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## Multi-level modeling to explain methamphetamine use among gay and bisexual men

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### Abstract

**Aim**—The popularity of methamphetamine among gay men has been documented; however, few studies have examined the complex behavioral and psychological motivations behind methamphetamine use, particularly over time. This study aimed to (i) identify the trajectories for methamphetamine use; (ii) explore factors related to methamphetamine use; and (iii) determine factors which predict changes in usage over a year.

**Design**—This analysis utilized hierarchical linear modeling to identify the trajectories for methamphetamine use and explore factors related to patterns of methamphetamine use.

**Participants**—A sample of 293 gay and bisexual men who indicated methamphetamine use at baseline were drawn from Project BUMPS (Boys Using Multiple Party Substances), which was a longitudinal, mixed-methodologies study of 450 club drug-using gay and bisexual men.

**Measurements**—Participants were assessed via quantitative measures in four waves of data collection over the course of a year (baseline, 4, 8 and 12 months post-baseline).

**Findings**—Frequency of methamphetamine use is related to reliance on the drug to avoid unpleasant emotions and physical discomfort, outcome expectancies for use and combining the drug with Viagra. Those with higher levels of drug-related sensation-seeking and those who combine use with Viagra show more consistent use over time, although a decrease in use is noted for most of the sample.

**Conclusions**—Longitudinal analyses support the idea that methamphetamine is used by gay men to mask feelings of discomfort and to enhance sensations as well as sexual pleasure. Longitudinal non-intervention studies of drug use may have intervention-like effects.

### Keywords

Club drugs; gay and bisexual men; HLM; methamphetamine; trajectories

## INTRODUCTION

The popularity of methamphetamine in the gay male community has been documented in several studies [1–5]. Methamphetamine is perceived to have aphrodisiac-like qualities and is administered typically to enhance and prolong sexual activities [1,6,7]. Stimulant drugs, such as methamphetamine, are appealing to gay men because the drug counteracts pre-existing anxieties about sex [7]. For some gay and bisexual men, methamphetamine becomes part of their sexual identity [8]. It has been suggested that the sexual and emotional effects of methamphetamine conspire to make it the quintessential gay drug [3].

Behavioral research regarding methamphetamine has examined the association between methamphetamine use and HIV transmission [9–11]. However, few studies have examined the complex behavioral and psychologically driven motivations behind methamphetamine use [12–14]. To our knowledge there are no studies that have investigated the factors which explain patterns of methamphetamine use over time. Responding to these gaps in knowledge, multi-level modeling was used in the present study to explore factors related to methamphetamine use as well as to determine the factors that predict changes in usage over a year.

While research demonstrates that methamphetamine use is associated with high-risk sex among gay and bisexual men [1,4,7,12,15,16], it appears to be layered with complex psychologically driven motivations, such as increased self-esteem, increased confidence, feeling of acceptance and attractiveness [3,13,14]. However, the role of psychological factors is still unclear and it is important to disentangle the sexual and psychological factors, which contribute to the patterns of use. Furthermore, many of the studies that have attempted to explain these associations have relied on qualitative rather than quantitative methodologies. One such study found that HIV-positive men tend to use methamphetamine as a form of sexual enhancement and self-medication [14]. Another reported similar findings in that methamphetamine was associated with risky sexual behaviors, sexual confidence, performance, endurance and disinhibitory qualities [12]. Furthermore, an extensive qualitative study of methamphetamine-using men in Los Angeles considers sex-on-methamphetamine as an element of gay cultural identity and inclusion, and which is used primarily to increase sensory experiences, especially as they relate to sexual activity and as a means of escaping from the feelings of boredom, isolation, hopelessness and grief [13]. Similarly, others indicated that methamphetamine use might be a mechanism by which gay and bisexual men cope with difficult emotions, including the avoidance of unpleasant emotions and physical pain, tensions of socialization and the prejudice experienced for being gay [2,9,17]. It has also been indicated that internalized homophobia, feelings of shame, isolation and exclusion can draw gay and bisexual men to drug use [17]. This may be particularly true for methamphetamine because the drug gives users a feeling of acceptance and attractiveness [7] and diminishes any preexisting fears, anxieties and depression.

In sum, sexual and psychological motivations are probably associated with methamphetamine use. However, the relation between sexual and psychological motivations and changes in methamphetamine use patterns has not been assessed quantitatively over time; studies have tended to be cross-sectional in nature, leading potentially to results that

are spurious. Thus, researchers have begun to realize the importance of studying individual development of drug use over time [18]. Therefore, there is a growing appreciation that greater attention needs to be directed toward individual growth curves and the description and explanation of differences in intraindividual change [19,20]. Personcentered techniques that examine individual growth curves have gained popularity among developmental psychologists and drug researchers [21,22].

