

# Patterns of Drug Use from Adolescence to Young Adulthood: III. Predictors of Progression

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**Abstract:** Possible linkages of influence among classes of drugs in the observed sequential progression from adolescence to young adulthood are investigated through event history analyses. Three stages are examined: initiation to marijuana, to the use of other illicit drugs, and to prescribed psychoactive drugs. The data are based on a follow-up cohort of former adolescents representative of high school students in grade 10 and 11 in New York State who were reinterviewed nine years later at ages 24–25. The sequential order between alcohol and/or cigarettes and marijuana reflects not only the effect of the use of legal drugs on marijuana initiation, but also age effects on onset of these drugs, controlling for individual characteristics measured in adolescence; marijuana use by one's

friends in adolescence is an additional important predictor of marijuana initiation. Prior use of marijuana is necessary for progression to other illicit drugs. Multiple factors are involved in the progression to prescribed drugs, with adolescent depressive symptomatology and use of other illicit drugs important for both sexes, and maternal use of psychoactive drugs, dropping out of school, and prior use of marijuana of additional importance for women. Although licit drugs influence initiation into marijuana independently of age effects, it is especially for the progression from marijuana to other illicit drugs that the earlier drug is associated with the progression to a higher stage drug. (*Am J Public Health* 1984; 74:673–681.)

## Introduction

Clear temporal developmental stages in the use of licit, illicit, and medically prescribed psychoactive drugs from adolescence through young adulthood have been identified, as reported in the second article in this series in this issue of the *Journal*.<sup>1</sup> For men, the pattern of progression is one in which alcohol precedes marijuana; alcohol and marijuana precede other illicit drugs; and alcohol, cigarettes, and marijuana precede the use of prescribed psychoactive drugs. For women, either alcohol or cigarettes precedes marijuana; alcohol, cigarettes, and marijuana precede other illicit drugs; alcohol and either cigarettes or marijuana precede prescribed psychoactive drugs. However, the sequential progression may reflect the relationships between the use of certain drugs and age and/or individual attributes rather than the specific effect of the use of one class of drug on the use of another.

In this paper, we address the question of whether the use of certain drugs lower in the sequence influences the initiation of higher drugs through event history analysis. If the statistical effect of the use of an antecedent drug on initiation of a subsequent drug persists when other antecedent variables which could potentially explain initiation of the later drug are controlled, the earlier drug can be assumed to constitute a risk factor for progression. The independent variables being introduced as controls include—in addition to drug behaviors and age—selected antecedent individual behaviors, attitudes, and interpersonal factors found in our own earlier work carried out while respondents were adolescents,<sup>2–4</sup> and in other studies,<sup>5–14</sup> to be the most important correlates of drug use at one point in time and the most important predictors of initiation into different drugs over a short time interval.

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## Methods

### Samples and Field Procedures

The analyses are based on a follow-up in 1980–1981 of two cohorts ( $n = 1,325$ ), representative of adolescents enrolled nine years earlier in grades 10 and 11 in public secondary schools in New York State. The average age at time of the reinterview was 24.7 years. The sampling design and interview schedule are described in an earlier paper in this issue of the *Journal*.<sup>15</sup> An unusual component of the interview schedule consisted of two charts designed to reconstruct on a monthly basis the respondents' drug and life histories. Detailed information was collected on the histories of use of each of 12 drugs ever used 10 times or more. The initial high school survey provided data about members of the cohort when they were adolescents through structured questionnaires administered in classrooms.<sup>2–16</sup>

### Event History Analyses

Analyses were carried out based on methods recently developed for event history analyses.<sup>17–19</sup> Since these methods take into account the specific timing of occurrence of the events of interest, they guarantee the temporal order between the independent variables and the dependent event; they also allow for antecedent predictive factors to be controlled. The initiation of marijuana, other illicit drugs, and medically prescribed psychoactive drugs were the dependent events. Alcohol and cigarette initiations were not predicted because they represent the earliest stage of involvement and we were interested specifically in identifying the role of prior drugs on the use of subsequent drugs.

The exponential hazards model with time-variant independent variables was used to estimate the determinants of hazard rates, which express the instantaneous rate of initiating a drug, given use of a prior drug and other factors (see Appendix, Section A). Use of any drug less than 10 times in a lifetime was considered as non-use. Four distinct groups of independent variables were introduced: 1) use of drugs at a lower stage during the preceding month, or lifetime for those who did not use in the preceding month; 2) age at time of initiation of the class of drug under examination; 3) age of onset dummy variables for selected other drugs; and 4) pre-existing characteristics measured in adolescence that may

explain subsequent involvement in particular drugs, independent of prior experience with other substances (see Appendix, Section B). The variables retained in the analyses are listed in Table 1. The first, second, and third sets of variables are time-varying variables measured each month in predicting initiation during the subsequent month. The fourth set includes time-constant variables measured at the time of the initial survey, with the exception of a time-varying variable for dropping out of high school that occurred subsequently.

To avoid confounding antecedents and consequences of drug involvement, the analyses were restricted to persons who initiated each class of drugs after September 1971, when

the time-constant variables were measured, i.e., 76 per cent of the total cohort for initiation of marijuana, 95 per cent for other illicit drugs, and 99 per cent for prescribed psychoactive drugs. Thus, determinants of initiation identified in the analyses do not necessarily apply to the youths excluded from the analyses who initiated use prior to ages 15–16, especially in the case of marijuana.

Two categorizations of current and former use of lower stage drugs were introduced: 1) unique drug use variables and selected interaction terms between them; and 2) cumulative drug use stage variables that describe only the highest stage of drugs used currently or in the past (see Appendix, Section C).

