Drug and Alcohol Dependence

Sources of information about MDMA (3,4-methylenedioxymethamphetamine): perceived accuracy, importance, and implications for prevention among young adult users☆

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Abstract

The goal of this cross-sectional study was to assess the perceived accuracy and the importance of various sources of information about MDMA/ecstasy among young adult users. A respondent driven sampling plan was used to recruit a community sample of recent ecstasy users ($n = 304$), aged 18–30, in Ohio, who responded to structured interviews. Friends, drug abuse treatment programs, and physicians were perceived to be the most accurate sources of information about ecstasy by 45.7, 37.2, and 30.3% of the sample, respectively. Friends were considered the most important source of information about ecstasy (40.2%), followed by web sites like DanceSafe (16.2%), and MTV/VH1 televison specials (6.9%). About half the sample used the Internet to obtain information about ecstasy, with younger and more educated participants significantly more likely to do so. Educated users were also significantly more likely to consider the Internet to be an important source of information. Web sites like DanceSafe were visited by four times as many users as government-sponsored web sites. Findings support the development of peer-oriented, network strategies to reach ecstasy users with prevention messages. Efforts to make prevention web sites more attractive should be considered.

Keywords: MDMA; Ecstasy; Substance abuse; Prevention; Peer intervention; Internet

1. Introduction

Although 3,4-methelyenedioxymethamphetamine (MDMA, "ecstasy") was first synthesized nearly ninety years ago, the compound remained relatively obscure until the late 1960s when it surfaced in the San Francisco Bay area (Siegel, 1986). Some of the desired acute effects of the drug, which is structurally related to amphetamine and mescaline, include euphoria and sensory alterations (Shulgin, 1981; Steele et al., 1994). By the mid-1970s, MDMA had developed a following in several areas of the United States among people who were using it non-medically as well as quasi-medically (Smith et al., 1985; Siegel, 1986). By the 1990s, the use of MDMA—by then often referred to as ecstasy—had spread across geographies and social groups (Beck and Rosenbaum, 1994). Today ecstasy use in the United States is not uncommon with some estimates of lifetime prevalence exceeding 10% among young adults (Johnston et al., 2001). Along with the upsurge in ecstasy use has come widespread concern about the drug's effects on users' health. The list of possible adverse consequences associated with ecstasy use is wide-ranging with neurotoxicity the focus of much attention (Hayner and McKinney, 1986; Steele et al., 1994; Curran, 2000; McCann et al., 1996). Prevention strategies targeting users can help reduce ecstasy-related morbidity. Since information will be a critical component of any such efforts, having a better understanding of what users think of various sources of information about the drug is of practical importance.

The beliefs people hold about a drug such as MDMA/ecstasy influence whether or not they will use that drug (Fishbein and Middlestadt, 1987; Johnston et al., 2001). In turn, the information a person receives about a drug helps shape these beliefs (McGuire, 1974, 1985). Indeed, some

☆ Readers wanting additional information on the questionnaire used in this study are encouraged to contact the authors.

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research suggests that information alone can affect behavior (Fishbein, 1995). Consequently, sources of drug information are a subject of considerable interest since source characteristics (e.g. demographics, credibility, perceived accuracy) help determine whether beliefs, attitudes, and behaviors are impacted.

For some time now, source credibility as well as the perceived accuracy of the drug information provided have been recognized as integral to drug abuse prevention efforts (Blum et al., 1976). One of the earliest studies of source credibility involved Canadian high school students ($n = 2507$) and found that drug users relied heavily on their drug using friends for trustworthy and expert information about drugs (Smart and Fejer, 1972). A study involving young people ($n = 108$), drawn from a high school in Manhattan, Kansas, and a treatment center in St. Louis, found that the credibility attributed to sources of drug information varied significantly according to drug use status. Non-users believed that users were the least credible and physicians the most credible, while for users, other users and their own experience were most credible, law enforcement sources were least credible, and physicians near the middle. Among users, friends who used drugs ranked high in credibility. Less than half of both groups saw television or mainstream newspapers as credible sources, but about half of the users saw underground papers as credible (Sinnett et al., 1975). A study of junior and senior high-school students ($n = 682$) in a New York City suburb found that more than 60% considered physicians, former users, and friends to be the "most believable" sources of drug information; television and newspapers were considered "most believable" by 29% and 36% of the students, respectively (Dembo et al., 1977). Research involving rural Southwestern high-school students, whose drug using status was not addressed, found that friends were a highly used source of information about drugs, and that girls relied more on friends for such information than did boys (Harris et al., 1991). A study of juvenile and adult cocaine users ($n = 110$) in Baltimore area drug abuse treatment programs found that television and friends were the most often used sources of information about cocaine, although the information provided by friends was seen as lacking in accuracy compared to other sources (Hickey et al., 1991). In general, these studies suggest that friends rank high as important sources of information about drugs, but ranking varies according to the types and number of sources considered as well as the drug using status of the subjects studied.