Hierarchical linear modeling (HLM) [23,24] (see also Willett, Singer & Martin [20]; Rogosa & Willett [25]) provides one method of approach to investigate patterns and predictors of growth curves (for the purposes of our study, methamphetamine use) because its hierarchical structure utilizes a two-level procedure to examine intraindividual growth (level 1) and interindividual differences in growth (level 2) over time. A growth curve analysis using HLM confers numerous advantages over more traditional methods of investigating change over time in methamphetamine use among gay and bisexual men, such as repeated-measures analysis of variance [23,24]. HLM uses empirical Bayes estimation [26] to derive the final estimates for each participant, drawing on information at both levels of the analysis. As a result, HLM affords more precise estimates of individual growth over time and greater power to detect predictors of individual differences in change [23]. This process also allows HLM to handle missing data, using any available data points to fit a growth trajectory for each participant.

Thus, the purpose of our analysis is to examine whether demographic, psychosocial and behavioral factors are related to the use of methamphetamine among gay and bisexual men in New York City. In addition, this analysis delineates individual trajectories of methamphetamine use over a period of a year and the factors which explain these patterns using growth curve modeling. As methamphetamine use continues to rise, the need to understand both the sexual and psychological motivations associated with its use becomes fundamental in informing the most efficacious treatment approaches and outreach programs.

The analyses presented here are based on a longitudinal study of 450 club drug-using men in New York City. We sought to use multi-level modeling to explore factors related to methamphetamine use, as well as to determine the factors which predict changes in usage over time. The use of HLM is a novel analytical approach to establishing relationships with regard to methamphetamine use, which have been examined traditionally through cross-sectional analysis. This approach allows more precise estimates of individual growth over time and greater power to detect predictors of individual differences in change [23], thus yielding more robust results by eliminating the threat to internal validity inherent in the potentially spurious relationships detected in cross-sectional analyses.

## METHODS

### Design

Project BUMPS (Boys Using Multiple Party Substances), funded by the National Institute on Drug Abuse, was a longitudinal, mixed-methodologies study of 450 club drug-using gay and bisexual men in New York City. Participants were assessed via quantitative and qualitative measures in four waves of data collection over the course of a year (baseline, 4,

8 and 12 months post-baseline). The overall purpose of the study was to examine frequency of club drug use, behaviors associated with use, as well as psychological and behavioral correlates of use.

Participants were recruited from February 2001 to October 2002 using active and passive techniques in venues frequented by gay and bisexual men. Potential participants were screened for eligibility via telephone interviews. Eligibility requirements included being 18 years of age or older, self-identifying as gay or bisexual and self-reporting six instances of club drug use in the year prior to assessment. For the purposes of our study, club drugs were defined as GHB, ketamine, ecstasy (MDMA), methamphetamine and powdered cocaine. Those who met eligibility requirements were scheduled for a baseline interview, when the initial assessment and consent occurred. In addition, HIV status was confirmed using OraSure testing for those who reported a seronegative or unknown serostatus. HIV-positive participants were asked to provide evidence of their status (i.e. HIV antiretroviral prescription, physician's note).

All quantitative assessments were administered via Audio CASI (ACASI), using a computer and voice recording so that the participant heard (through headphones) and saw (on the screen) each question and response list. After completing the quantitative portion of the assessment, trained staff members conducted semistructured qualitative interviews covering a variety of topics related to drug use, sexual behavior and psychological states. The Institutional Review Board of New York University approved the protocol for this study.

For the purposes of the present analyses, we used quantitative data only. Methamphetamine use data from all waves were utilized. In addition, antecedent factors to explain growth curves were collected at baseline allowing us to conduct conditional growth curve modeling.

## Measures

**Methamphetamine use**—Use of methamphetamine was measured via a version of a scale developed for a previous study by the investigative team [4]. This scale assessed the frequency (as defined by days of use) that methamphetamine was used over a period of 4 months prior to each assessment (baseline and months 4, 8 and 12).

**Socio-demographics**—Participants were asked to report their age, race/ethnicity and sexual orientation. In addition, as noted earlier, HIV status was confirmed.

**Psychological states**—The depression subscale ( $n = 7$ ) of the Brief Symptom Inventory [27] was used to assess this construct ( $\alpha = 0.88$ ). The UCLA Loneliness Scale [28] was also included in our assessment ( $\alpha = 0.90$ ). We assessed sensation-seeking using the Substance Use-seeking Scale ( $n = 8$ ,  $\alpha = 0.75$ ) based on a modified version of Kalichman *et al.* [29], and also assessed compulsivity ( $n = 10$ ,  $\alpha = 0.90$ ) based on Kalichman's Sexual Compulsivity Scale [29–31].