TABLE 1—Predictors of Initiation of Marijuana Use

|  | Men (N = 449)        |                      |                      | Women (N = 558)      |                      |                      |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|  | Model 1              | Model 2              | Model 3              | Model 1              | Model 2              | Model 3              |
| I. Effects of Drugs (vs never used before):    |                      |                      |                      |                      |                      |                      |
| (a) current alcohol use                        | 1.501***<br>(0.379)  | 1.463***<br>(0.380)  | 1.353**<br>(0.520)   | 0.933***<br>(0.260)  | 0.853**<br>(0.262)   | -0.075<br>(0.460)    |
| (b) former alcohol use                         | 1.450**<br>(0.463)   | 1.502**<br>(0.466)   | 1.314*<br>(0.578)    | 0.049<br>(0.492)     | 0.055<br>(0.493)     | -0.995<br>(0.629)    |
| (c) current cigarette use                      | 1.952***<br>(0.480)  | 1.907***<br>(0.481)  | 1.953***<br>(0.480)  | 1.331***<br>(0.349)  | 1.202***<br>(0.352)  | 1.331***<br>(0.349)  |
| (d) former cigarette use                       | 0.174<br>(0.238)     | 0.126<br>(0.260)     | 0.164<br>(0.238)     | -0.280<br>(0.307)    | -0.321<br>(0.310)    | -0.338<br>(0.308)    |
| (e) Interaction: a × c                         | -1.701***<br>(0.502) | -1.747***<br>(0.505) | -1.711***<br>(0.503) | -0.844**<br>(0.384)  | -0.769*<br>(0.385)   | -0.894*<br>(0.384)   |
| (f) Interaction: b × c                         | -2.540*<br>(1.057)   | -2.650*<br>(1.060)   | -2.536*<br>(1.057)   | 0.344<br>(0.631)     | 0.432<br>(0.632)     | 0.273<br>(0.636)     |
| II. Age Effects (vs under 16)                  |                      |                      |                      |                      |                      |                      |
| 16–17  | -0.239<br>(0.233)    | -0.233<br>(0.233)    | -0.232<br>(0.235)    | -0.041<br>(0.275)    | -0.003<br>(0.276)    | -0.020<br>(0.287)    |
| 18–19  | -0.281<br>(0.238)    | -0.245<br>(0.239)    | -0.256<br>(0.244)    | 0.018<br>(0.277)     | 0.157<br>(0.278)     | 0.139<br>(0.277)     |
| 20–21  | -1.471***<br>(0.302) | -1.412***<br>(0.304) | -1.439***<br>(0.308) | -0.942**<br>(0.316)  | -0.759*<br>(0.318)   | -0.775*<br>(0.320)   |
| 22 and over                                    | -2.606***<br>(0.387) | -2.554***<br>(0.388) | -2.571***<br>(0.392) | -1.971***<br>(0.376) | -1.772***<br>(0.379) | -1.777**<br>(0.380)  |
| III. Age of Alcohol Onset (vs age 18 and over) |                      |                      |                      |                      |                      |                      |
| Under 14                                       | —                    | —                    | 0.141<br>(0.370)     | —                    | —                    | 0.938*<br>(0.408)    |
| 14–15  | —                    | —                    | 0.224<br>(0.383)     | —                    | —                    | 1.194**<br>(0.411)   |
| 16–17  | —                    | —                    | 0.091<br>(0.384)     | —                    | —                    | 1.095**<br>(0.410)   |
| IV. Adolescent Characteristics                 |                      |                      |                      |                      |                      |                      |
| Delinquency                                    | —                    | 0.403*<br>(0.185)    | —                    | —                    | 0.279<br>(0.168)     | —                    |
| Friends' marijuana use                         | —                    | 0.420*<br>(0.195)    | —                    | —                    | 0.459*<br>(0.180)    | —                    |
| Regular marijuana use harmful                  | —                    | -0.399**<br>(0.159)  | —                    | —                    | -0.221<br>(0.159)    | —                    |
| Closeness to parents                           | —                    | 0.172<br>(0.243)     | —                    | —                    | -0.122<br>(0.200)    | —                    |
| Depressive symptoms                            | —                    | -0.097<br>(0.199)    | —                    | —                    | -0.232<br>(0.159)    | —                    |
| Mother's psychoactive drug use                 | —                    | -0.154<br>(0.174)    | —                    | —                    | 0.243<br>(0.156)     | —                    |
| Being a former absentee                        | —                    | -0.030<br>(0.160)    | —                    | —                    | 0.003<br>(0.187)     | —                    |
| Dropping out of high school                    | —                    | 0.290<br>(0.218)     | —                    | —                    | -0.713*<br>(0.282)   | —                    |
| V. Constant                                    |                      |                      |                      |                      |                      |                      |
|  | -5.677***<br>(0.402) | -5.880***<br>(0.493) | -5.687***<br>(0.404) | -5.809***<br>(0.317) | -5.833***<br>(0.394) | -5.868***<br>(0.320) |
| VI. $\chi^2$                                   |                      |                      |                      |                      |                      |                      |
| df   | 151.72<br>10         | 173.90<br>18         | 152.35<br>13         | 138.23<br>10         | 172.38<br>18         | 149.95<br>13         |

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

Age of onset dummy variables were introduced to assess the interaction effects between the use (current or former) of a drug and its age of onset on initiation of another drug (see Appendix, Section C). The time-varying age of onset dummy variables take the value 1 only after initiation of the drug.

#### Sequential Patterns of Progression

For each drug initiation, three models were tested. Model 1 included age dummy variables and drug-use variables at prior stage(s), which could represent a higher stage of involvement than the current stage at the time of the transition. Model 2 added constant control variables measured in adolescence and a time-varying variable for dropping out of high school. Model 3 included age of onset of drug at a lower stage, but excluded the control variables in Model 2, due to the size limitation of the computer memory.\* For the same reason, the control variables in Model 2 were selected from a larger pool and included only those that had the greatest relative significance in event historical regressions carried out without prior drug-use variables (see Appendix, Section B).

### Results

#### Initiation of Marijuana Use

Models of initiation of marijuana use are presented in Table 1. Current use of alcohol and cigarettes have strong effects on the initiation of marijuana use among men and women (Model 1). The main effects (current use of one drug and non-use of the other) of alcohol and cigarettes and their joint effect are stronger among men than women, although the additional use of cigarettes when already using alcohol has a stronger effect among women than men.\*\* Former use of alcohol also has a significant effect among men.

Strong age effects exist among men and women. Individuals 20 years old and over, especially those aged 22 and over, are much less likely to initiate marijuana than those under age 20.<sup>15</sup>

Controlling for selected antecedent behavioral, attitudinal, and environmental factors measured in adolescence, the effects of alcohol and cigarettes remain almost unchanged (Table 1, Model 2). Friends' use of marijuana has the strongest positive influence on initiation of marijuana. Among men, involvement in delinquent activities and the

\*Event history analysis with time-varying independent variables requires storage of data either by variable and person-period or by variable and covariate pattern, where a covariate pattern implies a distinct combination of the values of independent variables. Due to the large number of person-month records in the file (142,000), the first method was not feasible. While the use of dummy variables reduces the number of covariate patterns, the latter increase geometrically with the number of variables. Although all possible cases may not appear in the data, as many as 10,000 covariate patterns can be obtained easily with single dummy variables for 14 factors. With 20 independent variables, and 10,000 covariate patterns, the size necessary for the program will exceed 1,024 K, the current maximum size of the typical computer core memory.

