Typology of club drug use among young adults recruited using time-space sampling

Danielle E. Ramo[a], **Christian Grov**[b,c], **Kevin Delucchi**[a], **Brian C. Kelly**[c,d], and **Jeffrey T. Parsons**[c,e,f,*]

[a] Department of Psychiatry, University of California, San Francisco, 401 Parnassus Avenue, TRC 0984, San Francisco, CA 94143, USA, 401 Parnassus Avenue, TRC 0984, San Francisco, CA 94143, USA

[b] Department of Health and Nutrition Sciences, Brooklyn College of the City University of New York, 2900 Bedford Ave., Brooklyn, NY. 11210

[c] The Center for HIV/AIDS Educational Studies and Training (CHEST), 250 West 26th Street, #300, New York, NY. 10001

[d] Department of Sociology and Department of Anthropology, Purdue University, 700 State Street, West Lafayette, IN 47907, USA

[e] Department of Psychology, Hunter College of the City University of New York, 695 Park Avenue, New York, New York, 10065, USA

[f] Social-Personality Doctoral Subprogram, Graduate Center of the City University of New York, 695 Park Avenue, New York, NY 10065, USA

Abstract

The present study examined patterns of recent club drug use among 400 young adults (18–29) recruited using time-space sampling in NYC. Subjects had used at least one of six club drugs (MDMA, Ketamine, GHB, Cocaine, Methamphetamine, and LSD) within the prior 3 months. We used latent class analysis (LCA) to estimate latent groups based on patterns of recent club drug use and examined differences in demographic and psychological variables by class. A 3-class model fit the data best. Patterns were: *Primary cocaine users* (42% of sample), *Mainstream users* (44% of sample), and *Wide-range users* (14% of sample). Those most likely to be *Primary cocaine users* were significantly less likely to be heterosexual males and had higher educational attainment than the other two classes. Those most likely to be *Wide-range users* were less likely to be heterosexual females, more likely to be gay/bisexual males, dependent on club drugs, had significantly greater drug and sexual sensation-seeking, and were more likely to use when experiencing physical discomfort or pleasant times with others compared to the other two groups. Findings highlight the utility of using person-centered approaches to understand patterns of substance use, as well as highlight several patterns of club drug use among young adults.

Keywords

Club drugs; cocaine; young adults

1. Introduction

Club drugs, substances associated with rave and club cultures, proliferated through the 1990s and remain key substances among youth and young adults. Such drugs include methylenedioxymethamphetamine (MDMA, or "ecstasy"), methamphetamine (crystal meth), cocaine, ketamine ("Special K"), d-lysergic acid diethylamide(LSD), and *gamma*-hydroxybutyrate (GHB) and its derivatives (Maxwell, 2005). During the past decade, club drug use has remained prevalent, particularly among young adults, in the United States and elsewhere (Substance Abuse and Mental Health Services Administration, 2008). Having diffused from the rave scene, these drugs are now used in multiple scenes and settings from college bars to parks to house parties to concerts (Hansen et al., 2001). Depending upon the substance, club drugs may lead to a range of harms including cognitive impairment, hyperthermia, depression, sexual risk taking, coma, or death (Kelly, 2005; Maxwell, 2005; McDowell, 2004; Morgan et al., 2006).

It is becoming increasingly clear that patterns of club drug involvement are heterogeneous, having multiple pathways which have not been well classified to date. While recent research suggests cocaine is the most widely used club drug (Kelly et al., 2006), many club drug users are highly likely to use multiple illicit substances which are associated with more profound immediate and long-term consequences (Fendrich et al., 2003; Kelly and Parsons, 2008; Lankenau and Clatts, 2005; Parsons et al., 2006a; Verduin et al., 2007). Such potential for polydrug use remains an important focus for prevention and intervention efforts with young adults.

Most studies of club drug use to date have examined prevalence and correlates of club drug use among groups (e.g., Verduin et al., 2007), rather than characterizing patterns of club drug use among individuals. While these studies have demonstrated the prevalence of multiple substance use among club drug users, more research is needed to characterize the specific patterns of club drug use. To address some of the need for research in these areas, we present a typology of patterns of club drug use using latent class analysis (LCA) that also accounts for a range of factors including demographic characteristics, such as gender and sexual orientation, as well as psychological factors that may be related to these patterns.

1.1 Gender/sexual orientation and club drug use

There is mixed evidence on the relationship between gender and club drug use. Males have been found more likely to use illegal drugs than females, in part given higher rates of opportunities to use drugs (van Etten et al., 1999). Yet, some studies have shown gender equitable rates of club drug use, primarily ecstasy, amongst youth (Akram and Galt, 1999; Boyd et al., 2003; Boys et al., 1999; Hammersley et al., 1999), and that females are more likely to report negative health consequences from ecstasy (Measham et al., 2001; Milani et al., 2004; Topp et al., 1999). This gender difference is likely related to the more intense subjective effects of MDMA reported by women (Liecht et al., 2001), and these findings are less consistent for other club drugs (Kelly et al., 2006). The influence of gender on patterns of club drug use remains complicated, perhaps even more so when accounting for the intersection of gender and sexual orientation.

Sexual orientation also shapes patterns of club drug use. Several studies have documented differential rates of drug use by gay, lesbian, and bisexually identified people compared to their

heterosexual counterparts (Beatty et al., 1999; Kelly et al., 2006; Koh, 2000; Parsons et al., 2006a; Parsons et al., 2006b; Skinner and Otis, 1996). This is also the case with club drugs (Kelly et al., 2006; Parsons et al., 2006b). Gay, lesbian, and bisexual college students ware more likely to have used MDMA than their heterosexual classmates (Boyd et al., 2003), and gay and bisexual men are more likely than heterosexual men to use club drugs, specifically MDMA, hallucinogens, and amphetamines (Stall and Wiley, 1988). Lesbian-identified women are more likely to use common club drugs such as MDMA, cocaine, methamphetamine and LSD compared to heterosexual women (Cochran et al., 2004; Parsons et al., 2006b). Thus, various patterns of drug use are influenced by the intersection of gender and sexuality. Yet, few studies have examined patterns of club drug use as they relate to gender and sexuality together. The examination of gender, sexuality and club drug use remains important to determine the extent to which prevention and education messages should be tailored to gay, lesbian, and bisexual young adults, particularly since dance club venues tend to cater to different subgroups.

1.2 Other correlates of club drug use

Previous research has identified potential psychosocial correlates of club drug use. Sensation seeking, a personality disposition characterized by the tendency to pursue novel, exciting, and optimal levels of stimulation and arousal (Zuckerman, 1971, 1994) is associated with club drug use among adolescents (Martins et al., 2008) and young adults (Hanson et al., 2008). Previous work has distinguished between sexual sensation-seeking and drug sensation seeking. Sexual sensation seeking has been negatively associated with use of club drugs among gay and bisexual men (Palamar et al., 2008). Drug-related sensation seeking has been associated with polydrug use among cocaine users (Kelly and Parsons, 2008).

Another potential correlate of number of club drugs used is the number of different situations in which club drugs are used. Situational triggers for use have been shown to differ based on extent of club-drug use and whether a person uses multiple drugs at once. In a longitudinal study of cocaine use among gay and bisexual men who attend clubs in New York City, Palamar and colleagues (2008) found that frequency of cocaine use at baseline was positively associated with triggers of unpleasant emotions, physical discomfort, and the desire for pleasant times with others. Further, men who reported using cocaine to avoid physical discomfort or to enhance pleasant times with others were also more likely to decrease their frequency of use during the year-long investigation. In addition, compared to those who used only cocaine, polydrug users are more likely to use drugs to deal with unpleasant emotions and to have pleasant times with others (Kelly and Parsons, 2008). Thus, the motivational contexts of use account for psychological and contextual factors that are important for determining patterns of club drug use. These psychosocial correlates may play a role in shaping patterns of polydrug use among club drug users.

Finally, club drug dependence symptoms are a potentially important correlate of the range of club drugs used. Club drugs have a range of addiction liabilities. Nonetheless, dependence is of particular concern for polydrug users. Lifetime episodes of ecstasy use have been associated with patterns of ecstasy dependence symptoms (Scheier et al., 2008), and lifetime occasions of MDMA use have been associated with range of all drug use (Carlson et al., 2005). However, it is as yet unclear whether the range of club drugs used would be associated with symptoms of club drug dependence.