Several recent studies have focused on Internet web sites as sources of information about drugs, hallucinogens and club drugs—like ecstasy—in particular. Employing a harm reduction perspective, some web sites offer a range of information from drug users' reports about their experiences to abstracts and full-texts of scientific articles, though the scope and depth of information available varies from site to site. Some sites are major sources of information if the number of visits they receive is any indication. For example, one non-government site, the Vaults of Erowid, reports on its homepage getting 25,000 visits per day (Erowid, 2003). The accuracy of the information provided by well known sites such as DanceSafe.org, Erowid.org, and Ecstasy.org are the subject of some dispute. One investigator, who reviewed the accuracy of the information on the subjective and physiological effects, the biological sources, and the synthesis and extraction procedures for selected drugs posted on several popular web sites, and compared that information with the published scientific literature, found the on-line information to be largely accurate (Bogenschutz, 2000). In contrast, a group of investigators who evaluated the accuracy of selected information appearing on seven sites, including the three noted above, concluded that each site presented potentially harmful misinformation on the management of adverse drug reactions (Boyer et al., 2001). Other researchers have been impressed by what they consider to be the "extraordinary wealth of online information" on all aspects of hallucinogenic drug use (Halpern and Pope, 2001). These findings are of some consequence, since there is evidence that young people use the Internet to obtain information about drugs and that such information can influence drug-taking behavior (Borzekowski and Rickert, 2002; Wax, 2002).

Knowing how drug users rate sources on the basis of the perceived accuracy of the information provided, as well as which sources users consider most important to them, can aid the development of drug abuse prevention strategies. The study presented here attempts to shed light on sources of information about MDMA/ecstasy and how they are viewed by people who have recent experience with the drug. Two questions form the basis for this research: (1) what sources of information about ecstasy do users consider to be the most accurate? (2) What do users consider to be their most important source of information about the drug? Use of the Internet to obtain information about ecstasy is also explored.

2. Methods

2.1. Sample

The subjects in this study were 304 people living in a metropolitan area in central Ohio, who, between May and December 2002, agreed to participate in a natural history research project examining the use of ecstasy and other "club" drugs among young adults. To be eligible for the natural history project's baseline interview, participants had to be between 18 and 30 years old; an Ohio resident; not involved in a formal drug treatment program within the past 30 days; able to give an address and telephone number at which they could be contacted for follow-up; and report having used MDMA/ecstasy at least once in the past six months.

A respondent-driven sampling (RDS) plan was used to recruit participants (Heckathorn, 1997). Similar to chain-referral sampling, the RDS plan relied on the identification and recruitment of a range of "seeds," in this instance recent ecstasy users, who gave referral coupons to friends and

acquaintances whom they felt were potentially eligible for study participation. In turn, eligible participants referred by "seeds" gave referral coupons to their friends and acquaintances, and the sample "snowballed." Project staff employed ethnographic research methods to identify "seeds" at dance clubs, music festivals, raves, and other venues. To maximize the representativeness of the sample, a diversity of "seeds" was identified based on gender, ethnicity, frequency of ecstasy use, and educational status. To moderate potential recruitment biases resulting from differences in the size of personal networks, referrals from each participant were limited to three people. "Seeds" and participants were not given the specific eligibility criteria to help avoid that information being used by ineligible individuals to gain entry into the project. Participants were compensated US$ 15 for each referral who presented at the field site office for an eligibility determination.

Since the research project employed a natural history design, no interventions were conducted; however, passive referrals for information, treatment, and counseling services were made at the conclusion of the interview. In addition, participants were offered educational pamphlets on STD/HIV risk reduction. Informed consent was obtained from all participants following a protocol that was approved by the university's Institutional Review Board. In addition to being compensated for their recruitment efforts, participants received US$ 50 for the time they spent responding to the 2–3 h baseline interview.

2.2. Data collection

Interviews were conducted in field site offices located in a nondescript office building in a densely populated urban setting. Interviewers were trained by two of the project's senior research staff who periodically monitored questionnaire administration. Given the concerns about the effects of the post-ecstasy use wash-out period affecting the interview (Curran and Travill, 1997; Curran, 2000), no subject was interviewed within three days of last having used the drug. The baseline questionnaire was largely interviewer-administered with a short segment on sex risk behaviors audio computer self-administered by the subject. The questionnaire consisted of standardized and author-generated items. Data were collected in a variety of areas including, but not limited to, sociodemographics; age of first ecstasy use; the venue where ecstasy was most often used; the total number of occasions ecstasy has been used; and intentions to use ecstasy again. Other data on patterns of drug use were collected using a format employed successfully in an earlier study of crack-cocaine users (Siegal et al., 1998).

2.3. Measures

The measures of interest in this study are: (1) the perceived accuracy of information about ecstasy that participants attributed to various sources; (2) the most important sources of information about ecstasy for participants; (3) whether participants had ever used the Internet to learn about ecstasy; and (4) whether participants had ever visited selected Internet sites to learn about ecstasy.

To obtain these data, participants were asked the following questions. Regarding the perceived accuracy of information: "How would you rate the following sources in terms of accuracy of the information they provide about ecstasy?" with a response scale of 0: not accurate, 1: somewhat accurate, 2: mostly accurate, and 3: very accurate. Do not know and refused were also response options. Participants were given a response card as well as a list of sources to view as the interviewer read the following list of 16 sources: (1) US federal government; (2) television ads/commercials sponsored by groups like the Partnership for a Drug-Free America (i.e. this is your brain on drugs/egg in frying pan); (3) MTV or VH1 specials (Music TeleVision and Video Hits 1 are youth-oriented cable/satellite television networks whose programming consists of music videos, music-related features such as musician biographies, documentaries, cartoons, and so-called "real life" shows); (4) television specials on drugs by major networks (CBS, NBC, ABC, Fox), including shows like Dateline, 20/20, and 48 hours; (5) local and national TV news, including CNN, NBC, ABC, etc.; (6) radio; (7) mainstream daily newspapers, like USA Today, New York Times, the local daily paper; (8) alternative press newspapers and magazines, like Rolling Stone and Spin; (9) mainstream magazines, like Time and Newsweek; (10) drug abuse treatment programs; (11) physicians in general; (12) your parents; (13) your brothers or sisters; (14) your friends; (15) Internet web sites, like, but not limited to—DanceSafe.org, Ecstasy.org or Erowid.org; and (16) other people in general who use drugs. To determine the most important source of information from the aforementioned list, participants were asked; "For you, what is the single most important source of information about ecstasy?" Regarding the Internet, participants were asked several questions: "Have you ever used the Internet to learn about ecstasy?"; "Have you ever visited a web site sponsored by a US government agency, like the National Institute on Drug Abuse?"; and "Have you ever visited the DanceSafe.org, Ecstasy.org, or Erowid.org websites to learn about ecstasy?" In addition, participants were asked, "How important has the Internet been to you in learning about ecstasy?" with "not important," "somewhat important," "important," and "very important" as response options.