\*\*Whenever two drugs have an effect, a negative interaction between them is also present that reduces their joint effect to a lower value than the sum of the two independent effects. For example, when both alcohol and cigarettes are used concurrently, men are 5.7 times ( $=\exp(1.501 + 1.952 - 1.701)$ ) rather than 31.6 times ( $=\exp(1.501 + 1.952)$ ) more likely and women are 4.1 times ( $=\exp(0.933 + 1.331 - 0.844)$ ) rather than 9.6 times ( $\exp(0.933 + 1.331)$ ) more likely to initiate marijuana use than persons who never used either, controlling for age. Similarly, the effect of the additional use of cigarettes when using alcohol is 1.3 times ( $=\exp(1.952 - 1.701)$ ) rather than 7.0 times ( $\exp(1.952)$ ) higher on the rate of marijuana initiation among men, and 1.6 times ( $=\exp(1.331 - 0.844)$ ) rather than 3.8 times ( $=\exp(1.331)$ ) higher among women.

belief that marijuana use is not harmful are also significant predictors.\*\*\*

The age of onset of drugs at a lower stage lengthens the period during which individuals are at higher risk for initiating a drug at a higher stage. The inclusion of dummy age of onset variables for alcohol and cigarettes in the model, in addition to the current or former use of these drugs, tests whether the rate of initiation per unit time varies consistently according to age of onset, i.e., interaction between use (current or former) and age of onset. Model 3 introduces variables for age of onset to alcohol, after having excluded a similar set for cigarettes due to their insignificance. Interactions between age of onset and use of alcohol are present only among women: the effects of alcohol on marijuana initiation disappear when alcohol is initiated after age 18.

Whether this sex difference in interactions leads to major differences in the overall effect of age of alcohol onset, including its main effect through lengthening the period of use, needs to be determined. The proportions of individuals expected to initiate marijuana use by certain ages were calculated for synthetic cohorts representing different ages of exclusive alcohol as well as joint alcohol and cigarettes initiations, under the assumption that no one had initiated marijuana use by age 15, and that use of the licit drugs was continuous (i.e., used at least once a month) after onset (see Appendix, Section D). The age of onset of alcohol strongly influences the probabilities of initiating marijuana use, more strongly for men than women. Assuming continuous use since onset, by age 25 an additional 39 per cent will have initiated marijuana among men who started drinking alcohol at age 15 as compared to those who started at age 21; among women, the excess proportion is 30 per cent. The additional use of cigarettes also has strong effects on marijuana initiation, particularly when the legal drugs are initiated at age 17 or below. Depending on their ages at onset, the joint uses of alcohol and cigarettes will generate a maximum difference of about 52 percentage points for men and 46 percentage points for women in the probability of initiating marijuana use through the age period 15 to 25 between those who start using legal drugs at age 15, and those who have never used them by age 25. There is, however, some probability of initiating marijuana use without prior use of the two legal drugs, ranging from .7 to .20 depending upon the assumed age of marijuana initiation. This pattern of progression characterizes only 4 per cent of the sample, however.

Thus, the temporal order between alcohol or cigarettes and marijuana reflects not only the influence of the legal drugs on marijuana initiation but differences in the structure of age effects, with earlier initiation of alcohol than of cigarette and marijuana use. The relative ambiguity in the temporal ordering of initiations between cigarettes and marijuana compared with alcohol and marijuana does not reflect the weaker influence of cigarette use on marijuana initiation but age effects that do not contribute to the ordering of these two drugs to the same extent as to the ordering between alcohol and marijuana.

#### Initiation of Illicit Drugs other than Marijuana

Although the sequences between alcohol and cigarettes, and between cigarettes and marijuana, are somewhat inde-

\*\*\*Although a negative effect of dropping out of high school is found among women, this unexpected effect seems to be the result of the strong association between dropping out of high school and cigarette use during the period of high risk for initiation of marijuana use. The effect of dropping out of high school becomes insignificant when the drug use variables are removed from the model (data not presented).

terminate in predicting initiation of illicit drugs other than marijuana,<sup>15</sup> an ordering among drugs is assumed that reflects the dominant sequential pattern, i.e., alcohol, cigarettes, and marijuana.

The propensity to initiate other illicit drugs increases strongly among men and women who are currently using marijuana or prescribed psychoactive drugs (Table 2, Model 1). The lack of a statistically significant difference between the coefficients for the use of marijuana and prescribed

psychoactives indicates that the additional use of the latter has no effect beyond that attributable to marijuana, an earlier stage in the sequence. Use of marijuana in the past, even when the individual is currently in a lower stage (cigarette, alcohol, or no drug), increases the propensity of initiating other illicit drugs.

As with marijuana, there is a steady decline with age in the initiation of other illicit drugs.<sup>15</sup>

