

Into the World of Illegal Drug Use: Exposure Opportunity and Other Mechanisms Linking the Use of Alcohol, Tobacco, Marijuana, and Cocaine

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Drawing upon an “exposure opportunity” concept described by Wade Hampton Frost, the authors studied two mechanisms to help account for prior observations about the “stepping-stone” or “gateway” sequences that link the use of alcohol, tobacco, marijuana, and cocaine. Data were obtained from four nationally representative and independent cross-sectional samples of US household residents ($n = 44,624$ persons aged 12–25 years). Data were gathered using standardized self-report methods and were analyzed via survival methods. Results indicated that users of tobacco and alcohol were more likely than nonusers to have an opportunity to try marijuana and were more likely to actually use marijuana once a marijuana opportunity had occurred. Opportunity to use cocaine was associated with prior marijuana smoking. Among young people with a cocaine opportunity, those who had used marijuana were more likely to use cocaine than were those with no history of marijuana use. The observed associations did not seem to arise solely as a result of young drug users’ seeking out opportunities to use drugs. Applying Frost’s epidemiologic concept of exposure opportunity, the authors offer new epidemiologic evidence on the sequences that link earlier use of alcohol and tobacco to later illegal drug involvement. *Am J Epidemiol* 2002;155:918–25.

adolescent behavior; alcohol drinking; cocaine; marijuana smoking; psychology; smoking; social environment; street drugs

In 1999, a US National Academy of Sciences task-force panel breathed new life into the decades-old issue of whether marijuana is a “stepping-stone” into the world of more serious illegal drug use, discussing both marijuana and tobacco as “gateways” to the use of drugs such as cocaine (1–3). In this study, we probed possible mechanisms that might account for observed “stepping-stone” and “gateway” associations, building from O’Donnell’s speculations:

Cigarette and alcohol use, *by mechanisms not considered* [our emphasis], contribute to marijuana use. Marijuana use, in turn, is one of the causes of further nonmedical drug use... One of the mechanisms by which this probably occurs is that continued use of marijuana, especially heavy use, makes more probable contact with drug sellers and the drug subculture to assure a continuous supply. This contact in some cases leads to friendship with users of other drugs, which, in turn, increases the probability of using other drugs (4, p. 149).

With respect to “mechanisms not considered” by O’Donnell, we drew upon the concept of “exposure opportunity” that was used by Professor Wade Hampton Frost to teach infectious disease epidemiology (5). Applied here, the idea is that young people using alcohol or tobacco are more likely to be offered a chance to try marijuana or to face some other form of “marijuana exposure opportunity” at home or within a peer-group setting (6). In addition, as an elaboration of the trajectory, marijuana smokers might be more likely to have chances to try cocaine in similar settings, as compared with youths who do not smoke marijuana.

A separate idea about mechanisms takes exposure opportunity as a given: Once the “marijuana exposure opportunity” has occurred, alcohol or tobacco users might be more likely to actually use marijuana, as compared with other youths. Next in sequence, once the “cocaine exposure opportunity” has occurred, marijuana-smoking youths might be more likely to actually use cocaine. These hypothesized mechanisms, hitherto unexamined, represent fairly simple elaborations of prior ideas, but new evidence might influence the design and evaluation of programs for preventing youthful drug use.

It also might be true that alcohol or tobacco users seek out opportunities to try marijuana, and marijuana users might seek out opportunities to try cocaine; but once the influence of drug-seeking is constrained, do links from alcohol or tobacco to marijuana remain? Does the sequence from marijuana to cocaine remain? These unanswered questions seem central to our understanding of observed sequences of increasing drug involvement.

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Abbreviations: CI, confidence interval; NHSDA(s), National Household Survey(s) on Drug Abuse.

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Inspired by Frost's concept that infection by an agent is possible only if there is opportunity for exposure to the agent, we investigated how the occurrence of a marijuana exposure opportunity might depend on a young person's prior history of alcohol or tobacco use and how the occurrence of actual marijuana use might depend on history of alcohol or tobacco use once a marijuana exposure opportunity has occurred. We then estimated the degree to which the occurrence of a cocaine exposure opportunity might depend on history of marijuana smoking and the degree to which the occurrence of actual cocaine use might depend on history of marijuana smoking once a cocaine exposure opportunity has occurred. Finally, we probed whether these sequences might be traced solely to greater marijuana-seeking among alcohol or tobacco users or to greater cocaine-seeking among marijuana users.