**Outcome expectancies for methamphetamine use**—Based on our previous work [32], we developed a scale to assess outcome expectancies. Factor analysis yielded two

subscales which explained 48% of the variance: positive expectancies for methamphetamine use ( $n = 12$ ,  $\alpha = 0.88$ ) and negative expectancies for methamphetamine use ( $n = 3$ ,  $\alpha = 0.75$ ). Because this is a newly developed scale, items are shown in Table 1.

**Reasons for methamphetamine use**—To assess reasons for use we utilized the Inventory of Methamphetamine Using Situations. This measure consisted of 35 items modified from the Inventory of Drug Taking Situations (IDTS) [33]. Participants were asked to respond using a five-point Likert scale, ranging from ‘never’ to ‘always’, indicating how often they had used methamphetamine under various situations during the past 3 months. The measure included five subscales: unpleasant emotions,  $\alpha = 0.97$ , physical discomfort,  $\alpha = 0.72$ , conflict with others,  $\alpha = 0.95$ , social pressure,  $\alpha = 0.85$  and pleasant times with others,  $\alpha = 0.81$ ; reflecting categories of situations under which drug use might occur.

**Viagra use**—Using a forced choice item, participants were asked to indicate whether or not they had used Viagra with methamphetamine.

## RESULTS

### Sample characteristics

The sample consisted of 293 men who indicated methamphetamine use at baseline. Mean age of the participants was 33 ( $SD = 7.99$ ) and ranged from 18 to 67 years. Sample characteristics are shown further in Table 2, and suggest that the sample is primarily gay and white. Differences between methamphetamine users and non-users in the sample can be found in Halkitis, Green & Morugues [2]. In this initial examination of the data [2] we considered only cross-sectional associations in the data set, and build upon these earlier findings by applying analytical techniques designed for longitudinal data in our present analysis. Results of this earlier investigation found that African Americans were less likely to report using methamphetamine than whites, Latinos and Asian/Pacific Islanders, and respondents with higher educational attainment demonstrated a greater likelihood of use; moreover, methamphetamine use was associated with the social environments of sex parties and bathhouses.

### Description of methamphetamine use

Among the 293 methamphetamine users at baseline, the drug was used on average of 11.76 days (median = 5,  $SD = 19.24$ ) in the 4 months prior to baseline assessment, with a range of 1–120 days. It should be noted that more than half the sample reported using the drug on 1–5 days. At the 4-month follow-up assessment, 229 participants reported using methamphetamine, on average, for 9.24 days (median = 4,  $SD = 17.36$ ), with a range of 0–120 days; more than half the sample reported using the drug on 0–6 days; and at the 8-month follow-up assessment 214 participants reported using methamphetamine, on average, for 7.95 days (median = 2,  $SD = 16.05$ ) with a range of 0–120 days; more than half the sample reported using the drug on 0–6 days. At our last assessment point, 205 participants reported using methamphetamine, on average, for 7.81 days (median = 2,  $SD = 15.31$ ), with a range of 0–120; more than half the sample reported using the drug on 0–7 days. Patterns of methamphetamine use over time are shown in Fig. 1.

**Missing data considerations**—We retained 70% ( $n = 205$ ) of the original 293 by time 4. Before we proceeded with our modeling, we considered if these missing individuals differed from those whom we retained at time 4 on key factors. Our analysis demonstrated that those who retained at time 4 did not differ from those whom we lost by time 4 in terms of age, race, sexual orientation and HIV status. More importantly, the retainees did not differ from those we lost at time 4 in terms of their baseline reported methamphetamine use.

### Multi-level modeling of methamphetamine use

HLM treating methamphetamine use as having a Poisson distribution was used to conduct a growth curve analysis. First, we describe the unconditional model, and then build upon these findings to explain the prediction of growth curve through the univariate conditional model.

**Unconditional growth model**—An unconditional model was examined to describe how the use of methamphetamine changed over time among those 293 who reported use at baseline. Table 3 illustrates the results of the unconditional model. For methamphetamine use among gay and bisexual men, the intercept and slope coefficients are significantly different from zero. The non-zero intercept (1.88,  $P < 0.001$ ) indicates use among these men at baseline, and the negative coefficient for the linear slope ( $-0.36$ ,  $P < 0.001$ ) indicates that, on average, methamphetamine use among these men decreased over the year-long period of assessment. In addition, the variance components for the intercept and slope were significant ( $P < 0.001$ ), suggesting that there is much variation in both initial use and change over time which could be explained with the correct predictors in a conditional model.