Selected control variables do not reduce significantly

**TABLE 2—Predictors of Initiation of Other Illicit Drug Use**

|   | Men (N = 586)        |                      |                      | Women (N = 673)      |                      |                      |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|   | Model 1              | Model 2              | Model 3              | Model 1              | Model 2              | Model 3              |
| <b>I. Effects of Drugs</b>                              |                      |                      |                      |                      |                      |                      |
| Current stage <sup>a</sup>                              |                      |                      |                      |                      |                      |                      |
| Alcohol   | -0.445<br>(0.760)    | -0.530<br>(0.762)    | -0.436<br>(0.760)    | 0.626<br>(0.795)     | 0.648<br>(0.795)     | 0.599<br>(0.794)     |
| Cigarettes  | 0.039<br>(0.739)     | -0.105<br>(0.740)    | -0.001<br>(0.737)    | 1.394<br>(0.749)     | 1.272<br>(0.751)     | 1.354<br>(0.748)     |
| Marijuana   | 3.326***<br>(0.682)  | 3.091***<br>(0.687)  | 2.228**<br>(0.887)   | 3.207***<br>(0.700)  | 3.053**<br>(0.707)   | 2.856***<br>(0.824)  |
| Prescribed psychoactives                                | 3.586***<br>(0.773)  | 3.385***<br>(0.782)  | 2.756**<br>(0.986)   | 3.901***<br>(0.754)  | 3.772***<br>(0.765)  | 3.588***<br>(0.803)  |
| Former stage higher than present stage <sup>b</sup>     |                      |                      |                      |                      |                      |                      |
| Marijuana   | 2.546***<br>(0.539)  | 2.342***<br>(0.592)  | 1.409<br>(0.784)     | 1.122*<br>(0.468)    | 0.955*<br>(0.476)    | 0.707<br>(0.647)     |
| Prescribed psychoactive drugs                           | 1.108<br>(0.572)     | 0.788<br>(0.580)     | 1.220*<br>(0.576)    | 0.221<br>(0.549)     | 0.197<br>(0.565)     | 0.188<br>(0.552)     |
| <b>II. Age Effects (vs under age 16)</b>                |                      |                      |                      |                      |                      |                      |
| 16-17   | 0.002<br>(0.491)     | 0.044<br>(0.401)     | 0.126<br>(0.404)     | -0.971*<br>(0.406)   | -0.956*<br>(0.408)   | -0.866*<br>(0.415)   |
| 18-19   | -0.544<br>(0.408)    | -0.433<br>(0.410)    | -0.241<br>(0.416)    | -1.381***<br>(0.407) | -1.343**<br>(0.412)  | -1.191**<br>(0.427)  |
| 20-21   | -0.853*<br>(0.420)   | -0.711<br>(0.422)    | -0.442<br>(0.430)    | -1.271**<br>(0.399)  | -1.217**<br>(0.406)  | -1.029*<br>(0.427)   |
| 22-23   | -0.828*<br>(0.424)   | -0.665<br>(0.429)    | -0.372<br>(0.437)    | -1.412***<br>(0.413) | -1.361**<br>(0.420)  | -1.138*<br>(0.444)   |
| 24 and over   | -1.582**<br>(0.594)  | -1.402*<br>(0.598)   | -1.079<br>(0.604)    | -1.606**<br>(0.560)  | -1.607**<br>(0.568)  | -1.310*<br>(0.586)   |
| <b>III. Age of Marijuana Onset (vs age 20 and over)</b> |                      |                      |                      |                      |                      |                      |
| Under 14  | —                    | —                    | 1.588*<br>(0.615)    | —                    | —                    | 0.857<br>(0.509)     |
| 14-15   | —                    | —                    | 1.346*<br>(0.600)    | —                    | —                    | 0.227<br>(0.496)     |
| 16-17   | —                    | —                    | 0.811<br>(0.606)     | —                    | —                    | 0.351<br>(0.492)     |
| 18-19   | —                    | —                    | 0.542<br>(0.628)     | —                    | —                    | 0.072<br>(0.519)     |
| <b>IV. Adolescent Characteristics</b>                   |                      |                      |                      |                      |                      |                      |
| Delinquency   | —                    | 0.416<br>(0.286)     | —                    | —                    | 0.201<br>(0.295)     | —                    |
| Friends' marijuana use                                  | —                    | 0.545*<br>(0.258)    | —                    | —                    | 0.440<br>(0.316)     | —                    |
| Regular marijuana use harmful                           | —                    | -0.073<br>(0.220)    | —                    | —                    | -0.177<br>(0.268)    | —                    |
| Closeness to parents                                    | —                    | -0.034<br>(0.264)    | —                    | —                    | 0.287<br>(0.322)     | —                    |
| Depressive symptoms                                     | —                    | -0.054<br>(0.295)    | —                    | —                    | -0.020<br>(0.264)    | —                    |
| Mother's psychoactive drug use                          | —                    | 0.392<br>(0.207)     | —                    | —                    | 0.033<br>(0.259)     | —                    |
| Being a former absentee                                 | —                    | -0.231<br>(0.217)    | —                    | —                    | 0.315<br>(0.280)     | —                    |
| Dropping out of high school                             | —                    | 0.162<br>(0.247)     | —                    | —                    | 0.370<br>(0.306)     | —                    |
| <b>V. Constant</b>                                      |                      |                      |                      |                      |                      |                      |
|   | -7.898***<br>(0.748) | -8.280***<br>(0.835) | -8.153***<br>(0.760) | -7.695***<br>(0.727) | -8.156***<br>(0.832) | -7.835***<br>(0.737) |
| $\chi^2$  | 201.68               | 218.97               | 220.06               | 113.85               | 121.56               | 118.61               |
| df  | 11                   | 19                   | 15                   | 11                   | 19                   | 15                   |

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

<sup>a</sup>Contrasted to no use of any drug.

<sup>b</sup>Contrasted to lower current stage, including no current use.

the effect of marijuana use on the initiation of other illicit drugs (Table 2, Model 2). Although both adolescent delinquency among men, and friends' marijuana use among men and women, have strong effects on the initiation of other illicit drug use without the simultaneous inclusion of drug use variables ( $p < .001$ —data not presented), only the effect of friends' marijuana use remains marginally significant among men when the drug use variables are included in the model. The elimination or weakening of the effects of adolescent characteristics indicates the dominance of marijuana use in explaining the subsequent initiation of other illicit drugs. Whether characteristics measured at the time of initiation rather than in adolescence are important cannot be assessed with the data available.

The effects of adolescent characteristics may be weakened also by the time-lag between their measurement at ages 15–16 and the subsequent initiation to other illicit drugs. To investigate the predictive effects of these variables as a function of time-lag in measurement, an elaboration of the analysis was carried out for delinquency and friends' marijuana use by introducing interaction terms between these variables and age of initiation to other illicit drugs. Except for delinquency among men, the interactions are strong with the effects significant only under age 18 (data not presented). Two alternate interpretations are possible: 1) delinquency and friends' marijuana use influence the initiation of other illicit drugs only in adolescence, rather than in young adulthood; or 2) the effects of delinquency and friends' marijuana use are relatively short-lived and are observable only for a limited period (i.e., two years) after their measurement. The second interpretation is indirectly supported with respect to friends' influence by the finding that current friends' marijuana use is related to the individual's use of other illicit drugs in young adulthood at the time of the follow-up survey ( $r = .34$ ).<sup>5</sup> The weakened effect of friends' use of marijuana at age 18 and over may result from changes in social networks over time as well as from a weakening of the effect of friends' influence itself.

Among men, there is a strong interaction between age of onset of marijuana use and current or former use of marijuana on the rate of initiation to other illicit drugs (Table 2, Model 3). A similar trend not reaching significance is found among women. Men who initiate marijuana early, especially under age 16, are even more likely to initiate other illicit drugs than is expected from the longer period of risk resulting from an early age of onset.