MATERIALS AND METHODS

We used data from the 1991, 1992, 1993, and 1994 National Household Surveys on Drug Abuse (NHSDAs), detailed descriptions of which are published elsewhere (7–10). These are the largest available epidemiologic survey data sets containing information on age at first alcohol use, age at first tobacco use, first marijuana exposure opportunity, first actual marijuana use, first cocaine exposure opportunity, and first actual cocaine use. Although more recent surveys have been conducted, they have not asked the same key questions about opportunities to try marijuana and cocaine (10).

Briefly, the NHSDAs were designed as cross-sectional surveys. They measure prevalence and correlates of drug use in the noninstitutionalized civilian population of the United States. Excluded from the NHSDA sampling frames are persons with no fixed address, institutionalized persons, and military personnel. The NHSDAs use a multistage area probability sample design, and respondents are assessed after giving informed consent under an approved human-subjects protocol. Survey response rates were 84.2 percent in 1991, 82.5 percent in 1992, 79.2 percent in 1993, and 85.3 percent in 1994. In 1994, the NHSDA fielded a new survey questionnaire with no assessment of exposure opportunities, but a fraction of the total sample was asked to answer the old questions (including those on exposure opportunity). Hence, this study's estimates for 1994 were based on the NHSDA 1994a subsample (10).

To study marijuana use, we analyzed data from 26,015 respondents aged 12–18 years, the age range in which most marijuana use starts (7–10). Sample sizes for analyses of marijuana use were as follows: $n = 8,976$, $n = 8,179$, and $n = 7,617$ for the 1991, 1992, and 1993 NHSDA samples, respectively, and $n = 1,243$ for the 1994a subsample. For cocaine use, we extended the age range to include 44,624 respondents aged 12–25 years ($n = 15,546$, $n = 14,766$, $n = 12,338$, and $n = 1,974$ for the 1991, 1992, 1993, and 1994a NHSDA samples, respectively). This age extension reflected the later age of onset of cocaine use and allowed for observation of youths who started using marijuana in their late teenage years. Age stratification also limits the

span of time over which respondents must recall ages of first opportunity and actual use of marijuana and cocaine.

The 1991–1994 data were gathered using a standardized interview or questionnaire, with special methodology designed to promote complete and accurate reporting. Use of drugs was assessed via standardized questions—for example, “About how old were you the first time you actually used marijuana or hash, even once?” and “About how old were you the first time you actually used cocaine, even once?” Opportunities to use drugs were based on responses to the following questions: “About how old were you when you first had a chance to try marijuana or hash if you had wanted to?” and “About how old were you when you first had a chance to try cocaine if you had wanted to?” There were no questions on age at first opportunity to try tobacco and alcohol. This methodology has been described in prior published articles (11–15). In most versions, the gateway model identifies the first stage of drug involvement in terms of initial use of alcohol and/or tobacco (3). Hence, a variable was created to capture age at first occurrence of either tobacco use or alcohol use, whichever came first. Covariates under study included sex (male vs. female), race/ethnicity (Hispanic, non-Hispanic White, non-Hispanic Black, Native American, and Asian or Pacific Islander), year of assessment (1991, 1992, 1993, 1994), and age group at interview, with ages sorted a priori on the basis of prior drug research (16).

The cross-sectional data were reorganized in person-year records prepared for life table and survival analysis regression. All age data values were integers (i.e., there were no fine-grained calendar data or $\frac{1}{2}$ -year or $\frac{1}{4}$ -year values); in consequence, there were some “ties” in and uncertainties about the sequencing of events (i.e., equal ages of onset for use of tobacco, alcohol, marijuana, and cocaine). We analyzed all available data when the temporal sequencing of events was clear. Subjects with tied events were not excluded: They contributed person-year records up to the year of the tie; thereafter, temporal sequencing became uncertain.