**Conditional model**—A model was constructed to explore whether the patterns of methamphetamine use over the course of the year could be explained as a function of socio-demographic (age, sexual orientation, confirmed HIV status and race/ethnicity), psychosocial (depression, loneliness, sexual compulsivity, sensation-seeking for drugs, positive outcome expectancies, negative outcome expectancies, methamphetamine use to avoid unpleasant emotions, to avoid physical discomfort, to avoid conflict with others, to enhance social pressure and to enhance pleasant times with others) and behavioral (use of Viagra with methamphetamine) factors. These variables were selected for inclusion as dictated by the previous literature. The results of these models can be seen in Table 4. The variance in the intercepts is explained by negative outcome expectancies for methamphetamine use ( $\gamma = -0.06$ ,  $P = 0.01$ ), positive outcome expectancies for methamphetamine use ( $\gamma = 0.02$ ,  $P < 0.01$ ), using methamphetamine to avoid unpleasant emotions ( $\gamma = 0.03$ ,  $P = 0.001$ ), use of methamphetamine to avoid physical discomfort ( $\gamma = 0.08$ ,  $P < 0.01$ ), Viagra use with methamphetamine ( $\gamma = 0.38$ ,  $P < 0.01$ ) and for positive outcome expectancies for methamphetamine use ( $\gamma = -0.02$ ,  $P < 0.01$ ). The results suggest that at baseline more frequent use is associated with lower negative outcome expectancies for methamphetamine use, greater positive expectancies, higher levels of use to avoid unpleasant emotions and physical discomfort and greater likelihood of use with Viagra. The linear slope was explained only by drug-related sensation-seeking ( $\gamma = 0.03$ ,  $P = 0.04$ ) and Viagra use with methamphetamine ( $\gamma = 0.29$ ,  $P < 0.01$ ) and tangentially by age ( $\gamma = 0.01$ ,  $P = 0.07$ ) and use to avoid unpleasant emotions ( $\gamma = -0.02$ ,  $P = 0.05$ ). Given the significant negative slope, this model suggests that there is a less steep decrease in use over time for

those with higher levels of drug-related sensation-seeking, those who report using Viagra with methamphetamine and older men. More steep decreases were noted among those who initially reported reliance on methamphetamine to avoid unpleasant emotions.

## DISCUSSION

Project BUMPS was a longitudinal study of the patterns and antecedents of club drug use among gay and bisexual men in New York City. The focus of our work was on five drugs—cocaine, GHB, ketamine, ecstasy and methamphetamine. The latter is a drug that has grown exponentially in popularity on the East Coast of the United States only in the last 5 years, although use of the drug has a long history in gay and bisexual male communities of the West Coast [3,5].

We sought to examine patterns of methamphetamine use in our sample of 450 club drug-using men. As might be expected, rates of use were high (293 of the 450 men reported methamphetamine use in the recent past at their baseline assessment), and as we have noted previously, polydrug use was a common behavioral pattern among these men [2]. Despite the popularity of methamphetamine and abundant behavioral research few, if any, studies have applied multi-level modeling to examine patterns of use as well as factors associated with use of the drug. Such models have been used extensively in developmental psychology [23], as well as studies of substances such as marijuana, alcohol and nicotine [34–38]. The advantage of longitudinal data, and in turn multi-level modeling, is due to the fact that significant associations are more robust, and not subject to the potential spuriousness associated with cross-sectional data and correlational analyses. A descriptive analysis of the same sample provided frequencies of use across time-points; however, its analyses were not able to examine the complexities of individual growth and individual differences within the sample [2].

Our findings support previous work that contends that methamphetamine is used by many gay and bisexual men to mask difficult emotions [39,40] and to enhance sexual pleasure [14,40]. In our analysis of the longitudinal data, higher levels of use at baseline were noted among those who reported higher greater levels of reliance on the drug to avoid unpleasant emotions as well as physical discomfort. Also, higher rates of use were noted among those who perceived few negative outcomes and expressed great positive outcomes associated with use of methamphetamine. This latter finding is supported by social cognitive theory with regard to other club drugs such as ecstasy [41]. Finally, the men who reported combining Viagra with methamphetamine reported higher rates of methamphetamine use. This association provides a proxy indicator of the ‘meth–sex’ connection that has been documented extensively [3,9].