1.3 Latent Class Analysis/Person-centered approaches

Person-centered approaches have increasingly been used to understand patterns of alcohol and drug involvement (Muthèn and Muthèn, 2000). One advantage of these approaches is that they allow for the modeling of use of multiple drugs, which has increasingly been recognized a

significant problem among club drug users (Kelly and Parsons, 2008). Latent class analysis (LCA), a statistical method used to detect homogeneous groupings of individuals (Clogg, 1995; McCutcheon, 1987), is one such person-centered approach. LCA has been used to identify subtypes of alcoholics (Bucholz et al., 1996), examine transitions in alcohol symptomotology (Bucholz et al., 2000), classify longitudinal patterns of alcohol and tobacco use disorders (Jackson et al., 2000), and characterize patterns of tobacco (Furberg et al., 2005) and illicit drug use (Lynskey et al., 2006; Monga et al., 2007). Thus, LCA has applicability to determining typologies for a wide range of psychoactive substances.

Some recent studies have used LCA specifically with individuals who use club drugs. Carlson and colleagues (2005) used LCA to examine patterns of drug use among 402 recent MDMA users. They found three classes labeled *Limited range*, *Moderate range*, and *Wide range* drug use. White ethnicity, youth, and reporting more than 10 occasions of MDMA use were each associated with membership in the *Wide range* class. Scheier and colleagues (2008) used LCA to examine classes of MDMA users based on abuse and dependence symptoms. The best fitting model classified four groups of MDMA users by diagnostic symptoms including *sub-threshold users*, *diagnostic orphans,* a *transitional* group, and a *severe dependent* group. However, it is important to examine a broader range of club drug users as research has shown that patterns of polydrug use differ depending upon whether a substance is a "drug of choice" versus being a drug simply experimented with (Lankenau and Clatts, 2005).

Despite the frequency of multiple substance use among club drug users and the utility of person-centered approaches to classify individuals by patterns of substance, no research to date has used a LCA approach to characterize patterns of multiple club drug use. Evidence examining characteristics of specific substances (e.g., "ecstasy users") increasingly suggests that infrequent or "recreational" users are categorically different from heavy users in terms of drug-related consequences and impairment (Carlson et al., 2005; McGuire et al., 1994; Parrott et al., 2002; Scheier et al., 2008). The search for a reliable and effective description of typologies of club drug use has considerable implications for communicating consequences and designing prevention as well as treatment programs for those who use club drugs.

1.4 Present Study

To develop broad-reaching drug education and prevention initiatives, it is necessary to first fully investigate patterns of drug use across subpopulations. This information is vital given that young adulthood has been characterized by self-discovery and experimentation (including with drugs; Maxwell, 2005), that drugs have been connected to club culture (Measham et al., 2001; Measham et al., 1998), and that disproportionate rates of drug use have been reported across gender, sexual orientation, and other characteristics (Beatty et al., 1999; Patrick et al., 2009; van Etten et al., 1999).

The present study had two goals: 1) establish a typology of patterns of club drug use among club drug-using young adults who frequent night clubs; 2) examine associations among individual characteristics (gender, sexuality, other demographics, sensation-seeking, drug-taking situations) and the most likely club drug use classes. We hypothesized that the best-fitting model would identify more than one class of club drug users, and that being male, identifying as gay/bisexual, having a lower SES (lower education, income, and being unemployed), would all be associated with more severe use patterns compared to other club drug users. In addition, we hypothesized that having more symptoms of dependence, higher sensation-seeking, and using in high risk situations would also be associated with heavier use patterns compared to other club drug users.

2. Methods

Data for this study were taken from the *Club Drugs and Health Project*, a study of health issues among young adults (ages 18–29) involved in New York City dance club scenes. The project was designed to examine the patterns and contexts of club drug use and its associated risks among club-going young adults with the intent of assessing the potential for prevention and education efforts. The six specific club drugs of interest were MDMA, ketamine, GHB, methamphetamine, cocaine, and LSD. The assessments utilized in the study were designed to capture a broad understanding of drug use among club-going young adults as well as basic information on other health issues relevant to this population.

2.1 Participants and procedures

Time–space sampling (MacKellar et al., 2006; Muhib et al., 2001; Stueve et al., 2001), a probability-based method, was used to systematically generate a sample of club-going young adults attending any of 223 dance clubs, bars and lounges in New York City as well as special events throughout the city. Detailed recruitment procedures are described elsewhere (Kelly et al., 2006; Parsons et al., 2008; Parsons et al., 2009; Parsons et al., 2006b).

In the field, potential participants were approached with the following script: "Hi, my name is [NAME] and I am from Hunter College. We are conducting a brief 2-minute survey. Can I have just 2 minutes of your time?" If the patron provided verbal assent, trained staff conducted a brief survey on Palm Pilots® equipped with Handiworx survey software. If the patron refused, field staff noted the refusal and estimated age, gender, and race/ethnicity. These estimations were ascertained solely for supervision and global tracking of refusal rates and demographic characteristics of those declining to participate. There were no significant differences between those who refused to participate and those who were briefly interviewed in age, gender, or ethnicity. Field staff were instructed not to administer surveys to anyone who was visibly impaired by intoxicants, and no incentives were provided for completing the brief 2-minute survey.

Eligibility criteria for participation in the *Club Drugs and Health Project* were embedded in this brief survey. To be eligible for the longitudinal study, individuals had to report the use of any of the six club drugs listed previously at least three times in the previous year and at least once in the prior three months. Additionally, only individuals aged 18–29 years old were eligible. If a patron was found eligible, staff explained the larger project, distributed recruitment materials with project contact information, and collected contact information from the individual. Participants who joined the study later visited the research team's offices and completed measures on computers equipped with A-CASI software. Employing a stratified quota schema, 100 gay and bisexual men, 100 lesbian and bisexual women, 100 heterosexual men, and 100 heterosexual women were enrolled in the project ($N = 400$). Those who were screened as eligible but declined to participate did not significantly differ from those who did participate with regard to age and race/ethnicity. The 400 participants enrolled in the longitudinal study completed face-to-face assessments every 4 months for a year. Data for this analysis are taken from the baseline visit. The Institutional Review Board at Hunter College approved all procedures.

2.2 Measures

Demographics—Participants self-reported their gender, ethnicity, race, and sexual orientation from a list of possible choices: male, female, or transgendered; Latino or Non-Latino; White, Black, Asian/Pacific Islander, Native American, Mixed, or Other; and gay/lesbian/queer, bisexual, or heterosexual. They were also asked to provide their date of birth (from which their age was computed), their employment status, and personal income.

Club drug Use—Study participants were asked how many times they had recently used (past four months) each of six different club drugs: MDMA, cocaine, Ketamine, GHB, methamphetamine, and LSD. These were re-coded as dichotomous variables (used/not used) to conduct the LCA.

Club Drug Dependence—Symptoms of club drug dependence were measured using a modified version of the Composite International Diagnostic Interview (CIDI; Kessler and Ustun, 2004). Traditionally, this measure is used for a specific drug (e.g., "In the past 12 months, did your use of *cocaine* ever interfere with your work at school, a job, or at home?"). To prevent participant fatigue, we modified the questions to read "club drugs" (e.g., "… did your use of *club drugs* ever interfere with your work … ?"). A-CASI prompted participants with a reminder that club drugs were defined as any of the six drugs of interest to the study. Those participants demonstrating symptoms of dependence (i.e., they answered "yes" to three or more items) were asked, "Which of the six club drugs gives you the most problems?" More information on dependence in this sample has been reported elsewhere (see Parsons et al., 2008).

Sensation Seeking—We used two sensation seeking scales to ascertain levels of sensation seeking specific to both drug use and sexuality: the 11-item Sexual Sensation Seeking Scale ($\alpha = .812$) and the 8-item Substance Use Sensation Seeking Scale ($\alpha = .832$), both of which were adapted by Kalichman et al. (1996) from Zuckerman et al's Sensation-Seeking Scales (1964). Items on both scales were placed on a 4-point response format ranging from 1 ("not at all like me") to 4 ("very much like me"). Scores for each scale were computed by calculating the sum of all items in each scale.