2.4. Statistical analysis

Descriptive statistics were used to present the sample, rank the sources according to perceived accuracy and importance, the use of selected web sites, and the relationship between sample characteristics and most important information sources. Analysis of variance (ANOVA) was used to explore the relationships between sample characteristics and use of the Internet (SAS Institute, 1999).

3. Results

The sample ($n = 304$) was largely male (66.1%) and predominately white (81.6%), with a mean age of 21.2 years (S.D. = 2.8). Educationally, having some college or a college degree was reported by 50.3% of the participants; high school graduation by 38.8%; and less than a high school diploma by 10.9%. Almost half (48%) reported current enrollment in a college or university. All participants reported having used at least one drug other than MDMA for non-medical purposes in the 30 days prior to the baseline interview. These drugs included but were not limited to alcohol (92.8%), marijuana (87.1%), non-prescribed opioids (27.9%), cocaine (27.6%), non-prescribed tranquilizers (19.7%), psilocybin mushrooms (14.9%), amphetamine (11.7%), inhalants other than volatile nitrites (11.1%), LSD (5.0%), and heroin (2.7%). Daily tobacco use was common (61.7%). A history of formal drug abuse treatment was reported by 17.4% of the sample.

All participants had used MDMA/ecstasy in the last 6 months and 40.8% reported using it in the last 30 days. The mean age of first use of ecstasy was 18.7 years (S.D. = 2.9), and the lifetime mean number of occasions participants reported having used ecstasy was 34.2 (S.D. = 79.5). The locations where participants most often used ecstasy were dance clubs (17.8%), where attendance is open to virtually anyone over 18 years of age who can pay the admission price; "rolling" and house parties (30.3%), where attendance is by invitation and entrance controlled; raves (10.5%), where attendance is by word of mouth and open; and other locations (41.5%). More than half of these other locations (52.4%) consisted of small non-party gatherings at their own or friends' homes while the remainder included but was not limited to concerts, bars, parks and other outdoor venues. Regarding expressed intentions to use ecstasy again in the future, 8.3% of the participants said they definitely would not; 16.2% probably would not; 15.8% do not know; 37.3% probably will; and 22.4% definitely will.

The degree of accuracy that participants attributed to various sources of information about ecstasy is displayed in Table 1. Sources are listed in descending order on the basis of the percentage of participants ascribing a rating of very accurate to a source. Friends, drug abuse treatment programs, and physicians were the top three sources in terms of accuracy as they were perceived to be very accurate by 45.7, 37.2 and 30.3% of the sample, respectively. Web sites like DanceSafe and Erowid, hereafter referred to as non-government web sites, ranked fourth on the list, and were considered very accurate by 24.7% of the sample. Radio, parents, and mainstream newspapers ranked lowest with 2.3, 5.9, and 5.9% of the sample, respectively, considering them very accurate.

Friends were considered the single most important source of information by 40.2% of the sample, followed by non-government web sites (16.2%), MTV/VH1 specials (6.9%), physicians (5.6%), brothers/sisters (4.0%), and commercial television specials (4.0%). All other sources were 3% or less.

The sample was almost evenly divided between those who used the Internet to obtain information about ecstasy (50.3%) and those who did not. ANOVA results show that younger participants were more likely than older participants to have used the Internet to get information about ecstasy ($F^2_{302} = 5.47$, $P = 0.005$) (see top panel of Table 2). Also, those participants with more education were more likely than those with less education to have used the Internet ($F^2_{302} = 3.13$, $P = 0.004$). In the sample, 62 participants (20.4%) considered the Internet to be an important or very important source of information for themselves. Again, participants with more education were more likely than less educated participants to report this ($F^2_{302} = 4.79$, $P = 0.009$) (see bottom panel of Table 2).

Table 3 shows the use of selected web sites by sociodemographic characteristic. Overall, the non-government web

Table 1
User ratings of the perceived accuracy of MDMA/ecstasy information sources (in %) ($n = 304$)

Source	Very accurate	Mostly accurate	Somewhat accurate	Not accurate	Do not know
Friends	45.7	32.9	18.4	3.0	0.0
Drug treatment programs	37.2	16.8	8.5	2.3	34.9
Physicians in general	30.3	27.0	14.1	3.0	25.7
Non-government web sites	24.7	30.2	13.2	1.6	30.1
MTV/VHI specials	23.0	33.8	25.0	4.6	13.5
Alternative press	18.4	38.2	17.1	4.0	22.4
Commercial TV specials	18.4	33.5	25.0	12.1	10.9
Brothers/sisters	16.9	15.1	20.1	27.7	16.9
Other drug users	14.8	42.1	30.9	6.6	5.6
Mainstream magazines	13.8	35.9	21.4	4.3	24.7
TV news	10.9	30.9	37.8	7.6	13.5
US government sources	10.2	26.0	34.2	10.5	19.1
Partnership ads	8.9	25.3	41.5	21.4	3.0
Mainstream papers	5.9	32.2	32.9	7.4	21.7
Parents	5.9	8.2	24.0	47.4	14.5
Radio	2.3	14.1	29.9	11.8	41.8