In our analyses over time, and considering attrition, there was a significant decrease in the level of methamphetamine use between baseline and 1 year later. While our study was not an intervention trial, it is possible that our collection of both quantitative and qualitative data over the course of the year had intervention-like effects for this particular sample of self-identified methamphetamine users. From the perspective of the Transtheoretical Model [42] it could be hypothesized that this community-based sample of men was prepared to

initiate change in their use of this drug than a more general random sample of users, and for that reason opted to participate in the study. However, decrease in use was not as evident for those with higher levels of drug sensation-seeking as well as those who indicated that they combined methamphetamine with Viagra. The role of drug sensation-seeking has been documented in relation to club drug use [43]; in combination with the Viagra factor, these variables suggest a type of individual who links his methamphetamine use with sexual pleasure and stimulation of sensations.

### Limitations

Despite the fact that our analyses utilized longitudinal data and HLM to consider these relations, a few methodological issues limit our findings. First, our sample consisted of club drug users. Thus, comparisons of methamphetamine users with non-drug users were not possible. While approximately 35% of the men in our sample did not report methamphetamine use at baseline, they were using some combination of other drugs (e.g. cocaine, GHB, ketamine, ecstasy), and thus any comparison of methamphetamine users to non-users was confounded by this condition. For that reason, we chose to develop our models based on the 293 men who reported methamphetamine use at baseline. For similar reasons, it is important to note that the methamphetamine users are often also polydrug users, and in our study methamphetamine is only one of the drugs that were used actively [2]. This point is important, because use of other club drugs may be related to or affect methamphetamine use; moreover, behavioral factors associated with the use of methamphetamine as reported here could serve potentially as antecedents to the use of other drugs or the polydrug-use behavior. Thirdly, we utilized conditional multi-level modeling for our analyses [24], and thus utilized baseline states to explain use at baseline and change over time. This condition, in part, explains why the prediction of our intercepts is much stronger than the prediction of our slopes. While multivariate conditional modeling [44] would have been preferable, we were limited by the fact that all our psychosocial states, such as depression and loneliness, were assessed only at baseline and 4 months post-baseline, thus undermining our ability to develop trajectories for these states. Despite these limitations, the findings of our analyses are robust and strengthen our understanding of the correlates of methamphetamine use over and above previous findings, which have depended on cross-sectional methods.

### CONCLUSIONS

The use of methamphetamine by gay and bisexual men represents a multi-faceted behavior. Use is driven by a desire to heighten sensations, primarily in relation to sexual experiences, as well as to overcome painful emotions. Interventions to address this addiction must consider the synergy of methamphetamine use and sexual risk-taking, and how both these potentially harmful behaviors are rooted in matters of mental health, which may be heightened by the experience of stigmatization within a heterosexist culture.

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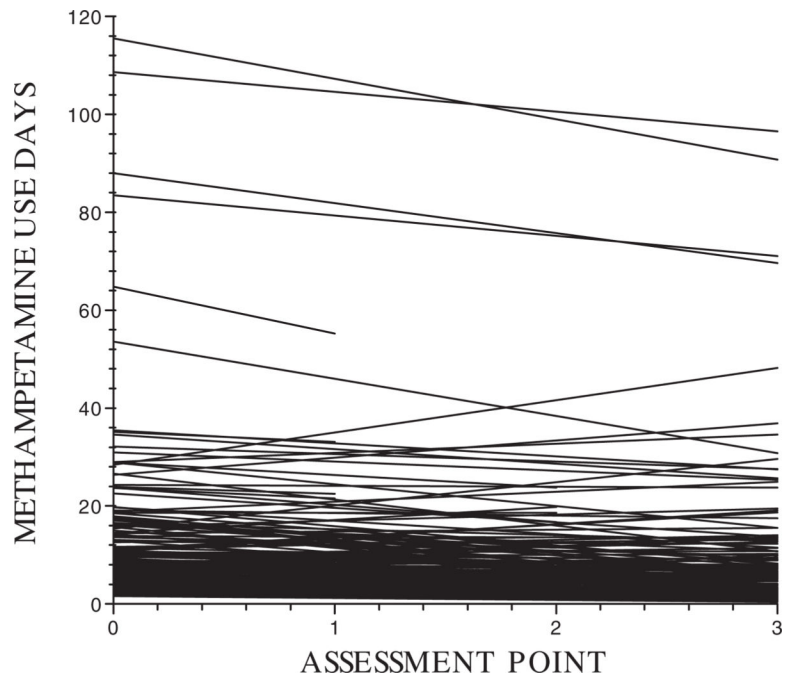
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## References

