

subjects showed superior knowledge about AIDS in the posttest ($p < 0.003$); however, both experimental and comparison subjects showed very low posttest levels of drug use, and condom use did not differ between groups. The small-group education approach has promise as one of several techniques that drug treatment programs can use in AIDS prevention.

BEHAVIORAL RESPONSES TO AIDS EDUCATION EFFORTS AMONG INTRAVENOUS DRUG USERS.

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Study was made of intravenous drug users (IVDUs) in San Francisco regarding their risk for contracting human immunodeficiency virus (HIV). Three cross-sections of subjects were recruited (N=438, N=623, N=568). Both drug treatment program clients and IVDUs not enrolled in treatment programs were sampled. A modified chain referral method was used to recruit IVDUs not enrolled in treatment programs, and volunteers were recruited in two drug detoxification clinics. Cross-sections were compared, and participation in risk behavior is examined over time. Results suggested that community health outreach workers (CHOWs), drug treatment clinics, and close associates were the primary means by which IVDUs gain knowledge about AIDS risk. A positive association between perception of CHOWs as important sources of AIDS information and adherence to safer needle hygiene was found. Significant change in IVDU risk behavior was found, coinciding with the broad dissemination of AIDS risk reduction messages to IVDUs through CHOWs and treatment programs. The study concluded that ongoing, one-to-one contact with IVDUs is instrumental in affecting behavior change, and that IVDUs can and do alter important areas of risk behavior when acceptable means of protection are readily available.

METHADONE TREATMENT AND AIDS RISK REDUCTION AMONG INTRAVENOUS HEROIN USERS.

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Heroin addiction renders individual or collective risk-reduction extremely difficult. A phased pattern of effects occurs, with successive 2-hour periods of euphoria, relative normalcy and approaching withdrawal. Agonizing withdrawal follows unless more heroin is taken. This cycle directly limits the time available to plan risk reduction, creates a need to use available time to plan and implement strategies to obtain drugs, and creates periods of intense need for heroin during which intentions not to share drug injection paraphernalia are often abandoned. Methadone, by contrast, has a much longer half-life of 24 hours. During this time, it blocks the craving for and euphoric effects of heroin. Furthermore, methadone clients are not subject to the physical and emotional disruption that heroin causes, since the usual methadone effects are stable rather than consisting of phases of euphoria and withdrawal. Consequently, methadone clients are able to stabilize their social and economic relationships. Methadone clients typically reduce injection at program admission and gradually thereafter. Most of what they continue to inject is cocaine or other nonopioids. Con-

siderable variation in the decrease in mean drug injection among programs indicates that some reduction in injections is due to psychosocial aspects of treatment. Because of behavior changes, methadone patients are less likely to be infected with HIV than detoxification patients or street users out of treatment. The experiences of the drug users union (Junkiebonden, or JB) in Western Europe show that methadone makes collective organization by intravenous drug users easier. JB has primarily been formed by Dutch methadone clients. Where street users have organized, core leaders have used methadone to reduce the degree to which they are personally dominated by the heroin cycle. Attempts to organize in the Federal Republic of Germany foundered due to the absence of methadone treatment. JB in the Netherlands have become active in innovative efforts to encourage AIDS risk reduction among intravenous drug users (IVDUs). Their efforts have been important, in part, precisely because they come from inside the IVDU culture and, thus, are less likely to be seen as intrusive outsiders. In conclusion, methadone facilitates individual and group risk reduction among IVDUs. This does *not*, however, mean that heroin users outside of methadone treatment are totally incapable of risk reduction. Partial risk reduction has been reported by street heroin users, and we have observed a local JB meeting at which some participants functioned effectively in spite of sustained heroin use before and during the meeting.

YOUNG PSYCHOPHARMACOLOGIST AWARD AND ADDRESS

Drug Effects on the Acquisition and Performance of Response Chains

Warren K. Bickel, University of Vermont College of Medicine, Burlington, VT

Chair: Larry D. Byrd, Yerkes Regional Primate Research Center, Emory University, Atlanta, GA

NEW FELLOW ADDRESS

Physiological and Biochemical Reactivity to Stress and Smoking

Ovide F. Pomerleau, University of Michigan, Ann Arbor, MI

Chair: James E. Smith, Louisiana State University Medical Center, Shreveport, LA

INVITED ADDRESS

Computer Models Instead of Animal Experiments?—The Computer Simulator's View

Earl B. Hunt, University of Washington, Seattle, WA

Chair: Cynthia H. Null, College of William and Mary, Williamsburg, VA

SYMPOSIUM

Marijuana: Recent Research on Smoking Topography and Behavioral Effects

Chair and Discussant: Maxine L. Stitzer, The Johns Hopkins University School of Medicine, Baltimore, MD

MARIJUANA DOSING: EFFECTS OF CIGARETTE POTENCY AND SUBJECT HISTORY. Ronald I. Herning. National Institute on Drug Abuse Addiction Research Cen-

ter, Baltimore, MD: William D. Hooker and Reese T. Jones. Langley Porter Psychiatric Institute, University of California, San Francisco, CA; and Richard L. Foltz and Michael A. Peat. Center for Human Toxicology, University of Utah, Salt Lake City, UT.

