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Meta-analysis of the association between ecstasy use and risky sexual behavior

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ABSTRACT

A random-effects meta-analysis was conducted to examine the association between ecstasy use and risky sexual behavior. Analysis of 17 studies revealed a small to moderate sized effect (mean weighted $r = 0.211$, 95% CI: 0.085–0.336). Random-effects homogeneity testing was non-significant, thus formal moderator analyses were not performed. Moreover, numerical and visual diagnostics suggested that publication bias was not a concern. It is hoped that the present meta-analytic findings and recommendations will encourage investigators to broaden their research methodologies and will stimulate new insights into the association between ecstasy use and risky sexual behavior.

The drug, 3,4-methylenedioxymethamphetamine, or MDMA, was first synthesized in 1914, but the recreational use of the drug did not emerge until the late 1970s and early 1980s (McElrath, 2005). Although recreational MDMA, or ecstasy, use has historically been associated with partying and the young adult "club scene," it has, in recent years, gravitated to new environments, and ecstasy is now used by a broader array of people (Sterk, Klein, & Elifson, 2008). The lifetime prevalence rate of ecstasy use among adults in the United States is around 10% (Keyes, Martins, & Hasin, 2008) and the corresponding lifetime estimate for adolescents is 5.5% (Johnston, O'Malley, Bachman, & Schulenberg, 2011). The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) estimates the lifetime prevalence rate of ecstasy use for the United Kingdom at 8.6% (http://www.emcdda.europa.eu/online/annual-report/2010/library/table6). As regards to annual (past year) prevalence rates for ecstasy use, the United Nations World Drug Report indicates estimates of 1.4% and 1.6% for the United States and United Kingdom, respectively (United Nations Office on Drugs and Crime, 2011). Because of its potential for misuse and harm, MDMA (ecstasy) is classified by the U.S. Drug Enforcement Agency as a Schedule I substance. Ecstasy use is associated with a multitude of physiological and psychological effects, including dehydration, euphoria, increased energy, a heightened sense of perceived interpersonal connectedness, greater sexual arousal, and increased cognitive impairment (Klitzman, Greenberg, Pollack, & Dolezal, 2002; Rosenbaum, 2002). The combination of impaired cognitive functioning, such as poor decision-making and diminished judgment, coupled with heightened sexual arousal is particularly problematic and places people at increased risk for unsafe sexual behavior.

Unsafe sexual behavior typically is defined as intercourse- and non-intercourse-related sexual activity that increases a person's risk of acquiring HIV and/or a sexually transmitted disease. A number of studies have found associations between heightened levels of alcohol and substance use and risky sexual behavior (see, for example, Bailey, Gao, & Clark, 2006; Cooper, 2002; Kalichman, Tannenbaum, & Nachimson, 1998; Leigh, 2002; Newcomb, Clerkin, & Mustanski, 2011). In a national study of college students, frequent binge drinkers were 22 times more likely than non-binge drinkers to engage in alcohol-related HIV-risky behaviors, such as unplanned sexual activity and failing to use protection during sexual intercourse (Wechsler, Dowdall, Maenner, Gledhill-Hoyt, & Lee, 1998). Hittner and Kennington (2008) found that substance use, in particular frequency of recent marijuana use, was an important predictor of unprotected intercourse in a college student sample. Thus, it is no surprise that college-aged students account for one-fourth of the new cases of sexually transmitted infections each year (Scholly, Katz, Gascoigne, & Holck, 2005). Recent epidemiological research indicates that 64% of those infected with HIV have used an illicit drug, and one in four people with the virus reported that they use alcohol and drugs in levels that warrant treatment (National Institute on Drug Abuse, 2011). In a study of injection drug users, male and female participants reported using condoms only 50% of the time with casual partners, but 80% of the time with paying partners. In addition, more than half of the female participants reported having greater than one hundred sexual partners in their lifetime (Tyndall et al., 2002). Community-based studies of methamphetamine use (a drug that is chemically similar to ecstasy) have found that meth users often engage in high-risk sexual behavior. In particular, studies of heterosexual adults and adolescents (Centers for Disease Control and Prevention, 2006; Molitor, Truax, Ruiz, & Sun, 1998), and studies of men who have sex with men (MSM, Buchacz et al., 2005) have found that methamphetamine

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users have more sex partners, are less likely to use condoms, are more likely to exchange sex for drugs or money, and are more likely to have sex with an injection drug user.

Despite the large body of research linking alcohol and general substance use to risky sexual behavior, comparatively little research has examined the association between ecstasy use and risky sexual behavior. In fact, the first published article on this topic didn't appear in the scholarly literature until 1986 (Buffum & Moser, 1986). Not only is there a need for more empirical research on ecstasy use and risky sexual behavior, there also is a need to quantitatively synthesize the research that has been conducted to date. Such a quantitative synthesis is important for several reasons. First, given the increased incidence of, and problems associated with, ecstasy use (National Institute on Drug Abuse, 2010), and considering the well-documented connection between substance use and risky sexual behavior, there is a need to understand the magnitude of association between ecstasy use and risky sexual behavior. Second, although there is evidence that risky sexual practices, STDs, and AIDS have decreased over time (Centers for Disease Control and Prevention, 2010), unsafe sex and its consequences still present a formidable challenge. For example, in a global analysis of risky sexual behavior, Slaymaker and colleagues found that 9.2% of adults, on average, in North and South American countries reported having had sex with a non-co-resident partner in the last year, without using a condom. Similarly, in European countries, 10.9% of adults, on average, reported having had unprotected intercourse with a non-co-resident partner in the last year (Slaymaker, Walker, Zaba, & Collumbien, 2004).