Table 2
Use and importance of the Internet to obtain MDMA information

	Users vs. non-users of Internet for information about MDMA/ecstasy ($n = 304$)		
	Users, *n* (%)	Non-Users, *n* (%)	
Gender			
Men	102 (50.7)	99 (49.3)	
Women	51 (49.5)	52 (50.5)	
			$F^1_{303} = 0.04$, $P = 0.839$
Age			
<20	65 (60.7)	42 (39.3)	
20–24	73 (48.3)	78 (51.7)	
25–30	15 (32.6)	31 (67.4)	
			$F^2_{302} = 5.47$, $P = 0.005$
Ethnicity			
White	127 (51.2)	121 (48.8)	
Other	26 (46.4)	30 (53.6)	
			$F^1_{303} = 0.42$, $P = 0.520$
Education			
<High school	11 (33.3)	22 (66.7)	
High school	56 (47.5)	62 (52.5)	
College	86 (56.2)	67 (43.8)	
			$F^2_{302} = 3.13$, $P = 0.004$
	MDMA users who consider Internet important vs. not important information source ($n = 304$)		
	Important	Not important	
Gender			
Men	47 (23.4)	154 (76.6)	
Women	15 (14.6)	88 (85.4)	
			$F^1_{303} = 3.28$, $P = 0.071$
Age			
<20	23 (21.5)	84 (78.5)	
20–24	31 (20.5)	120 (79.5)	
25–30	8 (17.4)	38 (84.8)	
			$F^2_{302} = 0.17$, $P = 0.846$
Ethnicity			
White	54 (21.8)	194 (78.2)	
Other	8 (14.3)	48 (85.7)	
			$F^1_{303} = 1.58$, $P = 0.210$
Education			
<High school	2 (6.1)	31 (93.9)	
High school	19 (16.1)	99 (83.9)	
College	41 (26.8)	112 (73.2)	
			$F^2_{302} = 4.79$, $P = 0.009$

sites attracted four times as many visitors as did government web sites. Sociodemographic differences exist. For example, seven times as many participants under 20 years old reported visiting non-government web sites as reported visiting government sites. The Other Sites category represents participants who used the Internet but did not visit the government or non-government web sites presented in the questionnaire. This category would likely consist of web sites run by academic or health organizations.

Table 4 cross tabulates the characteristics of participants with the single most important information sources. Particular attention is given to friends, the non-government web sites, MTV/VH1 television specials, and physicians, as they were considered by 68.9% of the sample to be the most important information sources. All other sources were combined into the Other category. Friends were the single most important source of information about ecstasy for both men (41.3%) and women (37.9%). However, more men (19.9%) than women (8.7%) considered non-government web sites most important, while more women (9.7%) than men (5.5%) considered MTV/VH1 specials to be most important. A similar pattern is evident with the remaining individual characteristics; friends predominate as the single most important source of information. Some other findings are notable. For example, a higher percentage of people under 20 years old (20.6%) considered the non-government web sites most

Table 3
Characteristics of MDMA users who use selected web sites to obtain MDMA/ecstasy information ($n = 304$)

	Government sites, *n* (%)	Non-government sites, *n* (%)	Other sites, *n* (%)	No web visits, *n* (%)
Gender				
Men	13 (6.5)	60 (29.9)	29 (14.4)	99 (49.3)
Women	7 (6.8)	25 (24.3)	19 (18.5)	52 (50.5)
Age				
<20	6 (5.6)	42 (39.3)	17 (15.9)	42 (39.5)
20–24	13 (8.6)	37 (24.5)	23 (15.2)	78 (51.7)
25–30	1 (2.2)	6 (13.4)	8 (17.9)	31 (67.4)
Ethnicity				
White	17 (6.9)	73 (29.4)	37 (14.9)	121 (48.9)
Other	3 (5.4)	12 (21.4)	11 (19.6)	30 (53.6)
Education				
<High school	0 (0)	6 (18.2)	5 (15.1)	22 (66.7)
High school	8 (6.8)	28 (23.7)	20 (17.0)	62 (52.6)
College	12 (7.9)	51 (33.3)	23 (15.0)	67 (43.8)

important compared to older users (10.8%), corroborating some findings presented in Table 3. Similarly, higher percentages of more educated participants (19.6%) identified these web sites as most important than did those with less education (9.1%). Finally, regarding venue of use, those participants who reported raves as the most common place for using ecstasy (i.e. Ravers) seemed to rely more on non-government web sites than did other groups.

Table 4
MDMA User characteristics and sources of information about MDMA/ecstasy identified as most important ($n = 304$)