Applying Cox's model for discrete-time survival regression with no covariates (17), we estimated cumulative probabilities and plotted curves to depict time to first opportunity to try marijuana; separate log rank and Wilcoxon rank sum test statistics were used as an aid to interpretation. To examine transitions from marijuana and cocaine exposure opportunities to actual use of each drug, we estimated the probability of initiating marijuana or cocaine use among young people who reported having had an exposure opportunity. In these analyses, sample sizes were smaller—constrained to persons who had had an exposure opportunity.

Stratified discrete-time survival regression models with covariate adjustment were used to estimate the relative risk of having an opportunity to try marijuana in relation to prior use of alcohol or tobacco, and then to estimate the relative risk of actually using marijuana given a marijuana exposure opportunity. Onset of tobacco smoking or alcohol use and opportunity to try marijuana were coded as time-varying characteristics (“0” until the event and “1” thereafter), whereas sex, age at interview, and race/ethnicity were not

time-varying. Separate survival analysis regressions were conducted for cocaine exposure opportunity and actual cocaine use, with age at first marijuana use included as an additional covariate in the models described above.

This form of discrete-time survival analysis regression was first suggested by D. R. Cox in 1972; more recent discussions include Singer and Willett's suggested applications in drug research (17–20). Prior to regression analysis, the person-year records for each subject were poststratified into analytical risk sets, each defined by a specific census tract or city block group of residence at the time of sampling and assessment, as well as by year of survey (i.e., 1991, 1992, 1993, and 1994). These stratifications represent an attempt to constrain potential confounding by neighborhood characteristics such as drug availability, police presence, and level of community disorganization, as discussed elsewhere (21–23).

It might be argued that our findings are predictable because users of one drug will seek out opportunities to use other drugs. If it is true that this study's observed associations can be explained entirely by drug-seeking behavior of this type, then observed associations should disappear or be much attenuated once we exclude youths who make a "rapid transition" from first opportunity to first use, meeting the following condition: (age at first use minus age at first opportunity) < 1 year. That is, as we explained in our prior reports (11–13), when youths are seeking out a first opportunity to try marijuana, we expect them to use marijuana soon after having their first opportunity (i.e., to make a "rapid transition"). It seems unlikely that a drug-seeking youth will seek out an opportunity but then wait for years until actual first use. In this sense, this supplementary analysis constrains and perhaps removes the potential influence of active drug-seeking behavior (11–13).

Appendix tables and data not shown in this paper are available from the authors upon request. They are also posted on the World Wide Web (<http://www.jhu.edu/~janthony/elcid.htm>).

RESULTS

Table 1 shows aggregate characteristics of the four NHSDA samples totaling 26,015 youths aged 12–18 years who were included in analyses on transitions from alcohol and tobacco use to marijuana involvement. Table 2 shows sample characteristics of 44,624 young respondents aged 12–25 years who were included in the cocaine transition analyses. Sample distributions did not differ appreciably by NHSDA year (data available upon request).

Accounting for the opportunity to try marijuana

We found a consistent pattern of marijuana exposure opportunity across the four NHSDA samples: Users of alcohol or tobacco were more likely than nonusers to have an opportunity to try marijuana ($p < 0.0001$). Figure 1, part A, depicts the estimated cumulative probability of having a marijuana exposure opportunity by a stated age for youths who had used either alcohol or tobacco or both (solid line)

versus nonusers (dotted line). For example, among users of alcohol or tobacco, an estimated three out of four had had an opportunity to try marijuana by the age of 18 years. In contrast, an estimated one fourth of nonusers had had an opportunity to try marijuana by that age. Values from regression analyses with stratification and covariate adjustment indicated that users of alcohol or tobacco were approximately three times more likely than nonusers to have an opportunity to try marijuana (95 percent confidence interval (CI): 2.8, 3.3), with essentially comparable estimates being obtained in the four independent samples (appendix tables available upon request).

Marijuana use, given a marijuana exposure opportunity

As is depicted in figure 1, part B, once a marijuana exposure opportunity had occurred, the likelihood of initiating marijuana use depended on prior history of using alcohol or tobacco ($p < 0.001$). An estimated 85–90 percent of alcohol or tobacco users who had an opportunity to try marijuana made the transition to marijuana use. The corresponding estimate for individuals who had never used alcohol or tobacco was under 25 percent within 6 years after the first marijuana exposure opportunity. Median lag time between first marijuana exposure opportunity and first marijuana use was 1 year among users of alcohol or tobacco. In contrast, fewer than 20 percent of nonusers went on to try marijuana within 5 years after their initial exposure opportunity.