Motivational Contexts—The 35-item Inventory of Drug Taking Situations (IDTS) was used to assess the situational contexts underlying club drug use (Turner et al., 1997). Individuals are asked to rate the extent to which they use club drugs in 35 situations, on a 5-point scale from 1 ("never") to 5 ("always"). Five factor-analytically derived scales were used for the present study: Unpleasant Emotions ($\alpha = .92$), Physical Discomfort ($\alpha = .61$), Conflict with Others ($\alpha = .87$), Social Pressures ($\alpha = .80$), and Pleasant Times with Others ($\alpha = .73$).

2.3 Analyses

Latent class models, from one to six classes, were estimated and the fit of each model was compared to the others using the MPlus program version 4.1 (Muthèn and Muthèn, 1998–2006). Model fit was evaluated using the three sets of criteria. The first criterion, the Lo–Mendel–Rubin likelihood ratio (LMR LR) test, is very helpful for making LCA model comparisons (Lo et al., 2001). The LMR LR statistic is not based on chi-square distribution, but a correctly derived distribution. A low *p*-value for a LMR LR test indicates that a given model has to be rejected in favor of a model with at least one additional class.

The second set of criteria are the Bayesian information criterion (BIC; Raferty, 1995) and Aikaike's information criterion (AIC; Akaike, 1973) statistics that balance two components: maximizing the likelihood and keeping the model parsimonious. A low BIC or AIC value indicates a better model fit, and as such, the model with the lowest AIC and BIC are generally preferred (Muthèn and Muthèn, 2000).

We also considered the entropy value, ranging from 0 to 1, which is a measure of the clarity of classification. While there is no clear cut point for the *entropy* value to ensure a minimum level of good classification, classification values that are close to 100% for individuals result in higher entropy and it can be a useful summary measure (Muthèn and Muthèn, 2000; Ramaswamy et al., 1993).

For a given model, parameter estimates include (1) class membership or posterior probabilities and (2) class-specific conditional response probabilities (CRPs). With LCA, observations are classified into their most likely latent classes on the basis of the estimated posterior probabilities for the observations. CRPs reflect the probability that an individual within a particular class has used a particular club drug. Based on the patterns of the estimated conditional probabilities, meaningful labels or definitions of the latent classes can be made.

Very often, class formation in a LCA model is based on a model in which no covariates are included. An extension of the LCA model is the inclusion of covariates to predict class membership. A common practice in traditional cluster analysis is to cluster the data first, then use discriminant analysis to describe differences between the clusters on covariates. A potential problem with such an approach is that the classification may not remain the same when covariates are included. With LCA modeling, the classification and prediction of class membership can be performed simultaneously, therefore avoiding distorted classification (e.g., incorrect class probabilities; Muthèn, 2004; Nagin, 1999; Roeder et al., 1999). The relationship between the latent class membership and any covariates are modeled by a multinomial logit model.

For the present study, we fit a series of latent class models using the recent club drug use variables (presence/absence of use of each club drug in past 4 months) without any covariates, and evaluated the best fitting model using the criteria outlined above (LMR LR, AIC, BIC, posterior probabilities, conditional response probabilities). Based on the best fitting model, we also fit two more models with that number of classes with the covariates for which we had the strongest a priori hypotheses: one with gender/sexual orientation alone (4 dummy-coded variables), and another with gender/sexual orientation and club drug dependence symptoms as covariates.

In order to validate the best-fitting model, we next examined the latent classes (most likely class membership) by frequency of past 4-month club drug use. These analyses were performed for each of the club drugs. Finally, we examined correlates of most-likely latent-class membership. For the variables for which we did not have specific a priori hypotheses about class differences (age, education, employment status, income, sensation-seeking, use situations), we used one-way ANOVA and chi-square analyses to examine differences in these variables by most likely class membership. As these class comparisons were largely exploratory, we evaluated differences in various characteristics using a standard $p<.05$ criterion.

3. Results

3.1 Sample characteristics

Demographic and substance use characteristics of the sample are presented in Table 1. Participants (mean age = 23.9 years) were primarily Caucasian (61.8%), who were enrolled in (24%) or had graduated from college (41.5%), were working full-time (43.8%). A great majority (90.3%) of participants had used cocaine recently, more than half had used MDMA (53.5%) and about one-fifth of the sample had used Ketamine (20.0%), LSD (19.5%), and methamphetamine (16.8%). Use of other substances has been reported elsewhere (Grov et al., 2009). More than half of the sample (63.5%) exhibited symptoms of club drug dependence.

3.2 Model selection

Model fit statistics for the one- to six-class solutions without any covariates are presented in Table 2. While the BIC was slightly lower for the 2-class solution than the 3-class solution (2089 vs. 2097), the AIC, LMR chi-square and entropy all favored a larger class solution.

Comparing the 3- and 4-class solutions, the AIC was almost identical in these solutions, the BIC favored the 3-class solution (2098 vs. 2125), and the chi-square favored the 4-class solution (14.22, $p = .10$ vs. LMR = 32.68, $p = .00002$). Although the evidence did not unequivocally support the 3-class solution over the 4-class solution, the 4-class solution did not indicate the existence of an additional, substantive class over the more parsimonious 3-class solution; there were only 6 individuals assigned to the 4th class, and this solution was not very stable as it changed drastically when covariates were added. Thus, the 3-class solution was chosen as the most parsimonious, best fitting model.

Once we determined that the 3-class model had the best model fit, we fitted two models with covariates into the 3-class model. Since the inclusion of covariates sometimes changes the classification (e.g., number of cases classified into each class), it has been recommended that classification and class membership predictors be included simultaneously. Model fit statistics for the 3-class model with gender/sexual orientation covariate and another with gender/sexual orientation and dependence diagnosis are presented in Table 2. Compared to the 3-class solution without any covariates, these two models with covariates had smaller AIC values, comparable BIC values, and higher LMR χ^2. Most concerning, however, the entropy values for the model with one covariate (.62) and with two covariates (.64) indicate that there was a poor level of orderliness in both models. For all these reasons, we rejected the models with covariates in favor of the 3-class model with no covariates.

3.2.1 Quality of classification—Table 3 shows the average individual posterior probabilities for being assigned to a specific latent class. The values on the diagonal are high, and the values off the diagonal are low. This indicates a good quality of classification. The entropy value of 0.73, while lower than that for the 4- and 5-class solutions, indicates a fairly clear classification.

3.2.2 Latent class probability and class definitions—Conditional response probabilities by class are shown in Figure 1. Class 1 was made up of individuals who used cocaine in the past 90 days (1.00). While they were also somewhat likely to have used MDMA (.22), the likelihood of this was substantially lower than in other classes, and thus this class was labeled *Primary cocaine users*.

Class 2 was made up of young adults who were very likely to have used MDMA (.86), and also used cocaine (.77), and to a lesser extent ketamine (.30) or LSD (.42). This group was labeled *Mainstream users*, as the number of club drugs they had used recently was greater than the *Primary cocaine users*, but less than the third class.

The conditional response probabilities for Class 3 are high for MDMA (.72), Methamphetamine (1.00) and cocaine (.93), and Ketamine (.52). While not exhibiting high conditional response probabilities, members of this class were also somewhat likely to have used GHB (.23), and LSD (.31) in the past 90 days. This class was labeled *Wide-range users.*

3.2.3 Validation of latent classes—In order to validate the 3-class model, frequencies of club drug use were examined by latent class. The mean days using each club drug in the past 4 months (with standard deviations in parentheses) for the total sample were: GHB, 0.43 (6.05); ketamine, 0.81 (2.71); LSD, 0.99 (3.46); methamphetamine, 1.03 (5.88); MDMA, 3.03 (8.07); and cocaine, 16.77 (22.80). The means of past 4-month club drug use by most-likely latent class, which were also examined, indicated that *Wide-range* users use club drugs more frequently than individuals in other classes, and that *Mainstream* users generally use club drugs more frequently than *Primary-cocaine* users. Since frequencies of all six club drugs were significantly skewed and kurtotic, the median values of each club drug were also examined across the 3 latent classes (Figure 2) since the medians may better represent these trends. Those

more likely to be *Primary-cocaine users* had a median of 6 days of cocaine use in the past 4 months, and 0 days use of all five other classes of club drugs. Those most likely to be in the *Mainstream* class had a slightly higher median days of cocaine use (8 days in the past 4 months), and 2 days of MDMA use. Finally, those most likely to be in the *Wide-range* using class had the highest median of cocaine use (15 days in the past four months), four days of MDMA use, 2 days of methamphetamine use, and 1 days of ketamine use. These were consistently higher frequencies of use than for the other classes. Overall, club drug frequencies were consistent with conditional response probabilities across latent classes.