	Friends, *n* (%)	Non-government web, *n* (%)	MTV/VH1, *n* (%)	Physicians, *n* (%)	Other, *n* (%)
Gender					
Men	83 (41.3)	40 (19.9)	11 (5.5)	10 (5.0)	57 (28.3)
Women	39 (37.9)	9 (8.7)	10 (9.7)	7 (6.8)	38 (36.9)
Age					
<20	44 (41.1)	22 (20.6)	7 (6.5)	6 (5.6)	28 (26.1)
20–24	63 (41.7)	22 (14.6)	8 (5.3)	10 (6.6)	48 (31.8)
25–30	15 (32.6)	5 (10.8)	6 (13.0)	2 (4.3)	19 (41.3)
Ethnicity					
White	101 (40.7)	44 (17.7)	16 (6.5)	12 (4.8)	75 (30.2)
Other	21 (37.5)	5 (8.9)	5 (8.9)	5 (8.9)	20 (35.7)
Education					
<High school	16 (48.5)	3 (9.1)	1 (3.0)	2 (6.0)	11 (33.3)
High school	50 (42.4)	16 (13.6)	8 (6.8)	7 (5.9)	37 (31.4)
College	56 (36.6)	30 (19.6)	12 (7.8)	8 (5.2)	47 (30.7)
Most common venue[a]					
Clubbers	18 (33.3)	6 (11.1)	3 (5.7)	3 (5.7)	24 (44.4)
Partiers	46 (50.0)	15 (16.3)	10 (10.9)	5 (5.4)	16 (17.4)
Ravers	14 (43.6)	10 (31.3)	0 (0)	1 (3.1)	7 (21.8)
Other home	44 (34.9)	18 (14.3)	8 (6.4)	8 (6.4)	48 (38.1)
Ecstasy use					
<5	80 (44.0)	29 (15.9)	9 (5.0)	7 (3.9)	57 (31.3)
5–9	17 (29.3)	9 (15.5)	7(12.1)	3 (5.2)	22 (37.9)
>10	25 (39.1)	11 (17.1)	5 (7.8)	7 (10.9)	16 (25.0)
Behavioral intentions to use ecstasy					
Definitely not	8 (32.0)	4 (16.0)	1 (4.0)	1 (4.0)	11 (44.0)
Probably not	17 (34.7)	9 (18.4)	4 (8.2)	15 (30.6)	4 (8.1)
Do not know	23 (47.9)	5 (10.4)	5 (10.4)	1 (2.1)	14 (29.1)
Probably will	47 (41.6)	22 (19.5)	7 (6.2)	7 (6.2)	30 (26.6)
Definitely will	27 (39.7)	9 (13.2)	3 (4.4)	4 (5.9)	25 (36.8)

[a] Defined on the basis of the place ecstasy was most often used.

4. Discussion

The results of this study describe the perceived accuracy as well as the importance ecstasy users attribute to various information sources. By asking users what they consider to be their most important source of information about the drug, the results also suggest where young adults turn to obtain that information. Given the critical nature of source characteristics in persuasive communication models (McGuire, 1974, 1985), and information in some behavior change models (Fishbein, 1995), the results of this exploratory study can help inform prevention strategies targeting ecstasy users. The findings highlight the significance of friends. Aside from being the source to which more users turn to learn about ecstasy than any other, friends also rated higher than any other source in the perceived accuracy of the information they provide. The non-government web sites specified in this study ranked second to friends as the most important source but behind drug abuse treatment programs and physicians in perceived accuracy. The stated behavioral intentions of participants are also noteworthy. Nearly 70% have expressed some degree of uncertainty regarding future ecstasy use: 15.8% said they "did not know" whether they would use ecstasy again, 16.2% reported they "probably would not" and 37.3% said they "probably will." This suggests there is a wide target for prevention efforts directed toward ecstasy users.

Similar to earlier research (Smart and Fejer, 1972; Sinnett et al., 1975; Dembo et al., 1977; Hickey et al., 1991), the overall results of this study again show the importance of friends as an information source about drugs, in this case, ecstasy. In terms of accuracy, nearly 80% of the sample considered friends to be accurate sources of information when the "very accurate" and "mostly accurate" categories are combined. No other source approaches friends in this regard (see Table 1). The findings on accuracy suggest that friends are perceived to be expert and, arguably, credible sources of information about ecstasy. Why sources were rated as they were is uncertain. It may be that young adult drug users are more likely to attribute credibility to those sources whom they consider trustworthy and think have some direct experience with MDMA/ecstasy, or experience with people who have used the drug. This may explain why friends, drug abuse treatment programs, and physicians rate highly. It may also explain why non-government web sites and MTV/VH1 rate relatively highly since both of these sources have used individuals who have experience with the drug to transmit information about the drug.

The findings of this study suggest that friends may be the lynchpin of ecstasy prevention programming. There is some additional support for this perspective. When asked who they would talk to about a serious problem, youths responding to the 1999 edition of the US National Household Survey on Drug Abuse overwhelming chose friends or siblings as the people to whom they would turn (National Household Survey on Drug Abuse, 2003). Also, there is good qualitative evidence that social networks are of critical importance in understanding the diffusion of ecstasy use (Carlson, 2001; Carlson et al., in press; Case, 2001; Schensul, 2001). Coupling these findings with the results from this study provide support for the development of network-based prevention efforts. Such an effort might involve enlisting users, training them in a brief educational protocol, providing them with scientifically-sound educational materials, and asking them to educate other users in their network about the potential adverse consequences associated with ecstasy use and how to avoid them. Although developing a network-based prevention program would be challenging, there is theoretical as well as practical support for such efforts with drug users (Latkin et al., 1996; Ferrence, 2001; Weeks et al., 2002).

Beyond demonstrating the critical role of friends in information dissemination, the results show a gap between the importance of sources and the degree of accuracy participants attributed to them. For example, both drug abuse treatment programs and physicians ranked near the top as sources that were perceived to be "very accurate" but relatively low as a "most important" source of information. In other words, these two sources, which were viewed as being providers of highly accurate information, are likely not used as frequently as are other sources with higher "importance" ratings. This is noteworthy because these sources would be most likely to provide information counter to that provided by friends since physicians and drug abuse treatment programs generally do not sanction non-therapeutic drug use. The low level of accuracy attributed to radio, parents, and mainstream newspapers, as well as their low rankings in importance, suggest that their communications are not likely to impact the ecstasy-using behavior of many current users. On the other hand, the findings suggest that non-government web sites, which had the lowest "not accurate" rating of all sources, and special MTV/VH1 television programs on ecstasy may influence behavior.