Survival analyses confirmed this evidence: Users of alcohol or tobacco were approximately seven times more likely than nonusers to actually use marijuana once a marijuana exposure opportunity had occurred (95 percent CI: 5.7, 9.5). This result was observed in analyses of pooled data as well as in each of the independent analyses (appendix tables available upon request).

Do these observed findings depend on seeking out marijuana exposure?

As is shown in figure 1, part C, when we excluded "rapid transition" respondents with no lag in years between initial opportunity and first use, the evidence remained much the same. Among youths who had experienced a marijuana exposure opportunity, those who had tried alcohol or tobacco were more likely to use marijuana than were alcohol and tobacco nonusers (adjusted relative risk = 8.9, 95 percent CI: 5.7, 14.1).

From marijuana use to cocaine exposure opportunity

Initial analyses of data on cocaine exposure opportunities showed variation across strata defined by history of using alcohol or tobacco ($\chi^2_{(1 \text{ df})} = 10.89, p < 0.001$). For this reason, our analyses of cocaine exposure opportunity involved stratification by history of alcohol or tobacco use (ever vs. never) and history of marijuana use ("0" until first marijuana use and "1" thereafter).

Among young people who had never used alcohol, tobacco, or marijuana, an estimated 13 percent had a cocaine

TABLE 1. Selected characteristics of youths aged 12–18 years included in analyses of initiation of marijuana use*

Characteristic	Lifetime marijuana use				Total	Estimated odds ratio	95% confidence interval
	Yes	%	No	%			
Alcohol/tobacco use†							
Ever	3,617	28.4	9,123	71.6	12,740	63.8	51.2, 79.5
Never	82	0.6	13,193	99.4	13,275	1.0	
Sex							
Male	2,023	15.5	11,021	84.5	13,044	1.2	1.2, 1.3
Female	1,676	12.9	11,295	87.1	12,971	1.0	
Race/ethnicity							
Non-Hispanic Black	774	11.4	6,024	88.6	6,798	0.7	0.6, 0.7
Hispanic	899	14.3	5,391	85.7	6,290	0.9	0.8, 0.9
American Indian	89	19.9	359	80.1	448	1.3	1.0, 1.6
Asian/Pacific Islander	67	6.6	949	93.4	1,016	0.4	0.3, 0.5
Non-Hispanic White	1,870	16.3	9,593	83.7	11,463	1.0	
Age (years)							
12–14	484	4.2	11,157	95.8	11,641	1.0	
15	526	14.0	3,234	86.0	3,760	3.7	3.3, 4.2
16–18	2,689	25.3	7,925	74.7	10,614	7.8	7.1, 8.7

* Data were obtained from the US National Household Surveys on Drug Abuse, 1991–1994.

† Alcohol/tobacco use was defined as having used either alcohol or tobacco.

exposure opportunity by the age of 25 years. In contrast, the corresponding estimate was 26 percent among alcohol and tobacco users with no marijuana use, 51 percent among

young people who smoked marijuana but did not use alcohol or tobacco, and 75 percent among young people with prior use of marijuana and either alcohol or tobacco (figure 2, part

TABLE 2. Selected characteristics of youths aged 12–25 years included in analyses of initiation of cocaine use*

Characteristic	Lifetime cocaine use				Total	Estimated odds ratio	95% confidence interval
	Yes	%	No	%			
Alcohol/tobacco use†							
Ever	3,375	16.4	17,194	83.6	20,569	20.9	18.2, 23.9
Never	224	0.9	23,831	99.1	24,055	1.0	
Marijuana use							
Ever	3,470	28.6	8,644	71.4	12,114	100.8	84.4, 120.3
Never	129	0.4	32,381	99.6	32,510	1.0	
Sex							
Male	1,905	8.9	19,392	91.1	21,297	1.3	1.2, 1.3
Female	1,694	7.3	21,633	92.7	23,327	1.0	
Race/ethnicity							
Non-Hispanic Black	497	4.4	10,722	95.6	11,219	0.4	0.4, 0.4
Hispanic	884	8.2	9,873	91.8	10,757	0.8	0.7, 0.8
American Indian	75	10.3	654	89.7	729	1.0	0.8, 1.3
Asian/Pacific Islander	47	2.7	1,681	97.3	1,728	0.2	0.2, 0.3
Non-Hispanic White	2,096	10.4	18,131	89.6	20,227	1.0	
Age (years)							
12–14	47	0.4	11,608	99.6	11,655	1.0	
15	65	1.7	3,675	98.3	3,740	4.4	3.0, 6.4
16–18	525	5.0	9,996	95.0	10,521	13.0	9.7, 17.6
19–25	2,962	15.8	15,746	84.2	18,708	46.6	35.0, 62.2