3.3 Characteristics of latent classes

Posthoc ANOVA and chi-square analyses examined differences in demographic and psychological characteristics across most likely latent class. Results are presented in Table 4. Those most likely to be *Primary cocaine users* were significantly less likely to be heterosexual males (χ^2 (6, $N = 400$) = 13.26, $p < .05$) and had higher educational attainment (χ^2 (10, $N = 400$) = 24.85, $p < .01$) than the other two classes. Those most likely to be *Wide-range users* were less likely to be heterosexual females, more likely to be gay/bisexual males, (χ^2 (6, $N = 400$) = 13.26, $p < .05$), dependent on club drugs (χ^2 (2, $N = 400$) = 19.35, $p < .001$), had significantly greater drug (F(2, 397) = 23.69, $p < .001$) and sexual (F(2, 397) = 3.11, $p < .05$) sensation-seeking, and were more likely to use when experiencing physical discomfort (F(2, 397) = 11.43, $p < .001$) or when experiencing pleasant times with others (F(2, 397) = 9.17, $p < .001$) compared to the other two groups. In order to better clarify the characteristics of gay/bisexual males in each class, post hoc analyses examined whether there were any differences between those gay men in the *Wide-range users* class compared to those in the *Primary cocaine users* class. Those in the *Wide-range users* class were significantly more likely to be dependent on club drugs (χ^2 (1, $N = 64$) = 6.71, $p < .01$). There were no differences between the two groups on age (F(1, 62) = 0.53, *N.S.*), ethnicity (White vs. non-White; χ^2 (1, $N = 64$) = 0.22, *N.S.*), income (χ^2 (2, $N = 64$) = 0.19, *N.S.*), or employment status (χ^2 (2, $N = 64$) = 0.85, *N.S.*).

4. Discussion

Club drug users are often spoken of as an undifferentiated monolith (e.g., Leshner, 2000). The present study found three dominant patterns of recent club drug use among club-going young adults. These findings parallel those found by Carlson et al. (2005) who examined general patterns of drug use among MDMA users. However, the samples were quite different between the two studies, and our sample provides a fuller profile of broader patterns of club drug use beyond MDMA. Carlson et al. examined a wide range of substances (e.g., alcohol, marijuana, opioids) specifically among MDMA users. Our study examined patterns of club drug use among a broader sample of club drug users. Nevertheless, the patterns of use found with LCA confirmed our hypothesis that use would be heterogeneous and demonstrated three classes based on range of use in each sample: A *Wide-range* pattern, a *Mainstream* pattern, and a more "limited range" pattern consisting of *Primary Cocaine* users. These studies highlight that patterns of club drug use are quite varied. Many individuals are likely to have experience with multiple club drugs and further, that there is heterogeneity even among polydrug using individuals. Our analyses suggest there are three types of club drug users. Beyond the three classes identified, it is also important to note a particular class that is absent from the LCA of our sample – *Primary-MDMA* users. This is notable in that MDMA has been identified as a core club drug, and examinations of MDMA have often served to represent broader patterns of drugs use. The three patterns found here indicate that prevention and intervention experts may need to be prepared to deal with three different types of drug users, as these patterns of use are likely to have different clinical implications.

4.1 Typologies of club drug use

Many individuals were likely to fall into the class of *Primary-cocaine* users. Such individuals reflect the latest trends in club drug use, as cocaine use rose over the course of the past decade across the United States (SAMHSA, 2008), even as the use of other club drugs, such as MDMA and ketamine, tailed off (Maxwell, 2004). Though primarily focused upon cocaine in this sample, more broadly, such individuals are devotees to a specific drug and either may not have had exposure to other drugs, or are disinclined to engage in polydrug use (consistent with low frequencies of other club drug use in this sample). Other users, (e.g. *Mainstream users*) are those who may be more inclined to experiment but are primarily focused on some core drugs that are among the most popular substances. These individuals have a higher frequency of cocaine use and are also likely to have had some experience with MDMA, but are not likely to have had extensive experience with other club drugs. The patterns of polydrug use by such individuals may be limited by perceptions that some club drugs are "harder" than others. In other words, a folk hierarchy of risk may exist, and it tempers broader experimentation for some. However, not all club drug users are measured in their patterns of use. Some club drug users engage in extensive polydrug use, such as the *Wide-range* users. Such individuals have been referred to as "garbage heads" (e.g. Klein et al, 2006) in reference to the suggestion that anything can be consumed by them in pursuit of a high. Such patterns of extensive polydrug use suggest a willingness to pursue drug highs in different ways, as these diverse drugs produce different effects on users.

Those who had a high probability of membership in our most limited range class (the *Primary cocaine users* class) were those who had used cocaine in the past 4 months, had a small likelihood (33%) of having used MDMA, and were unlikely to have used any other club drug. This finding suggests a wide prevalence of cocaine within this population, which is consistent with epidemiological findings that cocaine is the most widely used club drug (e.g., Substance Abuse and Mental Health Services Administration, 2008). However, since almost half of our sample (42%) was most likely to be assigned to the *Primary cocaine users* class, it also suggests that a significant portion of club drug users is not using multiple drugs. In this regard, club drug users are not universally polydrug users. Further, those most likely to be in this class use cocaine relatively infrequently (median = 6 days/4 months). Prevention efforts should consider that individuals who follow this pattern may not be susceptible to messages about drugs other than cocaine, and may feel differently about use than those who use more often. Interventions that take a less confrontational approach (e.g., Motivational Interviewing; Miller and Rollnick, 2002) may be particularly helpful in changing cocaine use behavior for these individuals.

The findings in the validation of the LCA through analysis of frequency data are also notable. Individuals who use a wider range of drugs are also likely to use all club drugs more frequently. For example, although cocaine use was found to be widely used throughout the sample, individuals in the *Primary-Cocaine* class were using cocaine itself less often than those individuals likely to fall into the *Mainstream* and *Wide-range* classes. *Wide-range* users, while using a wide array of substances, were also likely to use various club drugs more frequently than individuals likely to fall into other classes. This is notable as the findings suggest that, rather than dividing their time between different drugs, club drug users who engage in wide patterns of polydrug use may also be likely to intensify their use of *all* of the drugs they are involved with.

Compared to the other patterns of club drug use, those most likely to be in the *Wide-range* using class, tended to use all club drugs more frequently than other users, and were further distinguished from other users by their likelihood of methamphetamine use, which was highly unlikely in other classes. While this group of individuals only use methamphetamine somewhat infrequently (median methamphetamine use = 2 days), it was more often than those assigned to other classes. These individuals would likely benefit from public health messages focusing

on general stimulant use rather than just cocaine use, for those who enter treatment, a more intense level would likely be appropriate to change club drug use and associated problems.

4.2 Characteristics associated with club drug use patterns

Beyond these general patterns, there were notable differences in club drug use patterns by gender and sexual orientation. As hypothesized, on the whole, men were more likely to use a wider range of club drugs than women, in that a greater proportion of those assigned to the *Wide-range* class were men compared to women regardless of sexual orientation. Further, there were fewer heterosexual men likely to be in the *Primary cocaine users* class compared to other gender/sexual orientation groups. This may reflect the cultural influence of masculinity norms driving fringe drug consumption, and it is crucial to further explore how gender is situated within certain contexts that shape this pattern. This is consistent with previous findings from the *Club Drug and Health Project* that men are more likely to have ever used fringe club drugs, such as Ketamine, GHB, and crystal meth, than women (Kelly et al., 2006), as well as that men who use club drugs are more likely to be polydrug users than women (Kelly and Parsons, 2008). However, in a recent review of epidemiological club drug literature, Leung and Cottler (2008) noted very few gender differences in prevalence of club drug use across studies. Further, Carlson et al. (2005) did not find any gender difference in patterns of use among MDMA users. Taken together, these findings suggest that gender differences in patterns of club drug use may vary by type of substance studied and that other factors (e.g., gender's intersection with sexual orientation) need to be considered when designing effective prevention and intervention programs for the diverse types of club drug users. For example, heterosexual men may benefit from campaigns focused on polydrug use more so than others.