Given the relative lack of empirical research on ecstasy use and risky sexual behavior, and in view of the need to quantitatively synthesize the extant literature, we performed a meta-analysis of the human research on ecstasy use and risky sexual behavior. Our primary objective was to determine the overall mean (with 95% confidence interval) and median effect size between ecstasy use and risky sex. Our second objective was to assess the degree of variability in effect sizes across studies and, if present, to then perform formal moderator analyses. Our third and final aim was to perform publication bias diagnostics using both numerical and visual indices. To our knowledge, the present inquiry represents the first quantitative analysis of the ecstasy use and risky sexual behavior literature. Because research in the area of ecstasy use and risky sexual behavior is relatively new and emerging, our meta-analytic results will provide a barometer as to the nature and strength of the association, and will encourage researchers to broaden their research methodologies. We hope that our results will stimulate new insights into the association between ecstasy use and risky sexual behavior, which in turn could benefit clinical intervention and treatment.

1. Method

1.1. Literature search and study descriptives

Two strategies were employed to obtain relevant empirical research articles published through April, 2011. First, keyword searches were conducted using electronic databases, such as PsycINFO, PubMed, and Conference Papers Index. Second, the reference lists of key articles were examined for additional relevant studies. Electronic search terms included MDMA, ecstasy, sexual risk, HIV/AIDS, STDs, and high-risk behavior. All empirical articles examining the association between MDMA/ecstasy use and risky sexual behavior in humans were considered for inclusion. After an extensive literature search, fourteen empirical articles were identified. Six of these articles examined more than one sample: the Buffum and Moser (1986) article included female and male samples, the Klitzman et al. (2002) and Novoa, Ompad, Wu, Vlahov, and Galea (2005) articles included ecstasy and non-ecstasy users, the Theall, Elifson, and Sterk (2006) article included heavy and non-heavy ecstasy users, the Waldo, McFarland, Katz, MacKellar, and Valleroy (2000) article included both a younger and older aged sample, and the Wu, Ringwalt, Patkar, Hubbard, and Blazer (2009) article included a college sample and a non-college sample. McElrath's (2005) article was eliminated because the author did not report any statistical information or quantitative data. Overall, there were 20 samples, but after eliminating McElrath's study and two samples of non-ecstasy users, a total of 17 independent samples were retained.

The mean age in the 15 of 17 samples that reported age data was 26.1 (sd = 8.7) and the corresponding median was 22.0. As regards to the sexual orientation of the participants, the percent reporting each orientation and the number of samples reporting such data were as follows: Heterosexual (40.8%, 13), Gay/Lesbian (41.7%, 13), and Bisexual (13.3%, 11). Although only 4 of the 17 samples reported the participant's age at first ecstasy use, the average age at first use was 17.2 years (sd = 0.89). As for polydrug use, 43% of the participants reported using marijuana and 22% reported using cocaine (within the 11 and 7 samples, respectively, that reported such use). For more information regarding basic descriptive data on each of the independent samples, see Table 1.

1.2. Coding studies

In addition to recording the summary statistics and sample sizes necessary for computing effect sizes (see Procedure section), as well as general information about each article (e.g., authors, title, year published), information bearing on potential moderator variables was coded. These potential moderators consisted of a mix of categorical and continuously scaled variables. Examples of such moderators included: nature of the sample, design type, assessment format, gender, ethnic/racial breakdown, and age of the sample. Due to the modest number of independent studies (k = 17) and the degree of missing data on the potential moderators, we will conduct formal moderator analyses only if the test of homogeneity is significant (see Results section).

1.3. Procedure

The test statistics reported in the articles (e.g., *t*, *F*, group proportions, χ^2 values), were converted to correlation coefficients (*r*s) via standard conversion formulae (Rosenthal, 1991; Shadish, Robinson, & Lu, 1999). In the case of odds ratios, the transformation advocated by Digby (1983) was employed. Bonett (2007) recommended Digby's formula as an estimate of the tetrachoric approximation of the Pearson *r*. The correlation coefficient is a commonly used effect size index and has been recommended in the meta-analytic literature. For example, Rosenthal (1991) argued that the product-moment correlation, *r*, is more desirable than other indices because it does not require special adjustments. In addition, correlation coefficients arguably are more intuitively meaningful than other effect size measures and can be interpreted in terms of practical utility. For example, the square of the correlation represents the amount of variance shared between two variables. The correlation, *r*, also is desirable because of its greater flexibility relative to other effect size measures, such as Cohen's *d*. For example, *r* can always be computed from summary statistics whenever *d* can, but *d* cannot always be calculated whenever *r* can (see Rosenthal, 1991, p.18).

After converting summary statistics to correlation coefficients, all *r*s were transformed to z_rs via Fisher's (1928) *r*-to-z_r transformation. Unlike the sampling distribution of the correlation coefficient, which is skewed, the sampling distribution of z_r is approximately normally distributed (Fisher, 1928). Each z_r value was then weighted by the inverse of the squared standard error. Such inverse variance weighting gives greater emphasis to more precisely estimated effect sizes. The z_rs were then backtransformed to *r*s using the inverse of Fisher's (1928) transformation. Finally, the backtransformed *r*s were analyzed