Marijuana users can adjust the delivered dose of THC by altering their smoking patterns as has been observed in tobacco smokers, but evidence for THC dose regulation is sparse. We (Herning *et al.*, 1986) reported that marijuana users adjusted their smoking patterns in response to the potency of the marijuana. To investigate further how users might regulate the delivered dose, two additional studies were performed. In the first study, 32 subjects smoked four marijuana cigarettes with different THC potencies (0.0, 1.2, 2.9 and 3.9% by weight) on separate days. Smoking patterns and expired carbon monoxide (CO) as well as the subjective and cardiovascular effects of marijuana were measured. Subjective intoxication ratings and heart rate increased with potency, but expired CO did not. Puff and inhalation measures differed across THC potency. In the second study, 6 frequent (57.8 marijuana cigarettes/month) and 6 infrequent (2.4 marijuana cigarettes/month) smoked a 1.8% THC cigarette. Smoking patterns, subjective and cardiovascular effects were measured. Expired CO and THC plasma levels were also monitored. Both groups had similar cardiovascular and subjective changes after smoking. The frequent users' puff volumes and expired CO levels were more than double those of the infrequent users. Marijuana users can regulate the delivered dose of THC from a marijuana cigarette by modifying their smoking patterns. Frequent users inhale larger amounts of THC smoke to obtain the same subjective and cardiovascular effects as infrequent users. Potency-adjusted dosing patterns and acquired tolerance may account for discrepancies in dose-response relationships observed in marijuana studies.

SMOKING TOPOGRAPHY AND PERFORMANCE EFFECTS OF MARIJUANA IN HUMANS. Stephen J. Heishman and Maxine L. Stitzer. The Johns Hopkins University School of Medicine, Baltimore, MD.

Smoking is an efficient means of marijuana administration, producing rapid onset of pharmacological effects. However, it is difficult to control dosages via the inhalation route. To examine the effects of marijuana across a range of physiological, subjective and performance measures, six subjects smoked two marijuana cigarettes each containing 0, 1.3 or 2.7% Δ^9 -THC on separate days. Dosing was accomplished using a standardized smoking procedure which controlled number of puffs, breath hold duration and inter-puff interval, but not puff volume. Both active doses produced significant increases in heart rate and drug "high" ratings over placebo; however, there was no differentiation between the two active marijuana doses. Of three psychomotor tasks, circular lights, tracking and digit-symbol substitution (DSST), marijuana only slowed DSST performance; again, the active doses did not differ. Thus, orderly physiological, subjective and performance dose-response relationships were not achieved. One possible explanation is that subjects alter their smoking pattern (e.g., puff volume) of different potency cigarettes, thereby adjusting the delivered marijuana dose. Additionally, the lack of performance decrements may be explained by insensitive tasks. To investigate these issues, a second study was conducted in which

subjects smoked ad lib one cigarette containing 0, 1.3 or 2.7% Δ^9 -THC. Similar to the first study, both active marijuana doses significantly increased heart rate and subjective effects over placebo, but were not different from each other. Significant impairment was observed on a reverse digit span task, but not on forward digit span, divided attention (tracking and visual search) or DSST. Smoking topography measures indicated a trend toward smaller puff and inhalation volumes and shorter lung exposure duration for the high marijuana dose compared to the low dose. Expired air carbon monoxide (postsampling-presampling levels) for the high dose was significantly less than that for the low dose, indicating less smoke inhalation. The data suggest that marijuana smokers can adjust their delivered dose, thereby minimizing the likelihood of observing clear dose-response relationships.

UNIQUE BEHAVIORAL-PHARMACOLOGICAL PROFILES OF MARIJUANA EFFECTS IN HUMANS. John D. Roache. The University of Texas Health Science Center, Houston, TX; George E. Bigelow. The Johns Hopkins University School of Medicine, Baltimore, MD; and Warren K. Bickel. University of Vermont College of Medicine, Burlington, VT.

The effects of smoked THC-containing or placebo marijuana were compared with those of diazepam, secobarbital and amphetamine in 80 healthy adult male volunteers with recreational marijuana use histories. As a previous report described (NIDA Res. Monogr. 67:492, 1986), subjects were evaluated for intoxication by four members of the Los Angeles Police Department (LAPD) and also completed subjective ratings and objective performance tasks. Using a double-blind, triple-dummy, placebo-controlled design, all subjects smoked placebo or THC-containing marijuana cigarettes and ingested placebo or other drug-containing capsules; 10 subjects in each of three groups finally received 8 puffs (1 puff/30 sec) from each of two cigarettes containing either placebo, 1.2% or 2.8% THC. Marijuana did not significantly impair performance on any of the tasks, in contrast to diazepam and secobarbital which did impair circular lights (a saccadic hand-eye coordination test), DSST (computerized digit-symbol substitution), tracking (computer video) and 8-digit number recall (computer video) tasks. In contrast to the lack of marijuana effects on objective performance tasks, the blind observers (LAPD members) were surprisingly accurate in identifying and distinguishing the THC marijuana-treated subjects from those treated with placebo, amphetamine, diazepam or secobarbital. The four observers independently evaluated each of the subjects resulting in a total of 40 judgements for each dose. There was a dose-related increase in "marijuana intoxication" judgements from 0-11-28 across the placebo, 1.3% and 2.8% marijuana dose conditions; only 2 "stimulant" and 3 "depressant" judgements were made for the marijuana-treated subjects, and the remainder were identified as "not intoxicated." Analyses of the individual items which observers used to evaluate the subjects indicated observations of marijuana-specific effects in subjects' attitude, speech, physiological signs and motor function. Subject ratings on a checklist of 52 target symptoms indicated that marijuana produced some specific effects but also produced a mixed profile of "sedative" and "stimulant" symptoms. These results demonstrate a uniqueness in the profile of behavioral effects of marijuana as compared to other drugs.