The expected proportions of persons who will initiate other illicit drugs as a function of age of onset of marijuana use was calculated for synthetic cohorts assumed to have never used other illicit drugs by age 15, assuming continuous use of marijuana following onset, according to the method described in the Appendix, Section D.†

The age of onset of marijuana use strongly influences the proportions initiating the use of other illicit drugs, with the differences especially striking for men who start marijuana use below age 16 (27 per cent in the sample) and for women who start below age 14 (7 per cent). Marijuana use will generate a maximum difference of 68 per cent for men and 53 per cent for women in the probability of initiating other illicit drugs through the age period 15 to 25 between those who initiate marijuana use prior to age 14 and those who never start using marijuana. The probabilities of initiating other illicit drugs are very much reduced if marijuana is

initiated at age 20 or over, the case for 6 per cent of the total sample. Most importantly, persons who have not used marijuana have very small probabilities of initiating other illicit drugs, ranging from .01 to .03 (men) or .02 (women) depending on the time span between age 15 and initiation of these drugs. In this cohort, marijuana appears to be a necessary condition for the initiation of other illicit drugs. This pattern contrasts with the non-negligible probability of marijuana initiation in the absence of prior use of legal drugs, controlling for the age of onset of the legal drugs, as described above. While the temporal order between alcohol and marijuana results in part from differences in age effects on the initiation of these two drugs, the temporal order between initiation of marijuana and other illicit drugs reflects the necessary use of marijuana prior to the use of other illicit drugs.

Current cigarette use has also a marginally significant effect ( $p = .07$ ) on the initiation of other illicit drug use among women, in the absence of prior marijuana use. To assess the magnitude of this effect, a synthetic cohort analysis was carried out for age of onset to cigarettes and initiation of other illicit drug use.† Women who initiate cigarettes at age 15 and use continuously thereafter, but do not use marijuana, will have a 7 per cent probability of initiating other illicit drugs by age 25, as compared to 2 per cent of women who neither smoke cigarettes nor use marijuana.

#### Initiation of Prescribed Psychoactive Drugs

The overall explanatory power of Model 1 is low, especially for women ( $\chi^2 = 18.90$  with 10 df,  $p = .05$ ) (Table 3).

The use (current or former) of other illicit drugs promotes the initiation of prescribed psychoactive drugs, an effect that is not eliminated by the introduction of control variables (Model 2). Among men, there is also a weak association between high depressive symptomatology in adolescence and a higher probability of initiating prescribed psychoactive drugs. Among women, mother's psychoactive use and depressive affect in adolescence and dropping out of high school have positive effects on initiating prescribed psychoactive substances. The main effects of these control variables and the current use of other illicit drugs remain statistically significant, and the main effect of current marijuana use becomes significant, when interactions between these control variables and the (current or former) use of marijuana and/or other illicit drugs are introduced in the model (data not presented). The only significant interaction is with dropping out of high school, and it is negative, implying that the main effect of that variable is underestimated. These results indicate that a large number of factors, illicit drugs as well as other characteristics, increase the risk for initiation into prescribed drugs among women as compared to men. The independent effects of the three control variables explain why the use of prescribed psychoactive drugs by women may occur in the absence of the use of illicit drugs and, in particular, why a sequential order between marijuana and prescribed psychoactives is not as well established among women as among men, as discussed earlier.<sup>1</sup>

In contrast to the initiation of marijuana or of other illicit drugs, the propensity for initiating prescribed psychoactive drugs tends to increase with age, as noted earlier.<sup>15</sup>

The expected proportions of individuals who will initiate the use of prescribed psychoactive drugs as a function of age of onset of marijuana use was calculated for a synthetic

†Data available on request from the authors.

TABLE 3—Predictors of Initiation of Prescribed Psychoactive Drug Use

|   | Men (N = 610)        |                     | Women (N = 695)      |                      |
|---|----------------------|---------------------|----------------------|----------------------|
|   | Model 1              | Model 2             | Model 1              | Model 2              |
| <b>I. Effects of Drugs</b>                          |                      |                     |                      |                      |
| Current stage <sup>a</sup>                          |                      |                     |                      |                      |
| Alcohol   | -0.306<br>(0.760)    | -0.370<br>(0.762)   | 0.070<br>(0.404)     | 0.018<br>(0.407)     |
| Cigarettes  | 0.213<br>(0.749)     | 0.103<br>(0.755)    | 0.547<br>(0.389)     | 0.363<br>(0.392)     |
| Marijuana   | 0.243<br>(0.694)     | 0.140<br>(0.703)    | 0.593<br>(0.388)     | 0.570<br>(0.390)     |
| Other illicit drugs                                 | 1.246<br>(0.706)     | 1.244<br>(0.727)    | 1.306**<br>(0.472)   | 1.177*<br>(0.472)    |
| Former stage higher than present stage <sup>b</sup> |                      |                     |                      |                      |
| Marijuana   | -1.502<br>(1.282)    | -1.542<br>(1.288)   | 0.180<br>(0.372)     | 0.164<br>(0.381)     |
| Other illicit drugs                                 | 1.309***<br>(0.437)  | 1.452**<br>(0.456)  | 0.658<br>(0.395)     | 0.485<br>(0.408)     |
| <b>II. Age Effects (vs under age 18)</b>            |                      |                     |                      |                      |
| 18-19   | 1.587*<br>(0.649)    | 1.534*<br>(0.650)   | 0.024<br>(0.319)     | -0.009<br>(0.321)    |
| 20-21   | 1.237<br>(0.669)     | 1.176<br>(0.671)    | -0.205<br>(0.341)    | -0.235<br>(0.342)    |
| 22-23   | 1.272<br>(0.668)     | 1.196<br>(0.670)    | 0.055<br>(0.324)     | 0.039<br>(0.326)     |
| 24 and over   | 1.745*<br>(0.695)    | 1.631*<br>(0.698)   | 0.573<br>(0.363)     | 0.578<br>(0.368)     |
| <b>III. Adolescent Characteristics</b>              |                      |                     |                      |                      |
| Delinquency   | —                    | 0.064<br>(0.043)    | —                    | 0.161<br>(0.273)     |
| Friends' marijuana use                              | —                    | 0.383<br>(0.470)    | —                    | -0.210<br>(0.352)    |
| Regular marijuana use harmful                       | —                    | 0.806<br>(0.421)    | —                    | 0.161<br>(0.270)     |
| Closeness to parents                                | —                    | -0.220<br>(0.421)   | —                    | 0.168<br>(0.321)     |
| Depressive symptoms                                 | —                    | 0.902<br>(0.479)    | —                    | 0.652*<br>(0.261)    |
| Mother's psychoactive use                           | —                    | 0.324<br>(0.364)    | —                    | 0.652**<br>(0.247)   |
| Being a former absentee                             | —                    | 0.252<br>(0.316)    | —                    | -0.128<br>(0.379)    |
| Dropping out of high school                         | —                    | 0.562<br>(0.330)    | —                    | 0.738**<br>(0.264)   |
| <b>IV. Constant</b>                                 |                      |                     |                      |                      |
|   | -8.759***<br>(0.824) | -9.469**<br>(1.014) | -7.185***<br>(0.357) | -7.879***<br>(0.535) |
| $\chi^2$  | 36.90                | 49.16               | 18.90                | 43.32                |
| df  | 10                   | 18                  | 10                   | 18                   |