As one of the first studies to examine the use of the Internet by ecstasy users to obtain information about the drug, the findings provide another dimension to the picture drawn from studies of the sites themselves. Although Internet use is increasingly common among young people in the United States, research suggests well less than 20% use the web to get information about alcohol and other drugs (Borzekowski and Rickert, 2002). In contrast, among the ecstasy users in this sample, at least 50% got drug information on-line. Table 2 (top panel) shows that Internet users were younger and more educated than non-users, perhaps a reflection of the fact that nearly half the sample was enrolled in university course work at the time of the interview.

Recent studies examining drug information available on the Internet have noted that search engines do not find nearly as many "anti-drug" sites compared to harm reduction sites like DanceSafe or the Vaults of Erowid, and that the latter get a high volume of visits (Boyer et al., 2001; Halpern and Pope, 2001). This study's findings suggest that non-government web sites have been, and will be, utilized by many more ecstasy users than government-sponsored

web sites, thereby providing additional support for these earlier observations (see Table 3).

The results presented in Table 4 show the relationship between user characteristics and information sources—who goes where to learn about ecstasy. Such findings may prove helpful in formulating prevention strategies targeting ecstasy users. Some observers have suggested using peer-led interventions delivered in dance clubs as a way of communicating the risks posed by ecstasy use (Boot et al., 2000). The results provide support for such endeavors but also suggest the need to work in additional venues and employ other sources to reach users, since they are an increasingly heterogenous group (Carlson et al., in press). Prevention strategies will need to recognize these differences to reach the target audience(s). For example, the findings indicate that many young people who frequent raves rely heavily on non-governmental web sites to get information about ecstasy. Thus, a strategy that involves the Internet may be helpful in reaching this group. As others have suggested (Halpern and Pope, 2001; Boyer et al., 2001), this study's findings can be interpreted to suggest that government-sponsored web sites need to become more numerous and/or more appealing. How to accomplish this is beyond the scope of this study; however, such efforts might involve funding university-operated web sites that may be less likely to be viewed as being biased.

Aside from encouraging strategies focusing on personal networks and the Internet, the results also hint that involving other sources may be useful. As noted earlier, physicians and drug abuse treatment programs rank high as accurate sources of information about ecstasy, but they are not frequently seen as important sources. An assortment of prevention strategies can be envisioned that take this finding into account. One might be nationally-distributed television advertisements that employ as their communicator a physician who has experience counseling or treating ecstasy users, who is identified as such. Such advertisements could be further enhanced by attending to other important communicator characteristics that help determine whether a message reaches its destination and impacts behavior (McGuire, 1974, 1985; Petty and Wegener, 1998). In addition to well-conceived national media campaigns, efforts that would encourage physicians in office-based and other clinical settings to learn more about drugs like MDMA/ecstasy and routinely provide brief education/counseling sessions about them to adolescents and young adults may be beneficial. It is well-established that brief, physician-delivered interventions can have significant effects on patients non-medical drug use practices (Russell et al., 1979; Ockene et al., 1999).

Although the content of future prevention programs targeting ecstasy is yet to be determined, it is reasonable to say that it will be passionately debated due to current controversies in the field centering on the nature and extent of the drug's adverse effects on health (Ricaurte et al., 2002; McCann et al., 2000; Kish, 2002; Reneman et al., 2001; Grob, 2000; Simon and Mattick, 2002; Cole et al., 2002; Curran, 2000; Parrott et al., 2000). Some researchers have suggested employing strategies to minimize the risks of ecstasy use, not unlike those that have been and are now used to reduce the risk of acquiring and transmitting blood-born diseases among injection drug users (Beck and Rosenbaum, 1994; Boot et al., 2000). Beyond dispute, however, is that MDMA/ecstasy, like many other street drugs, is often misrepresented, adulterated, or inconsistently dosed, thereby presenting omnipresent and very serious threats to the health and safety of users (Falck and Seal, 1980; Green et al., 1995; Hayner, 2002; Cole et al., 2002). These issues have yet to become the central feature of a major prevention effort targeting ecstasy users.

This study has several limitations. First, the sample is not a random one; however, random samples are seldom, if ever, recruited among hidden populations such as not-in-treatment drug users (Watters and Bernacki, 1989). Also, the study's eligibility criteria excluded older (over 30) or very young (under 18) users. In addition, the overwhelming majority of the sample considered themselves to be heterosexual. Further, all study participants were residing in a large city in Ohio at the time of the interview, and it is possible that this midwestern orientation limits the generalizability of the results in unknown ways. Consequently, it is possible the study's findings may not be reflective of groups who differ in age, sexual orientation, or social geography from the sample described here. Nevertheless, the sampling plan attempted to increase the representativeness of the sample as compared to a simple opportunity sample. Second, when assessing the perceived accuracy of the 16 sources of MDMA information, whether participants had actually engaged each source is not known, save that one source which participants said they considered most important to them. The variation seen in the "Don't Know" response options suggests, however, that participants did not judge information sources which they had not encountered. Further, even if participants did rate those sources with which they had no experience, it can be argued that their perceptions of source accuracy do indeed reflect their likelihood of using that source or accepting its information. Lastly, regarding web site identification, it is possible that participants may have visited US government sponsored web sites and not known it. If so, the size of the differences in web site visits between government and non-government sites would likely not be so large. Arguing against this are findings from other research (Boyer et al., 2001; Halpern and Pope, 2001) and the results of this study on the comparative importance of government and non-government sites.