Beyond gender, there were also differences in patterns of club drug use by sexual orientation, specifically among men, such that there were fewer gay or bisexual-identified men assigned to the *Mainstream users* class compared to the other two classes. This is an interesting finding. Gay men tend to follow a pattern whereby they either use more heavily or make an effort to stay away from club drugs other than cocaine, especially compared to heterosexual men who are more likely to be assigned to the heavier using classes (*Mainstream users, Wide-range users*) compared to the *Primary cocaine users* class. This bifurcated pattern suggests that prevention and intervention messages may be reaching gay and bisexual men in divergent ways. For those men for whom these messages do not limit the use of drugs, they may ignore these messages altogether and engage in heavy patterns of club drug use. In addition, the practice of "Party-n-Play" (drug use with sex) may further exacerbate drug use patterns for some gay and bisexual men (Jerome et al., 2009; Kipke et al., 2007). This further underscores the importance of tailoring interventions with men by sexual orientation. Interestingly, there were no obvious differences in most likely class among women – there were approximately equal proportions of heterosexual and lesbian or bisexual identified women in each of the three classes. Sexuality may not be as strong predictor of drug use patterns among women as it is among men, which is consistent with previous research in this area (Carlson et al., 2005).

Patterns of club drugs differed by other important characteristics. Higher level of education was associated with membership in the *Primary cocaine users* class. This is consistent with findings that educational attainment is associated with lower likelihood of current illicit drug use (SAMHSA, 2008), and suggests that education may be inhibiting polydrug use among more highly educated club drug users. However, our findings contrast with Carlson and colleagues' (2005) findings that drug use patterns among MDMA users were not associated with education. Finally, in our sample, Caucasian individuals were less likely to be assigned to the *Wide-range users* class compared to the other two classes than those of other ethnic groups. These findings contrast previous findings that ethnicity is not correlated with heavier patterns of club drug use (Carlson et al., 2005; Kelly and Parsons, 2008), and emphasizes the

need to replicate these findings in future studies that combine person-centered and variable centered approaches, although these divergent findings may be due to the differences in the nature of the two samples. Nonetheless, taken together, these findings highlight an association between education and drug use as well as ethnicity and drug use. Additionally, it is important to note that both may be mediated by a number of important biological (e.g., genetic vulnerability; Luczak et al., 2004), psychological (e.g., psychiatric comorbidity; Huang et al., 2006), and social (e.g., participation in Greek life; Park et al., 2009) factors.

Other person-centered characteristics found to relate to class membership were similar to variables associated with polydrug use in a recent study using the same sample (Kelly and Parsons, 2008). Specifically, as hypothesized, club drug dependence, drug sensation-seeking, and using when experiencing pleasant times with others were all associated with polydrug use. This suggests that characteristics that predict recent (past 4 month) experience with multiple club drugs are similar to those that predict use of multiple drugs together. Future research can help to elucidate this more fully. However, both studies underscore the importance of sensation-seeking as a risk factor for varying patterns of substance use as it is for other risk behaviors (Zuckerman, 2007). Indeed, it is perhaps unsurprising that individuals inclined toward sensation seeking would pursue highs through a variety of different drugs. In addition to the connection with sensation seeking, the situational characteristics which best distinguish use patterns from one another highlight the social motivations of club drug use as particularly important.

4.3 Limitations, strengths, and implications

Although this study highlights several important issues, it has limitations. First, by employing LCA, one can assign individuals to the "most likely class" to which they belong based on their pattern of club drug use; however, each individual has a non-zero probability of assignment to other classes. Thus, we have used caution in the generalizations about patterns of club drug use which can be made from the LCA conducted here and do not assume that all people fall perfectly into one of the three classes we have identified in our study. Second, the sample was selected to have equal numbers of GLB and heterosexual men and women ($n = 100$ of each group). Thus, this may have influenced the estimation as some groups may be over-represented and carry a disproportionate weight in the analysis. However, this bias, if any, is likely small. Finally, our sample consisted of individuals who attended nightclubs in New York City, and may not generalize to other areas in the United States.

Despite these limitations, this study presents important information on patterns of use among club drug users. Our findings underscore the usefulness of this approach to identify heterogeneous patterns of drug involvement, and the importance of conceptualizing use as having multiple pathways in this population. Prevention efforts should take into account that many young adult club drug users in New York City are primarily using cocaine, but that there may be a need for varied interventions to target *Mainstream users*, and *Wide-range users*. Our findings also highlight the unique patterns of club drug use by various individual characteristics, and the importance of incorporating gender and sexual orientation as key factors into the development of efficacious prevention programs. Finally, personal characteristics are also important and may help to elucidate who is most at risk for use of multiple substances.

Acknowledgments

References

Akaike, H. In: Petrov, BN.; Csaki, F., editors. Information theory and an extension of the maximum likelihood principle; Second International Symposium in Information Theory; Akademiai, Kiado, Budapest. 1973. p. 267-281.

Akram G, Galt M. A profile of harm reduction practices and co-use of illicit and licit drugs amongst users of dance drugs. Drugs: Education, Prevention, & Policy 1999;6:215–225.

Beatty, RL.; Geckle, MO.; Huggins, J.; Kapner, C.; Lewis, K.; Sandstrom, DJ. Gay men, lesbians, and bisexuals. In: McCrady, BS.; Epstein, EE., editors. Addictions: A Comprehensive Guidebook. Oxford University Press; New York: 1999. p. 542-551.

Boyd CJ, McCabe SE, d'Arcy H. Ecstasy use among college undergraduates: Gender, race, and sexual identity. J Subst Abuse Treat 2003;24:209–215. [PubMed: 12810141]

Boys A, Marsden J, Griffiths P, Fountain J, Stillwell G, Strang J. Substance use among young people: The relationship between perceived functions and intentions. Addiction 1999;94:1043–1050. [PubMed: 10707442]

Bucholz KK, Heath AC, Madden PAF. Transitions in drinking in adolescent females: Evidence from the Missouri adolescent female twin study. Alcohol Clin Exp Res 2000;24:914–923. [PubMed: 10888082]

Bucholz KK, Heath AC, Reich T, Hesselbrock VM, Kramer JR, Nurnberger JI, Schuckit MA. Can we subtype alcoholism? A latent class analysis of data from relatives of alcoholics in a multi-center family study of alcoholism. Alcohol Clin Exp Res 1996;20:1462–1471. [PubMed: 8947326]

Carlson RG, Wang J, Falck RS, Siegal HA. Drug use practices among MDMA/ecstasy users in Ohio: A latent class analysis. Drug Alcohol Depend 2005;79:167–179. [PubMed: 16002026]

Clogg, C. Latent class models. In: Arminger, G.; Clogg, C.; Sobel, M., editors. Handbook of Statistical Modeling for the Social and Behavioral Sciences. Plenum Press; New York, NY: 1995. p. 311-359.

Cochran SD, Ackerman D, Mays VM, Ross MW. Prevalence of non-medical drug use and dependence among homosexually active men and women in the US population. Addiction 2004;99:989–998. [PubMed: 15265096]

Fendrich M, Wislar JS, Johnson TP, Hubbell A. A contextual profile of club drug use among adults in Chicago. Addiction 2003;98:1693–1703. [PubMed: 14651501]

Furberg H, Sullivan PF, Maes H, Prescott CA, Lerman C, Bulik C, Kendler KS. The types of regular cigarette smokers: A latent class analysis. Nicotine Tobacco Res 2005;7:351–360.

Grov C, Kelly BC, Parsons JT. Polydrug use among club-going you adults recruited through time-space sampling. Subst Use Misuse 2009;44:848–864. [PubMed: 19444726]

Hammersley R, Ditton J, Smith I, Short E. Patterns of ecstasy use by drug users. Br J Criminol 1999;39:625–647.