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

<sup>a</sup>Contrasted to no use of any drug.

<sup>b</sup>Contrasted to lower current stage, including no current use.

cohort.<sup>††</sup> Since age of onset of marijuana use influences initiation of other illicit drugs, and the use of other illicit drugs influences the initiation of prescribed psychoactive drugs, the age of onset of marijuana use is expected to influence the initiation of prescribed psychoactive drugs indirectly. The strength of these indirect influences can be

<sup>††</sup>The validity of the policy implications depends in part on the assumed absence of misspecifications in the modeling of the rates. The vulnerability of the inference of an increased risk for progression depends not only on the temporal order between two stages, but also on whether the age periods of risk for initiation to two adjacent stages of drug use overlap significantly. If these two age periods do not overlap significantly, the temporal order between the two stages can hold strongly without any influence of one on the other. By these criteria, the influence of marijuana on the use of other illicit drugs is much less vulnerable to the misspecification argument than the influence of licit drugs on marijuana or of marijuana on prescribed drugs. The synthetic cohort analysis indicated that it is especially in the first case that the age periods of risk for initiating each class of drugs overlap strongly.

assessed assuming that initiation of other illicit drugs occurs according to Model 3 in Table 2, and initiation of prescribed psychoactive drugs occurs according to Model 1 in Table 3. Because of the combined use of the two models as well as the overall low explanatory power of Model 1 for initiation of prescribed drugs, the resulting expected probabilities may be somewhat unreliable.

The age of onset of marijuana, assuming continuous use as well as the pattern of indirect influence described above, increases the proportion of persons who will initiate prescribed drugs by 8 per cent to 12 per cent during the age period 15 to 25, depending on sex. The influence is slightly stronger among women, since their average propensity for initiating prescribed psychoactive drugs is greater than among men.<sup>15</sup> Persons with early age of onset of marijuana use have about twice as high a probability of initiating prescribed psychoactive drugs compared with persons who

never used marijuana. Without prior use of marijuana, the probability of psychoactive drug initiation reaches about 6 per cent by age 25 for men and 9 per cent for women.

These findings indicate that the temporal order between the initiation of marijuana and that of prescribed psychoactive drugs among men, and to a lesser extent among women, reflects not only the indirect influence of marijuana use on the initiation of prescribed psychoactive drugs but also differences in the pattern of age effects in the initiation of the two classes of drugs. Marijuana use, although it has an indirect influence, is not always necessary for the initiation of prescribed psychoactive drugs. This is especially the case among women for whom such factors in adolescence as depressive symptomatology and mother's psychoactive drug use independently influence the subsequent initiation of these drugs in young adulthood.

### Discussion

Although a clear sequential order of progression characterizes involvement in legal and illegal drugs from adolescence to early adulthood, the extent to which this order represents an explicit linkage in which a drug lower in the sequence increases the risk for progression to the next higher stage varies for different stages. The observed temporal order between the initiation of the licit drugs and that of marijuana reflects not only the influence of the first on the second but also differences in age effects on the initiation of different classes of drugs. The temporal order between initiation of alcohol and marijuana is stronger than between cigarettes and marijuana, despite the fact that the effect of alcohol use on the initiation of marijuana is slightly weaker than the effect of cigarette use. Age effects contribute more to the temporal order of initiations between alcohol and marijuana than between cigarettes and marijuana.

Both current and former marijuana use strongly influence the initiation of other illicit drugs among men and women, controlling for age and selected preexisting individual differences. The probability that individuals who never use marijuana will initiate the use of other illicit drugs is very low. These findings, which strongly suggest that prior use of marijuana greatly increases the risk of initiating the use of other illicit drugs, corroborate conclusions reached earlier by O'Donnell and Clayton<sup>20</sup> on the basis of cross-sectional data.

The initiation of prescribed psychoactive drugs is the most difficult to predict, although it is affected by current or former use of other illicit drugs among men and women and by current marijuana use among women. The relatively low explanatory power of prior drug use and the importance of adolescent depressive symptomatology on the initiation of prescribed psychoactive drugs reflects the fact that the initiation of prescribed drugs is not solely under control of the individual user, but also depends in part on actions taken by a physician.<sup>22</sup> Prior analyses had indicated that, in adolescence, depressed marijuana users were more likely than the non-depressed to initiate the use of other illicit drugs. Furthermore, the depression seemed to abate over a six-month interval with continued use of these illicit drugs, suggesting that illicit drugs served a self-medicating function for some youths.<sup>21</sup> The present data indicate that young people using other illicit drugs (particularly marijuana among women and other illicit drugs among both men and women) between adolescence and young adulthood are more likely than non-users to use mood-changing psychoactive drugs

prescribed by physicians. Marijuana also has an indirect effect in drug progression, since marijuana users are more likely than non-users to initiate the use of other illicit drugs. Thus, early initiation into marijuana is associated with subsequent initiation to other illicit drugs and to medically prescribed psychoactive substances. The linkages with prescribed drugs are weaker and partly reflect age effects, however.

