users. These results are consistent with findings by Flory et al in their study of adolescents and young adults. They reported that sensation seeking predicted heavy marijuana use. In general, our findings provide some support for the theory by Cloninger that neurobiologic differences may account for variations in substance use habits among different groups of subjects. Chronic users were also more likely to have lower educational expectations and aspirations. From a cognitive perspective, low educational expectations and aspirations may have prevented chronic users from thinking about the consequences of substance use on their lives. From a sociological perspective, low educational expectations and aspirations may have provided chronic users with more opportunity to associate with substance-using peers who encouraged their marijuana use. Furthermore, low scores on our measure of self-control indicated less impulse control, resulting in actions such as losing one’s temper and becoming distracted. Such lack of self-control increased the likelihood of being a chronic user compared with a quitter or decreaser, an occasional user, or a nonuser or experimenter. In a related vein, Wills and Stoolmiller found that poor self-control was related to a high initial level of use and an increased growth rate of substance use growth in early adolescence. They further suggest that poor self-control may influence substance use via failure to meet expectations, failure to consider the consequences of substance use, and failure to form positive social relationships and that these factors, in turn, increase the likelihood of persistent substance use.

Compared with chronic users, quitters or decreasers, increasing users, or occasional users, the nonusers or experimenters manifested less externalizing behavior and the highest levels of the personal protective factors, such as greater self-control. These findings are in accord with several investigators who reported that nonusers of marijuana tend to be less likely to engage in externalizing behavior. Our findings add to the literature by demonstrating that the results of previous investigations (eg, studies by Brook et al and by Bryant and Zimmerman) can be applied to a description of the long-term trajectories of marijuana use.

Our measure of internalizing behavior, which included symptoms of depression and anxiety and interpersonal difficulty, differentiated chronic users and quitters from nonusers. However, it did not distinguish among the different trajectories of marijuana users (ie, chronic users, quitters or decreasers, increasing users, and occasional users) (also discussed by Windle and Wiesner). In general, the literature indicates that compared with externalizing characteristics, the link between emotional difficulties (internalizing behavior) and marijuana use is less strong.

Findings of the present research have several limitations. First, we did not control for possible familial or peer variables that may be associated with the development of risk and protective personality factors for substance use. Second, only adolescent personal risk factors studied at a single time point were included in this research to discriminate the different trajectories of marijuana use. Third, it is possible that the predictor variables that we examined are not stable over time, which then may alter the trajectories of marijuana use. Future research should focus on risk and protective factors that vary over time so that the developmental interactions between risk and protective factors and marijuana use may be better understood.
To our knowledge, this is the first research study to identify personal predictors of multiple trajectories of marijuana use extending from early adolescence to the mid-30s. In previous research, family factors predicted marijuana use\(^{20}\), however, personal variables have emerged as mediating factors. Together with the present study evidence, it shows that the personal dimensions included in these analyses predicted chronic marijuana use 14 years later. Early intervention aimed at reducing the level of these personal risk factors may have a positive effect on decreasing the likelihood of chronic use of marijuana over time. Moffitt and Caspi\(^{34}\) found that pediatrics were able to identify risk factors for childhood delinquency. Pediatricians should also take particular note when their young patients demonstrate personal risk factors for chronic marijuana use (ie, low self-control, externalizing behavior, orientation to sensation seeking, low educational aspirations or expectations, and internalizing behavior). The significant risk and protective factors identified in this study warrant further research for their potential integration into marijuana prevention and treatment programs.

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