The findings of this study have practical implications. They suggest that many young people who have used ecstasy are uncertain about their future use of the drug. Thus, prevention programming has an opportunity to influence drug use decisions as well as to mitigate health and safety risks posed by MDMA/ecstasy. This study's findings can help inform the development of that programming. Finally, although this study has focused on how MDMA/ecstasy users

view sources of information about the drug, it raises questions beyond this somewhat narrow scope. If, for example, the views held by participants on MDMA information sources are reflective of those young adult users hold about information sources for other drugs, then prevention efforts relying on traditional print and broadcast media may be missing their mark. Future research should examine this issue since source credibility is central to effective prevention programming.

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References

Beck, J., Rosenbaum, M., 1994. Pursuit of Ecstasy: The MDMA Experience. State University of New York Press, Albany, NY.

Blum, R.H., Blum, E., Garfield, E., 1976. Drug Education: Results and Recommendations. D.C. Heath, Lexington, MA.

Bogenschutz, M.P., 2000. Drug information libraries on the internet. J. Psychoactive Drugs 32, 249–258.

Borzekowski, D.L., Rickert, V.I., 2002. Urban girls, internet use, and accessing health information. J. Pediatr. Adolesc. Gynecol. 13, 94–95.

Boot, B.P., McGregor, I.S., Hall, W., 2000. MDMA (Ecstasy) neurotoxicity: assessing and communicating the risks. Lancet 355, 1818–1821.

Boyer, E.W., Shannon, M., Hibberd, P.L., 2001. Web sites with misinformation about illicit drugs. N. Engl. J. Med. 345, 469–471 [letter].

Carlson, R.G., 2001. Patterns and trends of MDMA abuse and risky sexual behavior in central Ohio. Conference Presentation: 'Ecstasy: A Scientific Conference', 19–20 July, Natcher Auditorium, NIH Campus, Bethesda, MD.

Carlson, R.G., Falck, R.S., McCaughan J.A., Siegal, H.A., in press. MDMA/'Ecstasy' use among young people in Ohio: perceived risk and barriers to intervention. J. Psychoactive Drugs.

Case, P., 2001. Patterns of MDMA use among men who have sex with men in Boston and New York City. Conference Presentation: 'Ecstasy: A Scientific Conference', 19–20 July, Natcher Auditorium, NIH Campus, Bethesda, MD.

Cole, J.C., Bailey, M., Sumnall, H.R., Wagstaff, G.F., King, L.A., 2002. The content of ecstasy tablets: implications for the study of their long-term effects. Addiction 97, 1531–1536.

Curran, H.V., 2000. Is MDMA ('Ecstasy') neurotoxic in humans? An overview of evidence and of methodological problems in research. Neuropsychobiology 42, 34–41.

Curran, H.V., Travill, R.A., 1997. Mood and cognitive effects of +/− (3,4)-methylene-dioxymethamphetamine (MDMA/Ecstasy): weekend high followed by mid-week low. Addiction 92, 821–831.

Dembo, R., Miran, M., Babst, D.V., Schmeidler, J., 1977. The believability of the media as sources of information on drugs. Int. J. Addict. 12, 959–969.

Erowid, 2003. Available at: http://www.erowid.org/general/about/about.shtml. Accessed 25 February 2003.

Falck, R., Seal, M., 1980. Street drug misrepresentation. J. Am. Med. Assoc. 244, 332 [letter].

Ferrence, R., 2001. Diffusion theory and drug use. Addiction 96, 165–173.

Fishbein, M., 1995. Developing effective behavior change interventions: some lessons learned from behavioral research. In: Backer, T.E., David, S.L., Soucy, G. (Eds.), Reviewing the Behavioral Science Knowledge Base on Technology Transfer. NIDA Research Monograph 155, Rockville, MD, pp. 246–261.

Fishbein, M., Middlestadt, S.E., 1987. Using the theory of reasoned action to develop educational interventions: Applications to illicit drug use. Health Educ. Res. 2, 361–371.

Green, A.R., Cross, A.J., Goodwin, G.M., 1995. Review of the pharmacology and clinical pharmacology of 3,4-methylenedioxymethamphetamine (MDMA or "Ecstasy"). Psychopharmacology 119, 247–260.

Grob, C.S., 2000. Deconstructing ecstasy: the politics of MDMA research. Addict. Res. 8, 549–588.

Halpern, J.H., Pope, H.G., 2001. Hallucinogens on the internet: a vast new source of underground drug information. Am. J. Psychiatry 158, 481–483.

Harris, M.B., Harris, R.J., Davis, S.M., 1991. Ethnic and gender differences in Southwestern students' sources of information about health. Health Educ. Res. 6, 31–42.

Hayner, G.N., 2002. MDMA misrepresentation: an unresolved problem for ecstasy users. J. Psychoactive Drugs 34, 195–198.

Hayner, G.N., McKinney, H., 1986. MDMA. The dark side of ecstasy. J. Psychoactive Drugs 18, 341–347.

Heckathorn, D.D., 1997. Respondent-driven sampling: a new approach to the study of hidden populations. Soc. Probl. 44, 174–199.

Hickey, J.E., Brown, B.S., Chung, A.S., Kolar, A.F., Michaelson, B.S., 1991. Perceived risk and sources of information regarding cocaine. Int. J. Addict. 26, 757–767.