* Data were obtained from the US National Household Surveys on Drug Abuse, 1991–1994.

† Alcohol/tobacco use was defined as having used either alcohol or tobacco.

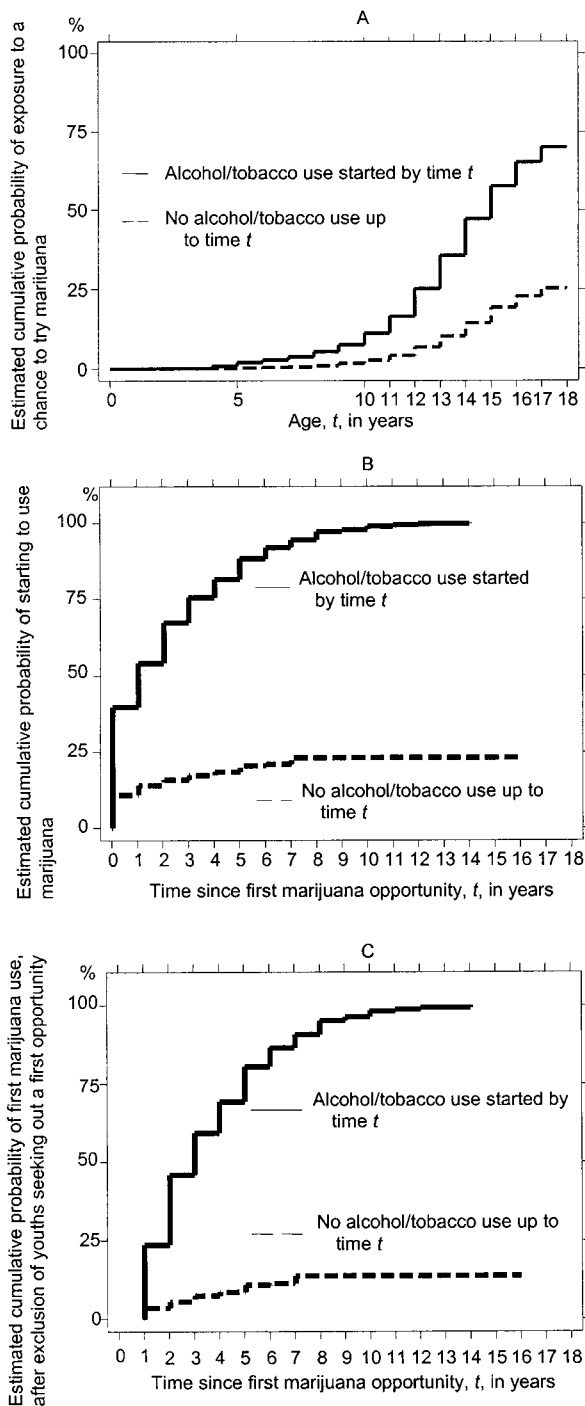


FIGURE 1. Estimated cumulative probabilities of exposure to an opportunity to try marijuana and first use of marijuana for young people aged 12–18 years, by alcohol/tobacco use. Alcohol/tobacco use was defined as having used alcohol and/or tobacco as of time t . Data were obtained from the US National Household Surveys on Drug Abuse, 1991–1994. Part A shows that alcohol/tobacco users were more likely to have an opportunity to try marijuana; part B shows that alcohol/tobacco users were more likely to use marijuana once an opportunity to use it had occurred; and part C shows that after exclusion of youths who actively sought out their first opportunity to try marijuana, alcohol/tobacco users were more likely to use marijuana once the opportunity to use it had occurred (all p 's ≤ 0.001).