As noted earlier, the limitations of the inferences that link the usage of one drug to usage of another must be stressed. Transition into a particular usage pattern is determined not only by the use of drugs at a lower stage but also by other factors, particularly personality and lifestyle variables. A limited set of variables was included and those included were measured in adolescence. On the average, initiation to marijuana took place 30.6 months after the initial high school survey, with initiation to other illicit drugs occurring 47.2 months later and to prescribed drugs 60.7 months later. Unmeasured variables, such as attitudes and family characteristics at the specific time of drug initiation rather than those measured in adolescence at the time of the initial survey, may account for the observed relationships between the uses of early and late stage drugs. However, the only time variant factor other than drug use variables that could be introduced into the models is age, weakening the possibility of establishing the nature of the risk among drug transitions. Other potentially important factors, not only additional individual attributes but such environmental factors as availability and supply were not included either. Furthermore, the analyses were restricted to those who initiated each class of drug after the initial survey and excluded a certain proportion of early users. However, event history analyses, by relying on the precise timing between events and the introduction of control variables, allow for inferences on the role of earlier stages on increasing the risk of progression to later stages to be developed, independently of the effects of age and other control variables on the sequential initiation of various drugs. The generalizability of the findings remains to be established. The earlier steps in the drug use sequence itself (most investigators ignore the use of medically prescribed psychoactives) have been shown to hold repeatedly for different samples in the United States, including national ones, at different periods,<sup>23-26</sup> and also for adolescents in other countries.<sup>27</sup> This leads us to hypothesize that the arguments developed here regarding linkages of influences among stages of drug use would hold in other samples as well. Since these patterns are observed in settings with wide variations in prevalence levels of use, the relation between usage of a drug at a particular stage and progression to a later stage in drug use cannot be explained solely by personality variables. An exclusive role for personality factors could be invoked only if one were to assume that personality variables that give rise to "drug proneness" also vary widely over time and over places. The fact that experimentation with one particular drug facilitates subsequent experimentation with other drugs higher up in the sequence does not negate the importance of a psychological dimension: experience with a particular drug, e.g., marijuana, may remove the fear and perceived risk associated with the use of other drugs, e.g. other illicit drugs, and may facilitate further escalation. However, this psychological set would derive from rather than precede involvement in the lower stage drug.

The findings in this paper suggest potentially important policy implications for the development of preventive and

educational efforts,†† namely that prevention of early involvement in legal drugs would reduce the use of marijuana, and that prevention of early involvement in marijuana use would reduce involvement in other illicit drugs. Prevention of early marijuana involvement might also have modest effects on decreasing the use of prescribed psychoactive drugs mainly through reducing the use of other illicit drugs. It is important to remember that age effects determine, in part, the sequential patterns observed between the licit drugs and marijuana and between marijuana and the prescribed drugs, while such age effects are minimal for the observed linkage between marijuana and other illicit drugs. Thus, we speculate that while prevention efforts aimed at reducing involvement in legal drugs would lead to a decrease of initiation to marijuana, a certain proportion of young people would still initiate marijuana use despite lack of prior experience with alcohol or cigarettes; by contrast, prevention efforts targeted toward reducing involvement in marijuana use would be the most successful with respect to lowering progression to higher stages of drug involvement. The specific impact of these strategies can only be established through controlled prospective trials. However, the results further suggest that for all drugs, prevention efforts will be more effective if they are targeted at reducing the risk of initiating the use of drugs rather than on decreasing use among users since both former and current use of drugs at a lower stage increases the risk of progression to a higher stage.

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## APPENDIX

### METHODOLOGICAL CONSIDERATIONS

#### A. Exponential Hazards Model with Time-Varying Independent Variables

In event history analyses, the rate of occurrence of the dependent event is assumed to be a log-linearly additive function of independent variables whose values may vary over time such that:

$$R(t) = \exp \left( \sum_{i=1}^n b_i x_i(t) + c \right)$$

where  $b_i$  is a regression-like coefficient indicating the effect of the independent variable  $x_i(t)$  on the occurrence of a specified dependent event. The coefficient  $b_i$  is the multiplier of the rate, such that for each additional unit of  $x_i(t)$  the event is  $\exp(b_i)$  times more likely to occur per unit time. As in regression analysis, the sign of  $b_i$  indicates the direction of the effect. The log-linear function is used in preference to the linear form because the latter does not ensure the non-negativity of the rates. Coefficients are estimated using maximum likelihood procedures and their statistical significance assessed from asymptotic standard errors. Overall significance of specific models is tested by the likelihood ratio chi-square calculated from the value difference in log-likelihood between the specified model and the constant rate model which does not introduce any independent variables. The degrees of freedom of each model equal the number of independent variables.

#### B. Variables Descriptions

Beer, wine, and distilled spirits were included in the alcohol class. Current use of any drug was use during the preceding month; former use was any lifetime use preceding any current monthly period. The illegal drugs other than marijuana included psychedelics, cocaine and heroin, and non-prescribed use of methadone, minor tranquilizers, sedatives, stimulants, major tranquilizers, and anti-depressants.

Six variables measured at the time of the initial high school survey were dichotomized in order to reduce the number of covariate patterns.

• *Delinquency*: lifetime participation in any of four major activities and

††(See earlier footnote.)



recent participation in seven minor ones, including stealing or running away from home:

- *Friends' marijuana use*: some, most, or all versus few or none ever used marijuana;
- *Attitude toward marijuana use*: agrees use is harmful versus disagrees or unsure;
- *Closeness to parents*: feel "somewhat" or "extremely" close to both parents versus all others;
- *Depressive symptoms*: six-item scale, with scores dichotomized at cut-off point at mean obtained by clinically depressed adolescents<sup>28</sup> (16 per cent of sample fell in this high category);
- *Mother's psychoactive drug use*: used tranquilizers, barbiturates, or stimulants within the past 12 months versus did not use

Because the Time 1 data were not available for the subsample of former school absentees, a dummy variable for being a former absentee was included in Model 1, and the mean sex-specific value of each Time 1 variable among former non-absentees was assigned to former absentees. When the absentee dummy variable is included in the model, the coefficients for Time 1 variables are invariant regardless of the constant values for these variables assigned to absentees. The coefficient for the absentee dummy variable, however, depends on these assigned values and reflects two inseparable effects: 1) an overall effect of the absentees' deviations from the mean values of non-absentees on the Time 1 variables; and 2) a possible unique effect of being a former absentee.

The following variables were also tested and excluded from Model 2: race, family intactness, father's education. Separate measures for minor and major delinquency were combined into a dummy variable for delinquency, and separate measures of closeness to mother and to father were combined into a dummy variable for closeness to parents.