Hansen D, Maycock B, Lower T. 'Weddings, parties, anything…', a qualitative analysis of ecstasy use in Perth, Western Australia. Int J Drug Policy 2001;12:181–199. [PubMed: 11399420]

Hanson KL, Luciana M, Sullwold K. Reward-related decision-making deficits and elevated impulsivity among MDMA and other drug users. Drug Alcohol Depend 2008;96:99–110. [PubMed: 18384979]

Huang B, Grant BF, Dawson DA, Stinson FS, Chou SP, Saha TD, Goldstein RB, Smith SM, Ruan WJ, Pickering RP. Race-ethnicity and the prevalence and co-occurrence of Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, alcohol and drug use disorders and Axis I and II disorders: United States, 2001 to 2002. Compr Psychiatry 2006;47:252–257. [PubMed: 16769298]

Jackson KM, Sher KJ, Wood PK. Trajectories of concurrent substance use disorders: A developmental, typological approach to comorbidity. Alcohol Clin Exp Res 2000;24:902–913. [PubMed: 10888081]

Jerome RC, Halkitis PN, Siconolfi DE. Club drug use, sexual behavior, and HIV seroconversion: A qualitative study of motivations. Subst Use Misuse 2009;44:431–447. [PubMed: 19212930]

Kalichman SC, Hackman T, Kelly JA. Sensation seeking as an explanation for the association between substance use and HIV-related risky sexual behavior. Arch Sex Behav 1996;25:141–154. [PubMed: 8740520]

Kelly BC. Conceptions of risk in the lives of club drug-using youth. Subst Use Misuse 2005;40:1443–1459. [PubMed: 16048827]

Kelly BC, Parsons JT. Predictors and comparisons of polydrug and non-polydrug cocaine use in club subcultures. The American Journal of Drug and Alcohol Abuse 2008;34:774–781. [PubMed: 19016183]

Kelly BC, Parsons JT, Wells BE. Patterns and prevalence of club drug use among club-going young adults. J Urban Health 2006;83:884–895. [PubMed: 16937088]

Kessler RC, Ustun TB. The World Mental Health (WMH) survey initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). International Journal of Methods in Psychiatric Research 2004;13:93–121. [PubMed: 15297906]

Kipke MD, Weiss G, Ramirez M, Dorey F, Ritt-Olson A, Iverson E, Ford W. Club drug use in Los Angeles among young men who have sex with men. Subst Use Misuse 2007;42:1723–1743. [PubMed: 17934992]

Koh AS. Use of preventive health behaviors by lesbian, bisexual, and heterosexual women: A questionnaire survey. West J Med 2000;2000:379–384. [PubMed: 10854384]

Lankenau SE, Clatts MC. Patterns of poly-drug use among Ketamine injectors in New York City. Subst Use Misuse 2005;40:1381–1397. [PubMed: 16048823]

Leshner AI. A club drug alert. 2000 NIDA Notes 14.

Leung KS, Cottler LB. Ecstasy and other club drugs: A review of recent literature. Current Opinion in Psychiatry 2008;21:234–241. [PubMed: 18382220]

Liecht ME, Gamma A, Vollenweider FX. Gender differences in teh subjective effects of MDMA. Psychopharmacology 2001;154:161–168. [PubMed: 11314678]

Lo Y, Mendell N, Rubin D. Testing the number of components in a normal mixture. Biometrika 2001;88:767–778.

Luczak SE, Wall TL, Cook TAR, Shea SH, Carr LG. ALDH2 Status and Conduct Disorder Mediate the Relationship Between Ethnicity and Alcohol Dependence in Chinese, Korean, and White American College Students. J Abnorm Psychol 2004;113:271–278. [PubMed: 15122947]

Lynskey MT, Agrawal A, Bucholz KK, Nelson EC, Madden PAF, Todorov AA, Grant JD, Martin NG, Heath AC. Subtypes of Illicit Drug Users: A Latent Class Analysis of Data From an Australian Twin Sample. Twin Research and Human Genetics 2006;9:523–530. [PubMed: 16899159]

MacKellar D, Valleroy L, Karon J, Lemp G, Janssen R. The Young Men's Survey: Methods for estimating HIV seroprevalence and risk factors among young men who have sex with men. Public Health Rep 2006;11:138–144.

Martins SS, Storr CL, Alexandre PK, Chilcoat HD. Adolescent ecstasy and other drug use in the National Survey of Parents and Youth: The role of sensation-seeking, parental monitoring and peer's drug use. Addict Behav 2008;33:919–933. [PubMed: 18355973]

Maxwell J. Party drugs: Properties, prevalence, patterns, and problems. Subst Use Misuse 2005;40:1203–1240. [PubMed: 16048814]

Maxwell, JC. Patterns of club drug use in the U.S., 2004. The Gulf Coast Addiction Technology Transfer Center, The University of Texas; Austin, Austin: 2004.

McCutcheon, A. Latent Class Analysis. Sage Publications; Beverly Hills, CA: 1987.

McDowell, DM. MDMA, ketamine, GHB, and the "club drug" scene. In: Galanter, M.; Kleber, HD., editors. Textbook of Substance Abuse Treatment. American Psychiatric Publishing; Arlington, VA: 2004. p. 321-331.

McGuire PK, Cope H, Fahy TA. Diversity pf psychopathology associated with use of 3, 4-methylenedioxymethamphetamine ('Ecstasy'). Br J Psychiatry 1994;165:391–395. [PubMed: 7994514]

Measham, F.; Aldridge, J.; Parker, H. Dancing on Drugs: Risk, Health, and Hedonism in the British Club Scene. Free Association; London: 2001.

Measham F, Parker H, Aldridge J. The teenage transition: from adolescent recreational drug use to the young adult dance culture in Britain in the mid-1990s. J Drug Iss 1998;28:9–32.

Milani RM, Parrott AC, Turner JD, Fox HC. Gender differences in self-reported anxiety, depression, and somatization among ecstasy/MDMA polydrug users, alcohol/tobacco users, and nondrug users. Addict Behav 2004;29:965–971. [PubMed: 15219343]

Miller, WR.; Rollnick, S. Motivational Interviewing: Preparing people for change. 2. Guilford; New York, NY: 2002.

Monga N, Rehm J, Fischer B, Brissette S, Bruneau J, El-Guebaly N, Noel L, Tyndall M, Wild C, Leri F, Fallu J-S, Bahl S. Using latent class analysis (LCA) to analyze patterns of drug use in a population of illegal opioid users. Drug Alcohol Depend 2007;88:1–8. [PubMed: 17049753]

Morgan JM, Impallomeni LC, Pirona A, Rogers RD. Elevated impulsivity and impaired decision-making in abstinent ecstasy (MDMA) users compared to polydrug and drug-naive controls. Neuropsychopharmacology 2006;31:1562–1573. [PubMed: 16292322]

Muhib FB, Lin LS, Stueve A, Ford WL, Miller RL, Johnson WD, Smith PJ. A venue-based method for sampling hard-to-reach populations. Public Health Rep 2001;116:216–222. [PubMed: 11889287]

Muthèn, B. Latent variable analysis: Growth mixture modeling and related techniques for longitudinal data. In: Kaplan, D., editor. The SAGE Handbook of Quantitative Methodology for the Social Sciences. Sage Publications; Newbury Park, CA: 2004. p. 345-368.

Muthèn BO, Muthèn LK. Integrating person-centered and variable-centered analysis: Growth mixture modeling with latent trajectory classes. Alcohol Clin Exp Res 2000;24:882–891. [PubMed: 10888079]

Muthèn, LK.; Muthèn, B. MPlus User's Guide. Muthèn & Muthèn; Los Angeles, CA: 1998–2006.

Nagin D. Analyzing developmental trajectories: A semiparametric, group-based approach. Psychological Methods 1999;4:139–157.

Palamar JJ, Mukherjee PP, Halkitis PN. A longitudinal investigation of powder cocaine use among club-drug using gay and bisexual men. Journal of Studies on Alcohol and Drugs 2008;69:806–813. [PubMed: 18925338]

Park A, Sher KJ, Wood PK, Krull JL. Dual mechanisms underlying accentuation of risky drinking via fraternity/sorority affiliation: The role of personality, peer norms, and alcohol availability. J Abnorm Psychol 2009;118:241–255. [PubMed: 19413401]

Parrott AC, Buchanan T, Scholey AB, Heffernan T, Ling J, Rodgers J. Ecstasy/MDMA attributed problems reported by novice, moderate and heavy recreational users. Human Psychopharmacology 2002;17:309–312. [PubMed: 12404677]

Parsons JT, Grov C, Kelly BC. Comparing the effectiveness of two forms of time-space sampling to identify club drug-using young adults. J Drug Iss 2008;38:1063–1084.