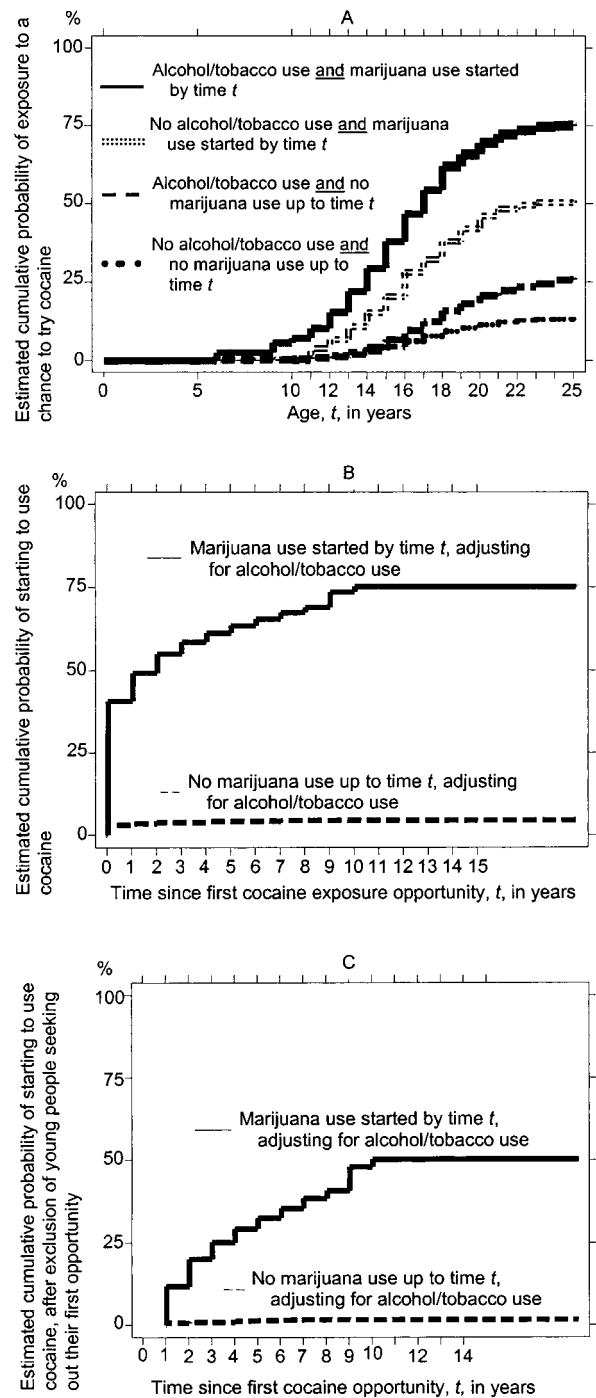


FIGURE 2. Estimated cumulative probabilities of exposure to an opportunity to try cocaine and first use of cocaine for young people aged 12–25 years, by alcohol/tobacco use and use of marijuana. Alcohol/tobacco use was defined as having used alcohol and/or tobacco as of time t . Data were obtained from the US National Household Surveys on Drug Abuse, 1991–1994. Part A shows that marijuana smokers were more likely to have an opportunity to try cocaine; part B shows that marijuana smokers were more likely to use cocaine once an opportunity to use it had occurred; and part C shows that after exclusion of youths who actively sought out their first opportunity to try cocaine, marijuana smokers were more likely to use cocaine once the opportunity to use it had occurred (all p 's ≤ 0.001).

A). Median age at first cocaine exposure opportunity was 17 years for marijuana smokers who had used either alcohol or tobacco, which contrasts with the median age of 23 years for marijuana users who had never used alcohol or tobacco. Observed differences between marijuana users and nonusers were present in each NHSDA sample ($p < 0.0001$; appendix tables available upon request).