Johnston, L.D., O'Malley, P.M., Bachman, J.G., 2001. Monitoring the Future. National Survey Results on Drug Use, 1975–2000. College Students and Adults, vol. II. Ages 19–40. NIDA, Bethesda, MD, pp. 153–168; 226.

Kish, S.J., 2002. How strong is the evidence that brain serotonin neurons are damaged in human users of ecstasy? Pharmacol. Biochem. Behav. 71, 845–855.

Latkin, C.A., Mandell, W., Vlahov, D., Oziemkowska, M., Celentano, D.D., 1996. The long-term outcome of a personal network-oriented HIV prevention intervention for injection drug users: the SAFE study. Am. J. Commun. Psychol. 24, 341–364.

McCann, U.D., Slate, S.O., Ricaurte, G.A., 1996. Adverse reactions with 3,4-methylenedioxymethamphetamine (MDMA; 'Ecstasy'). Drug Saf. 15, 107–115.

McCann, U.D., Eligulashvili, V., Ricaurte, G.A., 2000. (+/−) 3,4-Methylenedioxy-methamphetamine ('Ecstasy')-induced serotonin neurotoxicity: clinical studies. Neuropsychobiology 42, 11–16.

McGuire, W.J., 1974. Research on methods and programs of drug education. In: Goodstadt, M. (Ed.), Communication-Persuasion Models for Drug Education. Alcoholism and Drug Addiction Foundation of Ontario, Toronto, pp. 1–26.

McGuire, W.J., 1985. Attitudes and attitude change. In: Lindzey, G., Aronson, E. (Eds.), Handbook of Social Psychology. McGraw-Hill, New York, pp. 233–346.

National Household Survey on Drug Abuse, 2003. Youths' choice of consultant for serious problems related to substance use. The NHSDA Report. February 14. US Substance Abuse and Mental Health Services Administration.

Ockene, J.K., Adams, A., Hurley, T.G., Wheeler, E.V., Hebert, J.R., 1999. Brief physician- and nurse practitioner-delivered counseling for high risk drinkers: does it work? Arch. Intern. Med. 159, 2198–2205.

Parrott, A.C., Sisk, E., Turner, J.J.D., 2000. Psychobiological problems in heavy 'ecstasy' (MDMA) polydug users. Drug Alcohol Depend. 60, 105–110.

Petty, R.E., Wegener, D.T., 1998. Attitude change: multiple roles for persuasion variables. In: Gilbert, D.T., Fiske, S.T., Lindzey, G. (Eds.), Handbook of Social Psychology, McGraw-Hill, New York, pp. 323–390.

Reneman, L., Booij, J., de Bruin, K., Reitsma, J.B., de Wolff, F.A., Gunning, W.B., den Heeten, G.J., van den Brink, W., 2001. Effects of dose, sex, and long-term abstention from use on toxic effects of MDMA (ecstasy) on brain serotonin neurons. Lancet 358, 1864–1869.

Ricaurte, G.A., Yuan, J., Hatzidimitriou, G., Cord, B.J., McCann, U.D., 2002. Severe dopaminergic neurotoxicity in primates after a common recreational dose regimen of MDMA ("ecstasy"). Science 297, 2260–2263.

Russell, M., Wilson, C., Taylor, C., Baker, C., 1979. Effects of general practitioners advice against smoking. Br. J. Med. 2, 231–235.

SAS Institute, Inc., 1999. SAS/STAT User's Guide. Version 8, vol. 3. Cary, NC.

Schensul, J.J., 2001. The diffusion of MDMA among urban youth in Hartford, Connecticut: implications for drug and HIV prevention in club drug users and their networks. Conference Presentation: 'Ecstasy: A Scientific Conference', 19–20 July, Natcher Auditorium, NIH Campus, Bethesda, MD.

Shulgin, A.T., 1981. Hallucinogens. In: Wolff, M.T. (Ed.), Burger's Medicinal Chemistry—Part III, 4th ed. Wiley, New York, pp. 1109–1137.

Siegel, R.K., 1986. MDMA. Nonmedical use and intoxication. J. Psychoactive Drugs 18, 349–354.

Siegal, H.A., Falck, R.S., Carlson, R.G., Wang, J., Rahman, A.M., 1998. Health services research among crack-cocaine users: a case study from the Midwest. Am. Behavioral. Scientist 41, 1063–1078.

Simon, N.G., Mattick, R.P., 2002. The impact of regular ecstasy use on memory function. Addiction 97, 1523–1529.

Sinnett, E.R., Press, A., Bates, R.A., Harvey, W.M., 1975. Credibility of sources of information about drugs. Psychol. Rep. 36, 299–309.

Smart, R.G., Fejer, D., 1972. Credibility of sources of drug information for high school students. J. Drug Issues 2, 8–18.

Smith, D.E., Wesson, D.R., Buffum, J., 1985. MDMA: 'Ecstasy' as an adjunct to psychotherapy and a street drug of abuse. Calif. Soc. Treatment Alcohol. Other Drug Dependencies News 12, 1–3.

Steele, T.D., McCann, U.D., Ricaurte, G.A., 1994. 3,4-Methylenedioxymethamphetamine (MDMA, 'Ecstasy'): pharmacology and toxicology in animals and humans. Addiction 89, 539–551.

Watters, J.K., Bernacki, P., 1989. Targeted sampling: options for the study of hidden populations. Soc. Probl. 36, 416–430.

Wax, P.M., 2002. Just a click away: recreational drug web sites on the internet. Pediatrics 109, 1–4.

Weeks, M.R., Clair, S., Borgatti, S.P., Radda, K., Schensul, J.J., 2002. Social networks of drug users in high-risk sites: finding the connections. AIDS Behav. 6, 193–206.