Parsons JT, Grov C, Kelly BC. Club drug use and dependence among young adults recruited through time-space sampling. Public Health Rep 2009;124:246–254. [PubMed: 19320366]

Parsons JT, Halkitis PN, Bimbi DS. Club drug use among young adults frequenting dance clubs and other social venues in New York City. J Child Adolescent Subst Abuse 2006a;15:1–14.

Parsons JT, Kelly BC, Wells BE. Differences in club drug use between heterosexual and lesbian/bisexual females. Addict Behav 2006b;31:2344–2349. [PubMed: 16632210]

Patrick ME, Collins LM, Smith E, Caldwell L, Flisher A, Wegner L. A prospective longitudinal model of substance use onset among South African adolescents. Subst Use Misuse 2009;44:647–662. [PubMed: 19360538]

Raferty, A. Bayesian model selection in social research (with discussion). In: Marsden, P., editor. Sociological Methlodology. Blackwells; Cambridge, MA: 1995. p. 111-196.

Ramaswamy V, DeSarbo WS, Reibstein DJ, Robinson W. The empirical pooling approach for estimating marketing mix elasticities with PIMS data. Marketing Science 1993;12:103–124.

Roeder K, Lynch KG, Nagin DS. Modeling uncertainty in latent class membership: A case study in criminology. Journal of the American Statistical Association 1999;94:766–776.

Scheier LM, Ben Abdallah A, Inciardi JA, Copeland J, Cottler LB. Tri-city study of Ecstasy use problems: A latent class analysis. Drug Alcohol Depend 2008;98:249–263. [PubMed: 18674872]

Skinner WF, Otis MD. Drug and alcohol use among lesbian and gay people in a southern U.S. sample: Epidemiological, comparative, and methodological findings from the Trilogy Project. J Homosex 1996;30:59–92. [PubMed: 8743117]

Stall R, Wiley J. A comparison of alcohol and drug use patterns of homosexual and heterosexual men: The San Francisco Men's Health Study. Drug Alcohol Depend 1988;22:63–73. [PubMed: 3266145]

Stueve A, O'Donnell L, Duran R, Sandoval A, Blome J. Time-space sampling in minority communities: results with young Latino men who have sex with men. Am J Public Health 2001;91:922–926. [PubMed: 11392935]

Substance Abuse and Mental Health Services Administration. Office of Applied Studies. Results from the 2007 National Survey on Drug Use and Health: National Findings. Rockville, MD: 2008.

Topp L, Hando J, Dillon P, Roche A, Solowij N. Ecstsy use in Australia: Patterns of use associated with harm. Drug Alcohol Depend 1999;55:105–115. [PubMed: 10402155]

Turner NE, Annis HM, Sklar SM. Measurement of antecedents to drug and alcohol use: Psychometric properties of the Inventory of Drug-Taking Situations (IDTS). Behav Res Ther 1997;35:465–483. [PubMed: 9149457]

van Etten ML, Neumark YD, Anthony JC. Male-female differences in the earliest stages of drug involvement. Addiction 1999;94:1413–1419. [PubMed: 10615725]

Verduin ML, Payne RA, McRae AL, Back SE, Simpson SA, Sarang RY, KTB. Assessment of club drug use in a treatment-seeking sample of individuals with marijuana dependence. The American Journal on Addictions 2007;16:484–487. [PubMed: 18058415]

Zuckerman M. Dimensions of sensation seeking. J Consult Clin Psychol 1971;36:45–52.

Zuckerman, M. Biological Expressions and Biosocial Bases of Sensation Seeking. Cambridge Press; New York: 1994.

Zuckerman, M. Sensationseeking and risky behavior. American Psychological Association; Washington, DC: 2007.

Zuckerman M, Kolin EA, Price L, Zoob M. Development of a sensation seeking scale. J Consult Clin Psychol 1964;28:477–482.
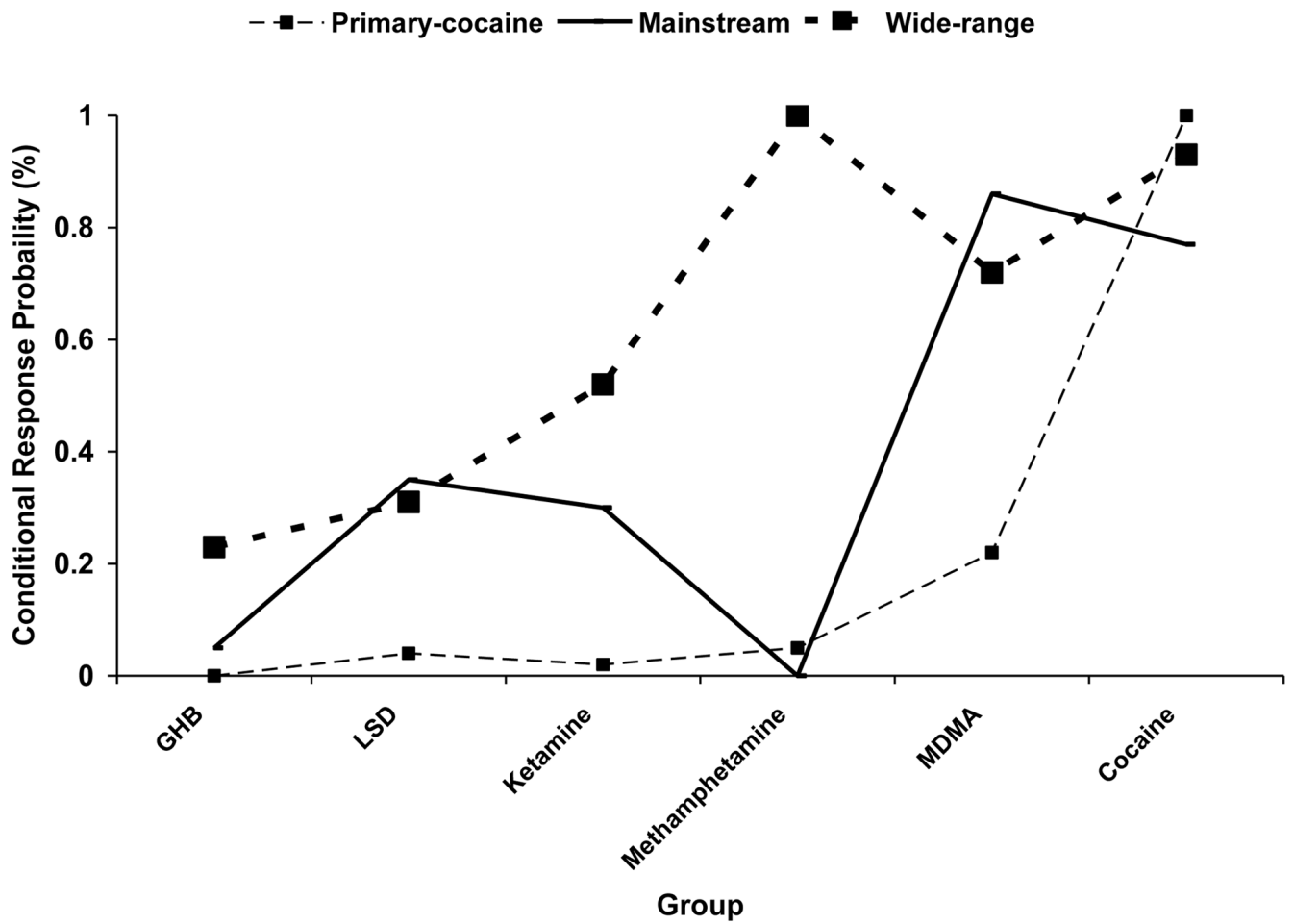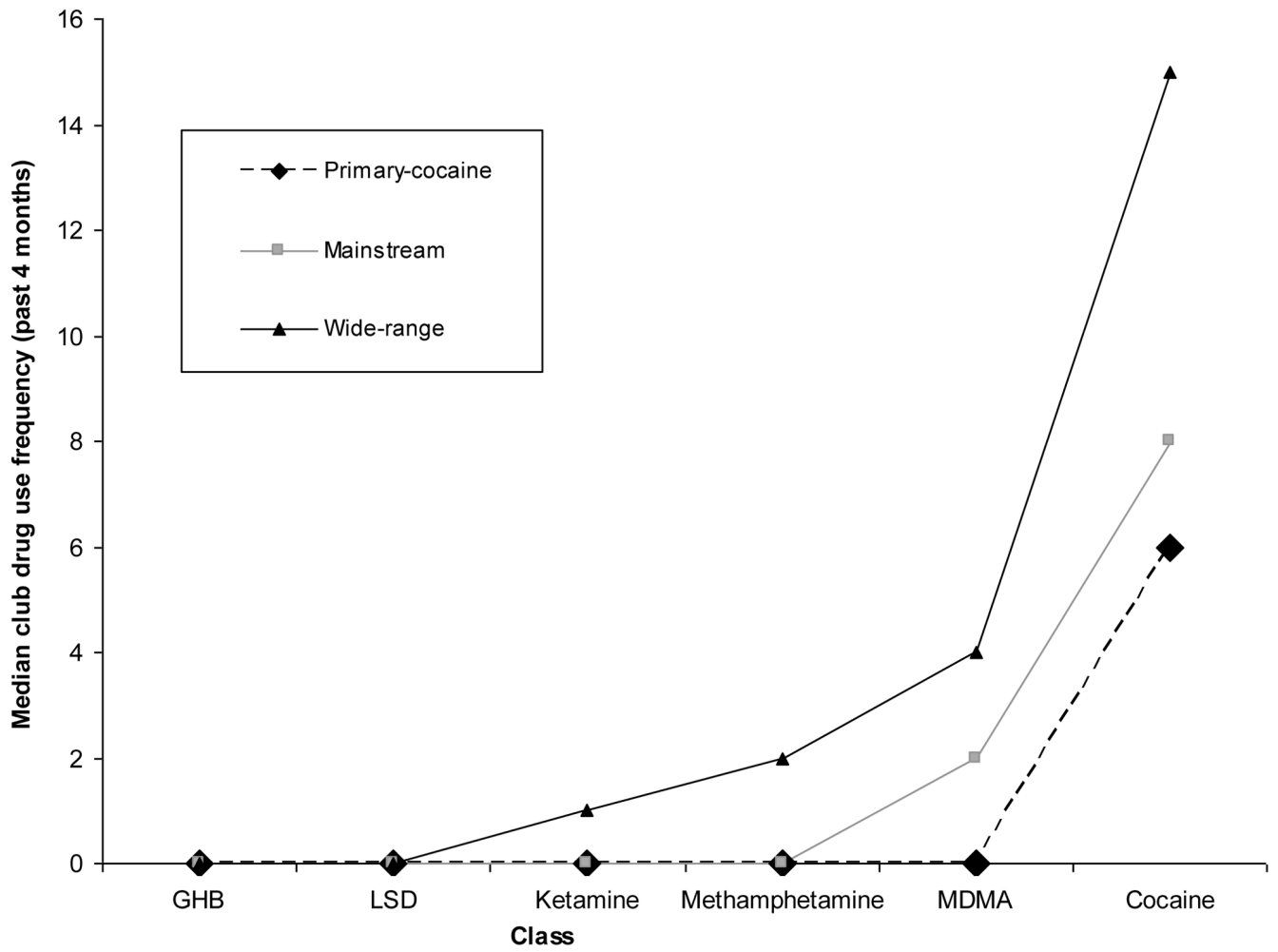
Figure 1.
Conditional Response Probabilities for 3-Class solution (% using in past 4 months).