Survival analysis regressions led to similar findings. Compared with the teens and young adults who had no history of alcohol, tobacco, or marijuana use, the alcohol or tobacco users who had not used marijuana were an estimated 1.9 times more likely to have an opportunity to try cocaine (95 percent CI: 1.7, 2.1); marijuana users who had used *neither* alcohol *nor* tobacco were an estimated 4.6 times more likely to have a cocaine exposure opportunity (95 percent CI: 3.8, 5.6); and marijuana users who had previously used either alcohol or tobacco were an estimated 7.6 times more likely to have an opportunity to try cocaine (95 percent CI: 6.9, 8.4).

From marijuana use to cocaine use, given a cocaine exposure opportunity

As is depicted in figure 2, part B, once a cocaine exposure opportunity had occurred, the likelihood of initiating cocaine use depended on history of marijuana use ($p < 0.001$). Stratification according to groups defined by history of alcohol and tobacco use was not necessary to express cocaine use given exposure opportunity; heterogeneity across strata was not substantiated in this respect ($\chi^2_{(1 df)} = 1.77, p > 0.18$). An estimated 50 percent of marijuana users started using cocaine within 2 years after their first cocaine exposure opportunity; corresponding estimates for marijuana nonusers were quite small 2 years after the initial cocaine exposure opportunity and remained under 10 percent many years after the first cocaine exposure opportunity. It is of interest that most (but not all) marijuana users with a cocaine exposure opportunity eventually used cocaine, the majority within the first 2 years after their first exposure opportunity. Among young people with a cocaine exposure opportunity, those who had used marijuana were an estimated 15 times more likely to actually use cocaine than were those with no history of marijuana use (95 percent CI: 11.3, 19.8).

Do these observed findings depend on seeking out cocaine exposure opportunities?

A large majority of teens and young adults in this study who used cocaine had an age of onset equal to the age at which they were first exposed to a cocaine opportunity (73 percent). This “rapid transition” might reflect the active behavior of “cocaine-seeking.” However, as is shown in figure 2, part C, among young people who had the opportunity to try cocaine, even with the “rapid transition” users excluded from the sample, the remaining marijuana users were substantially more likely to use cocaine (adjusted relative risk = 20.4, 95 percent CI: 10.2, 40.7).

DISCUSSION

The results of this study add new epidemiologic evidence to an already abundant body of literature on a possibly causal association linking earlier use of alcohol and tobacco to later marijuana use, and on a separate association linking earlier use of marijuana to use of other illegal drugs such as cocaine (2–4). For many years, alcohol and tobacco use has been described as a “gateway” experience with respect to subsequent use of marijuana and other illegal drugs (1). Nevertheless, the “gateway” concept is merely descriptive and does not seek to explain mechanisms that might operate to link alcohol or tobacco use with later use of marijuana or to link marijuana use with use of cocaine. To the best of our knowledge, this is the first time an epidemiologic study has produced evidence lending support to a conceptualization of two separate mechanisms involved in transitions from youthful alcohol or tobacco use to marijuana use, followed by related mechanisms interposed between marijuana use and cocaine use. The main observations of this study were: 1) use of a drug in one stage is associated with an increased likelihood of encountering an exposure opportunity to make the transition towards the next stage of involvement in illegal drug use; 2) prior use of one drug is associated with an increased likelihood of actually starting to use the next drug in the sequence, once an exposure opportunity has occurred; and 3) observed sequences from alcohol and tobacco use to marijuana and cocaine use cannot be explained solely by differential drug-seeking behavior once drug use has occurred, to the extent that we were able to constrain drug-seeking by requiring an appreciable lag time from first opportunity to first drug use.

In considering the possible implications of these observations, it is important to acknowledge several potential limitations related to the possibilities of methodological artifact and response bias. Possibilities of bias are present whenever cross-sectionally gathered data are reorganized to shed light on sequencing of discrete events (24). In this regard, one source of concern is the speculation that most seriously involved drug users are left out of the NHSDA sampling frame (e.g., they are homeless or disengaged from households or have suffered premature mortality in association with serious drug-taking). However, if NHSDA samples could be expanded to include these most seriously involved drug users, the observed associations might well be stronger than the values observed in this study (6, 25, 26).