1. Frosch D, Shoptaw S, Huber A, Rawson RA, Ling W Sexual HIV risk among gay and bisexual male methamphetamine abusers. *J Subst Abuse Treat* 1996; 13: 483–6. [PubMed: 9219145]
2. Halkitis PN, Green KA, Mourgues P Longitudinal investigation of methamphetamine use among gay and bisexual men in New York City: findings from Project BUMPS. *J Urban Health* 2005; 82: i18–25. [PubMed: 15738324]
3. Halkitis PN, Parsons JT, Stirratt MJA double epidemic: crystal methamphetamine drug use in relation to HIV transmission among gay men. *J Homosex* 2001; 41: 17–35. [PubMed: 11482426]
4. Halkitis PN, Parsons JT, Wilton L An exploratory study of contextual and situational factors related to methamphetamine use among gay and bisexual men in New York City. *J Drug Issues* 2003; 33: 413–32.
5. Rawson RA, Anglin MD, Ling W Will the methamphetamine problem go away? *J Addict Dis* 2002; 21: 5–19. [PubMed: 11831500]
6. Gawin F H Pharmacologic enhancement of the erotic: implications of an expanded definition of aphrodisiacs. *J Sex Res* 1978; 14: 107–17.
7. Guss J R Sex like you can't even imagine: 'crystal', crack and gay men. *J Gay Lesbian Psychother* 2000; 3: 105–22.
8. Reback CJ, Grella C E HIV risk behaviors of gay and bisexual male methamphetamine users contacted through street outreach. *J Drug Issues* 1999; 29: 155–66.
9. Halkitis PN, Green KA, Carragher D Methamphetamine use, sexual behavior and HIV seroconversion. *J Gay Lesbian Psychother* 2006; 10: 95–109.
10. Murray J B Psychophysiological aspects of amphetamine–methamphetamine abuse. *J Psychol Interdiscip Appl* 1998; 132: 227–37.
11. Miller M A History and epidemiology of amphetamine abuse in the United States. In: Klee H, editor. *Amphetamine Misuse*. Amsterdam: Harwood Academic Publishers; 1997, p. 113–33.
12. Lewis LA, Ross M W The gay dance party culture in Sydney: a qualitative analysis. *J Homosex* 1995; 29: 41–70.
13. Reback C J The Social Construction of a Gay Drug. Methamphetamine Use Among Gay and Bisexual Males in Los Angeles. Report funded by the City of Los Angeles (contract no. 93427). 1997. Available at: [http://www.uclaisap.org/documents/final-report\\_cjr\\_1-15-04.pdf](http://www.uclaisap.org/documents/final-report_cjr_1-15-04.pdf) (accessed 1 February 2006).
14. Semple SJ, Patterson TL, Grant I Motivations associated with methamphetamine use among HIV+ men who have sex with men. *J Subst Abuse Treat* 2002; 22: 149–56. [PubMed: 12039618]
15. Paul JP, Stall R, Davis F Sexual risk for HIV transmission among gay/bisexual men in substance-abuse treatment. *AIDS Educ Prev* 1993; 5: 11–24. [PubMed: 8481269]
16. Woody GE, Donnell D, Seage GR, Metzger D, Marmor M, Koblin B A et al. Non-injection substance use correlates with risky sex among men having sex with men: data from HIVNET. *Drug Alcohol Depend* 1999; 53: 197–205. [PubMed: 10080045]
17. Cabaj R P Substance abuse, internalized homophobia, and gay men and lesbians: psychodynamic issues and clinical implications. *J Gay Lesbian Psychother* 2000; 3: 5–24.
18. Cicchetti D, Rogosch F A Psychopathology as risk for adolescent substance use disorders: a developmental psychopathology perspective. *J Clin Child Psychol* 1999; 28: 355–65. [PubMed: 10446685]
19. White HR, Bates ME, Labouvie E Adult outcomes of adolescent drug use: a comparison of process-oriented and incremental analyses. In: Richard J, editor. *New Perspectives on Adolescent Risk Behavior*. New York: Cambridge University Press; 1998, p. 150–81.
20. Willett JB, Singer JD, Martin N C The design and analysis of longitudinal studies of development and psychopathology in context: statistical models and methodological recommendations. *Dev Psychopathol* 1998; 10: 395–426. [PubMed: 9635230]
21. von Sydow K, Lieb R, Pfister H, Hofler M, Wittchen H-U Use, abuse and dependence of ecstasy and related drugs in adolescents and young adults—a transient phenomenon? Results from a longitudinal community study. *Drug Alcohol Depend* 2002; 66: 147–59. [PubMed: 11906802]