C. Interaction Effects

The drug stage variables are introduced in analyzing initiations of other illicit drugs and of prescribed psychoactive drugs for parsimony and to avoid under-identification. When two drug use variables have significant effects, negative interactions between them are usually present. When a variable representing a higher stage drug such as marijuana is also in the model, these interactions reduce to insignificance the effects of the use of lower stage drugs in explaining the initiation of higher stage drugs. The stage variables incorporate these negative interaction effects. In addition, since persons who are using a higher stage drug are also likely to be using the lower stage drugs, events under state 1 (or 0) of one dummy variable completely overlap the events under state 1 (or 0) of the other variable. Introduction of interaction between a higher and a lower stage drug variable often generates under-identification between the higher stage drug variable and the interaction term. The stage variable removes these under-identification problems.

If use of a drug has a positive effect, its age of onset influences initiation by placing persons at higher risk of having the event for a longer period of time. In addition, the effect of use of a drug per unit time may increase or decrease depending on age of onset. Such interaction effects need to be taken into account in assessing the overall effect of age of onset. We present models with interaction terms only when they were found to be present.

D. Synthetic Cohort Estimates

Proportions of individuals expected to initiate the use of a particular drug by a certain age can be calculated by reconstructing the survivor function from the data presented in Tables 1-3. Coefficients for the age of onset effects on survivor rates are taken from the two-year grouped data in these tables and applied to mid-point age values in the synthetic analyses, i.e. the first month of the second year in each group. Table for marijuana use is presented in Appendix Table 1. (Other data are available on request from the authors.) For examples, if men start using alcohol and cigarettes at age 15, the expected proportion of their remaining marijuana nonusers for two years from age 15 to 17 is given by the expression below. Specific coefficients for each parameter are taken from Table 1:

$$0.638 = \exp[-12 \exp(\sum_{i=1}^5 b_i)] \times \exp[-12 \exp(\sum_{i=1}^6 b_i)]$$

(survivor rate from 15-16) (survivor rate from 16-17)

where  $b_1$  (constant) = -5.687,  $b_2$  (alcohol use) = 1.353,

$b_3$  (cigarette use) = 1.953,  $b_4$  (interaction) = -1.711

$b_5$  (age of alcohol onset, 14-15) = 0.224, and  $b_6$  (ages 16-17) = -0.232.

Hence, the expected proportion of young men who will initiate marijuana use by age 17, given continuous use of alcohol and cigarettes from age 15 to 17, becomes 36 per cent (1 - 0.638), as shown in Appendix Table 1.

A two-year difference in age of onset, however, will have a greater impact in early than in late adolescence on the probabilities of initiating marijuana use. This is due not only to the effects of age of alcohol onset mentioned earlier but also to the fact that current alcohol use generates different increases or decreases in the probabilities of marijuana initiation depending upon chronological age. The rate of marijuana initiation is significantly dampened at age 20 and over. Furthermore, there is the previously noted interaction between ages of alcohol and marijuana initiations among women. As a result, the impact of alcohol use becomes relatively small at age 20 and over among men, and at age 18 and over among women. This leads to a lack of difference in marijuana initiation between young adults who initiate alcohol at those ages and those who have never drunk alcohol. Both groups, comprising 4 per cent of the men and 21 per cent of the women, have low probabilities of marijuana initiation.

APPENDIX TABLE 1—Expected Proportions of Persons Who Will Initiate Marijuana as a Function of Age of Onset of Licit Drugs When (1) Only Alcohol Was Initiated and (2) Both Alcohol and Cigarettes Were Initiated: Synthetic Cohorts (Who Have Never Used Marijuana by Age 15)

|   |     | Expected Proportions of Persons Who Will Initiate Marijuana Use by Each Age <sup>a</sup> |     |     |     |     |     |                 |     |     |     |     |     |
|---|-----|--|-----|-----|-----|-----|-----|-----------------|-----|-----|-----|-----|-----|
|   |     | Men (N = 449)  |     |     |     |     |     | Women (N = 558) |     |     |     |     |     |
|   |     | 15   | 17  | 19  | 21  | 23  | 25  | 15              | 17  | 19  | 21  | 23  | 25  |
| (1) Used Alcohol Only                     |     |  |     |     |     |     |     |                 |     |     |     |     |     |
| Age of Onset of Alcohol <sup>b</sup>      |     |  |     |     |     |     |     |                 |     |     |     |     |     |
| 15  | .00 |  | .30 | .48 | .58 | .60 | .61 | .00             | .19 | .35 | .45 | .48 | .50 |
| 17  | .00 | .07  |     | .29 | .40 | .44 | .45 | .00             | .07 | .23 | .34 | .38 | .40 |
| 19  | .00 | .07  | .07 |     | .26 | .29 | .31 | .00             | .07 | .13 | .17 | .19 | .20 |
| 21  | .00 | .07  | .13 | .13 |     | .20 | .22 | .00             | .07 | .13 | .18 | .19 | .20 |
| 23  | .00 | .07  | .13 | .16 | .17 |     | .19 | .00             | .07 | .13 | .18 | .19 | .21 |
| Never used                                | .00 | .07  | .13 | .16 | .17 | .18 |     | .00             | .07 | .13 | .18 | .19 | .20 |
| (2) Used Alcohol and Cigarettes           |     |  |     |     |     |     |     |                 |     |     |     |     |     |
| Age of Onset of Alcohol and/or Cigarettes |     |  |     |     |     |     |     |                 |     |     |     |     |     |
| 15  | .00 |  | .36 | .57 | .67 | .69 | .70 | .00             | .27 | .48 | .60 | .64 | .66 |
| 17  | .00 | .07  |     | .34 | .47 | .51 | .52 | .00             | .07 | .31 | .46 | .51 | .53 |
| 19  | .00 | .07  | .07 |     | .29 | .33 | .35 | .00             | .07 | .13 | .20 | .22 | .23 |
| 21  | .00 | .07  | .13 | .13 |     | .21 | .24 | .00             | .07 | .13 | .18 | .20 | .21 |
| 23  | .00 | .07  | .13 | .16 | .17 |     | .20 | .00             | .07 | .13 | .18 | .19 | .21 |
| Never used                                | .00 | .07  | .13 | .16 | .17 | .18 |     | .00             | .07 | .13 | .18 | .19 | .20 |

<sup>a</sup>Probabilities in the lower triangular matrix refer to initiation of marijuana without prior use of a legal drug.

<sup>b</sup>Assumed to start using on the first month of the age specified and to continue using (1) alcohol or (2) alcohol and cigarettes after onset.