In initial scientific articles on “exposure opportunity” concepts, our research group (11–15) provided detailed discussions on potential threats to validity. For example, separate from concern about sampling-frame coverage of the most seriously involved drug users, there is a threat of response bias when data are gathered retrospectively by questionnaire or interview. Users of alcohol, tobacco, marijuana, and cocaine might report more or less completely and accurately than nonusers. However, because there is no other gold standard for age at first exposure opportunity or for age at first actual drug use, self-reporting will continue to be an important means of gathering data in studies of this type. Indeed, self-report data form the basis for all past studies of the “stepping-stone” and “gateway” models.

New studies, whether cross-sectional or prospective, could seek to obtain more fine-grained data on temporal sequences needed to confirm and illuminate age-by-age data gathered in NHSDA assessments (i.e., ages at first use and first opportunity); fine-grained data will be needed if we are to inspect temporal sequencing when there is a rapid transition from first opportunity to first use. Plans for future research also can encompass 1) a search for subgroup variation—for example, situations where cocaine use might precede use of marijuana and tobacco (27); 2) inclusion of population samples from other countries (e.g., see Delva et al. (14)); and 3) consideration of recent outbreaks of “club drug” use (e.g., 3,4-methylenedioxymethamphetamine (“Ecstasy”)) in the United States and elsewhere (28).

We cast a broad net in supplementary analyses concerning “rapid transitions” from first drug opportunity to first use. By excluding all youths who made a rapid transition from first opportunity to first use, we constrained the influence of active drug-seeking, but we also discarded information about other types of young people who made this rapid transition. For example, there are young people whose first cocaine exposure opportunity comes as an unbidden experience, perhaps even unexpected and unwanted, and who then immediately succumb to peer pressure or social influences to try cocaine; these young people were also excluded from the supplementary analyses. In this respect, our attempt to constrain the influence of active drug-seeking also entailed some constraint on the effects of peer pressure and social influence, and our estimates should be interpreted with this additional constraint in mind.

Notwithstanding limitations such as these, our observations have possible implications for theories on progression of drug use and for the design of drug prevention programs. By incorporating exposure opportunity as an elaboration of the current “stepping-stone” and “gateway” concepts, we can study and understand sequences from alcohol and tobacco use to marijuana and cocaine use more completely. With this elaboration of theory, we may be able to develop new insights about evidence that alcohol or tobacco users and marijuana users seem to be more likely to be introduced to the world of more serious illegal drug use.

There also might be some implications for the design and evaluation of drug prevention programs if new research strategies confirm these observations on “exposure opportunity” mechanisms linking alcohol, tobacco, marijuana, and cocaine use. For example, some recent drug prevention programs have sought to reduce illegal drug involvement by coaching parents to be better supervisors and monitors of their children. Evaluations of these programs generally focus on the more distal reduced risk of drug involvement (e.g., see Dishion and Andrews (29) and Storr et al. (30)). We speculate that parental supervision disrupts the more proximal occurrence of drug exposure opportunities. As such, the conceptual, measurement, and analysis models for evaluation of these drug prevention programs will be aided when drug exposure opportunities are introduced as more proximal responses to intervention.

These new observations should promote a growing appreciation of heterogeneity within populations exposed to drug

prevention programs (e.g., see Ellickson and Bell (31)). In classroom settings, there are students who have never experienced any drug exposure opportunity; students with drug exposure opportunities who have (thus far) declined to try drugs; tobacco and alcohol users; drug users who have sought out drug exposure opportunities; and students who didn’t seek out a drug but who tried it as soon as an opportunity occurred. If allied experience carries over to this context of public health research, optimal selection of interventions should be based on assessment of differential responses across important subgroups within the population (see Manski et al. (32)). In time, intervention selection rules can be guided by knowledge of important covariates, including characteristics such as whether drug exposure opportunities have occurred, other life circumstances, and personality traits (e.g., see Palmgreen et al. (33)).

Fortunately, assessment of drug exposure opportunity is relatively uncomplicated. For example, it is illegal to smoke marijuana or crack cocaine, and this illegality of the behavior complicates assessment and human-subjects protections. In contrast, it is not illegal to experience an opportunity to try these drugs. As such, epidemiologic surveillance of drug exposure opportunities can strengthen or complement surveillance of illegal drug use. One result may be reduced reporting bias associated with fear of criminal or social sanctions or with fear of reprisal in the form of increased police activity in classrooms, schools, and communities where surveys disclose illegal drug use as a prevalent behavior.

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