22. White HR, Bates MECessation from cocaine use. *Addiction*1995; 9: 947–57.
23. Bryk SW, Raudenbush ASExamining correlates of diversity. *J Educ Stat*1987; 12: 241–69.
24. Raudenbush SW, Bryk ASHierarchical linear models: applications and data analysis. Thousand oaks, CA: Sage: 2002.
25. Rogosa DR, Willett JBUnderstanding correlates of change by modeling individual differences in growth. *Psychometrika*1985; 50: 203–28.
26. Strenio JLF, Weisberg HI, Bryk ASEmpirical Bayes estimation of individual growth curves parameters and their relationship to covariates. *Biometrics*1983; 39: 71–86. [PubMed: 6871364]
27. Derogatis LR, Melisaratos NThe Brief Symptom Inventory: an introductory report. *Psychol Med*1983; 13: 595–605. [PubMed: 6622612]
28. Russell DWUCLA Loneliness Scale (version 3): reliability, validity, and factor structure. *J Pers Assess*1996, 66, 20–40. [PubMed: 8576833]
29. Kalichman SC, Hackman T, Kelly JASensation seeking as an explanation for the association between substance use and HIV-related risky sexual behavior. *Arch Sex Behav*1996; 25: 141–54. [PubMed: 8740520]
30. Kalichman SC, Johnson JR, Adair V, Rompa D, Multhauf K, Kelly JASexual sensation seeking. scale development and predicting AIDS-risk behavior among homosexually active men. *J Pers Assess*1994; 62: 385–97. [PubMed: 8027907]
31. Kalichman SC, Rompa DSexual sensation seeking and sexual compulsivity scales: reliability, validity, and predicting HIV risk behavior. *J Pers Assess*1995; 65: 586–601. [PubMed: 8609589]
32. Halkitis PN, Shrem MTPsychological differences between binge and chronic methamphetamine using gay and bisexual men. *Addict Behav*2006; 31: 549–52. [PubMed: 15967585]
33. Annis HM, Martin GIInventory of Drug-Taking Situations. Toronto, Canada: Addiction Research Foundation; 1985.
34. Bryant AL, Schulenberg JE, O'Malley PM, Bachman JG, Johnston LDHow academic achievement, attitudes, and behaviors relate to the course of substance use during adolescence: a 6-year, multiwave national longitudinal study. *J Res Adolesc*2003; 13: 361–97.
35. Welte JW, Barnes GM, Hoffman JH, Wieczorek WF, Zhang LSubstance involvement and the trajectory of criminal offending in young males. *Am J Drug Alcohol Abuse*2005; 31: 267–84. [PubMed: 15912716]
36. Aseltine HR, Gore SLThe variable effects of stress on alcohol use from adolescence to early adulthood. *Subst Use Misuse*2000; 35: 643–68. [PubMed: 10807150]
37. Mitchell CM, Novins DK, Holmes TMarijuana use among American Indian adolescents: a growth curve analysis from ages 14 through 20 years. *J Am Acad Child Adolesc Psychiatry*1999; 38: 72–8. [PubMed: 9893419]
38. Repetto PB, Caldwell CH, Zimmerman MAA longitudinal study of the relationship between depressive symptoms and cigarette use among African American adolescents. *Health Psychol*2005; 24: 209–19. [PubMed: 15755235]
39. Shoptaw S, Peck J, Reback CJ, Rotheram-Fuller EPsychiatric and substance dependence comorbidities, sexually transmitted diseases, and risk behaviors among methamphetamine-dependent gay and bisexual men seeking outpatient drug abuse treatment. *J Psychoact Drugs*2003; 35: 161–8.
40. Halkitis PN, Fischgrund BN, Parsons JTExplanations for methamphetamine use among gay and bisexual men in New York City. *Subst Use Misuse*2005; 40: 1331–45. [PubMed: 16048820]
41. Engels RCME, ter Bogt TOOutcome expectancies and ecstasy use in visitors of rave parties in the Netherlands. *Eur Addict Res*2004; 10: 156–62. [PubMed: 15367816]
42. Velasquez MM, von Sternberg K, Dodrill CL, Kan LY, Parsons JTThe Transtheoretical Model as a framework for developing substance abuse interventions. *J Addict Nurs*2005; 16: 31–40.
43. Simons JS, Gaher RM, Correia CJ, Bush JAClub drug use among college students. *Addict Behav*2005; 30: 1619–24. [PubMed: 16122624]
44. Curran PJA latent framework for the study of development trajectories in adolescent substance use. In: Rose JS, Chassin L, Presson CC, Sherman SJ, editors. *Multivariate Applications in Substance Use Research*, pp. 1–42. Mahwah, NJ: Lawrence Erlbaum; 2000.



**Figure 1.**  
Methamphetamine use across 12 months ( $n = 293$ )

**Table 1**

Outcome expectancies for methamphetamine use scale.