Figure 2.
Median days of club drug use (past 4 months) by latent class.

Table 1

Demographic and drug use characteristics of young adult club drug users

Characteristic	
Age (years)	23.90 (2.7)
% female	50
% gay/lesbian/bisexual identified	50
Ethnicity (%)	
White	61.8
African-American	6.5
Hispanic/Latino	19.3
Asian/Pacific Islander	4.0
Other	8.5
Education (%)	
some HS	3.3
HS diploma	8.0
Some college	17.0
Enrolled in college	24.0
BA	41.5
Graduate school	6.3
Employment (%)	
Full-time	43.8
Part-time	33.3
Unemployed	23.0
Income	
<10k	31.2
10k–30k	32.7
>30k	36.2
Club Drug Use Past 4 mo (%yes)	
MDMA	53.5
Ketamine	20.0
GHB	5.0
Methamphetamine	16.8
Cocaine	90.3
LSD	19.5
% Club drug dependence	63.5
Drug sensation-seeking	17.91 (4.2)
Sexual Sensation seeking	26.55 (6.4)
IDTS Scales	
Unpleasant Emotions	19.80 (8.4)
Physical Discomfort	8.93 (2.9)
Conflict with Others	15.39 (6.3)
Social Pressure	10.52 (4.1)

Characteristic	
Pleasant Times with Others	15.91 (3.8)

Table 2

Model comparison

	AIC	BIC	LMR CS	p-value	Entropy
Without covariates					
1-Class	2135.57	2159.52	---		
2-Class	2037.35	2089.24	109.61	<.00005	.57
3-Class	2017.89	2097.72	32.68	.0002	.73
4-Class	2017.37	2125.14	14.22	.10	.83
5-class	2024.48	2160.19	6.74	.24	.84
6-class	2033.89	2197.54	4.57	.19	.79
With covariates					
3-class gender/sexual orientation covariates	2003.76	2107.54	40.29	.09	.62
3-class gender/sexual orientation, dependence covariates	1965.86	2077.62	63.66	.00	.64

Table 3

Mean class assignment probability by class (N = 400)

	Class 1	Class 2	Class 3
Class 1 (n = 166)	.90	.08	.02
Class 2 (n = 177)	.22	.78	.00
Class 3 (n = 57)	.05	.00	.95

Table 4

Observed individual characteristics by latent class

	Class 1: *Primary cocaine* (n = 166)	Class 2: *Mainstream* (n = 177)	Class 3: *Wide- range* (n = 57)	*F, χ²*	*p*
Gender/sexual orientation (%)				13.26	.04
Lesbian/bisexual females	27.1	24.3	21.2		
Heterosexual females	28.3	24.3	17.5		
Gay/bisexual males	27.7	20.3	31.6		
Heterosexual males	16.9	31.1	29.8		
Mean age (SD)	24.11 (2.6)	23.78 (2.9)	23.67 (2.8)	.83	.44
% Caucasian	63.3	65.0	47.4	5.93	.05
Education (%)				24.85	.01
Some HS	0.6	5.6	3.5		
HS diploma	4.8	7.9	17.5		
Some college	15.1	16.4	24.6		
Enrolled in college	22.9	26.0	21.1		
BA	49.4	39.0	26.3		
Graduate school	7.2	5.1	7.0		
Employment (%)				2.80	.59
Full-time	44.0	42.9	45.6		
Part-time	36.1	32.8	26.3		
Unemployed	19.9	24.3	28.1		
Income (%)				2.51	.64
<10k	29.3	31.6	35.1		
10k–30k	31.1	32.8	36.8		
>30k	39.6	35.6	28.1		
% Dependence	59.0	59.3	89.5	19.35	.00
Symptoms					
Drug sensation- seeking (M, SD)	17.04 (3.6)	17.65 (4.0)	21.18 (4.7)	23.69	.00
Sexual sensation- seeking (M, SD)	26.72 (6.4)	25.83 (6.3)	28.26 (6.3)	3.12	.04
Use Situations (M, SD)					
Unpleasant emotions	19.27 (8.3)	19.56 (8.4)	22.07 (8.8)	2.49	.08
Physical Discomfort	8.77 (2.7)	8.54 (2.8)	10.58 (3.3)	11.43	.00

	Class 1: *Primary cocaine* (n = 166)	Class 2: *Mainstream* (n = 177)	Class 3: *Wide- range* (n = 57)	*F*, χ^2	*p*
Conflict with others	15.17 (6.1)	15.06 (6.3)	17.07 (6.6)	2.39	.09
Social Pressure	10.37 (4.4)	10.43 (43.8)	11.25 (4.1)	1.04	.36
Pleasant Times with Others	**15.27 (3.8)**	**15.93 (3.7)**	**17.70 (3.6)**	**9.18**	**.00**

Note. Bold text indicates significant F or chi-square at *p* < .05 level.