Item	Factor loading ( $\lambda$ )
Positive outcome expectancies	
When I do crystal I feel happier about myself	0.64
Lovers find me more hot when I am doing crystal	0.60
I am less worried about my problems when I do crystal	0.66
Doing crystal allows me to have the kind of sex I like	0.65
Crystal makes it easier to deal with the stress of work/school	0.61
I feel on top of the world when I do crystal	0.69
Time with friends is so much more fun when I do crystal	0.66
I am able to do more work when I am high on crystal	0.62
I feel smarter when I do crystal	0.76
Doing crystal helps me do chores or tasks that I hate	0.61
Doing crystal makes me feel more comfortable about my sexuality	0.69
My sexual partners enjoy me more when I am high on crystal	0.66
Negative outcome expectancies	
Doing crystal makes me feel sick	0.86
I have difficulty controlling my breathing and heart rate after I do crystal	0.66
I feel sick after I do crystal	0.81

**Table 2**Participant characteristics of methamphetamine users at baseline assessment ( $n = 293$ ).

	%	n
Race/ethnicity		
African American/black	10.9%	32
Asian/Pacific Islander	5.1%	15
Latino	19.1%	56
Mixed race	5.1%	15
White	56.3%	165
Confirmed HIV status		
HIV-positive	37.9%	111
HIV-negative	62.1%	182
Sexual orientation		
Gay/queer/homosexual	90.1%	264
Bisexual	9.9%	29

**Table 3**

Unconditional growth model for methamphetamine use among gay and bisexual men.

Effect	Linear model	
	Coefficient	SE
Fixed effects		
Intercept	1.88*	0.07
Linear slope	-0.36*	0.50
Random effects		
Intercept	1.26*	
Linear slope	0.45*	

\* $P < 0.001$ 

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**Table 4:**

Demographic and Psychosocial Predictors of Growth Parameters of Methamphetamine Use in Gay and Bisexual Men.

	Coefficient	SE	P-value
Fixed Effects			
For Intercept			
Intercept	1.81 <sup>***</sup>	0.26	< 0.001
<i>Demographic Factors</i>			
Age	-0.004	0.01	0.61
Sexual Orientation	-0.003	0.22	0.98
HIV Status	0.05	0.13	0.73
Black	-0.12	0.22	0.56
Latino	-0.05	0.17	0.76
Asian/Pacific Islander	0.07	0.30	0.81
Other	-0.16	0.24	0.52
<i>Psychosocial Factors</i>			
Depression	0.01	0.02	0.52
Loneliness	-0.01	0.01	0.32
Compulsivity	-0.01	0.01	0.29
Drug sensation seeking	-0.01	0.02	0.72
Positive outcome expectancies	0.02 <sup>**</sup>	0.01	< 0.01
Negative outcome expectancies	-0.06 <sup>*</sup>	0.02	0.01
Unpleasant emotions	0.03 <sup>***</sup>	0.01	0.001
Physical discomfort	0.08 <sup>**</sup>	0.03	< 0.01
Conflict with others	-0.01	0.01	0.65
Social pressure	0.01	0.02	0.61
Pleasant times with others	0.01	0.02	0.71
<i>Behavioral Factor</i>			
Viagra Use	0.38 <sup>**</sup>	0.13	< 0.01
For Linear Slope			
Intercept	-0.79 <sup>***</sup>	0.23	0.001
<i>Demographic Factors</i>			
Age	0.01	0.01	0.07
Sexual Orientation	0.14	0.19	0.47
HIV Status	-0.02	0.11	0.86
Black	-0.002	0.17	0.99
Latino	-0.05	0.14	0.72
Asian/Pacific Islander	0.27	0.23	0.25
Other	-0.33	0.20	0.11
<i>Psychosocial Factors</i>			
Depression	-0.01	0.01	0.46

	Coefficient	SE	P-value
Loneliness	-0.001	0.01	0.89
Compulsivity	0.02	0.01	0.10
Drug sensation seeking	0.03*	0.01	0.04
Positive outcome expectancies	-0.002	0.01	0.70
Negative outcome expectancies	-0.002	0.02	0.94
Unpleasant emotions	-0.02	0.01	0.05
Physical discomfort	-0.04	0.02	0.11
Conflict with others	-0.002	0.01	0.89
Social pressure	0.004	0.01	0.80
Pleasant times with others	0.02	0.01	0.24
<i>Behavioral Factor</i>			
Viagra Use	0.29*	0.11	< 0.01
Random Effects			
Intercept	0.80***		
Linear Slope	0.42***		

\*  
p .05

\*\*  
p .01

\*\*\*  
p .001