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Patterns and Predictors of Changes in Substance Use in Individuals with Schizophrenia and Affective Disorders

Melanie E. Bennett, Ph.D.^{1,2}, Clayton H. Brown, Ph.D.^{2,3}, Jason Peer, Ph.D.^{2,4}, Lan Li, M.S.¹, and Alan S. Bellack, Ph.D.^{1,2}

Melanie E. Bennett: mbennett@psych.umaryland.edu; Clayton H. Brown: cbrown@epi.umaryland.edu; Jason Peer: Jason.Peer@va.gov; Lan Li: lli@psych.umaryland.edu; Alan S. Bellack: abellack@psych.umaryland.edu

¹Department of Psychiatry, University of Maryland School of Medicine

²VA Capitol Network Mental Illness Research, Education, and Clinical Center (MIRECC)

³Department of Epidemiology and Public Health, University of Maryland School of Medicine

⁴VA Maryland Health Care System

Abstract

Objective—This study examined patterns and predictors of changes in substance use over one year in individuals with schizophrenia and affective disorders. We examined patterns of cocaine use over time, baseline predictors of continued cocaine use over one year, and predictors of transitions into and out of drug use and treatment.

Methods—We recruited 240 individuals with schizophrenia and affective disorders who met DSM-IV criteria for current cocaine dependence or cocaine dependence in early full or sustained full remission, and assessed them five times over twelve months.

Results—There was no change over time in either the proportion of the sample with at least one day of cocaine use in the past month or in the average number of days of cocaine use among those who reported any use. Baseline variables tapping actual substance use were found to predict a decreased likelihood of cocaine use. Several variables tapping actual substance use – including self-reported use of cocaine, positive urinalysis for marijuana, and positive urinalysis for cocaine – were predictive of transitions into and out of outpatient substance abuse treatment. Readiness to change variables such as self-efficacy and temptation to use drugs showed different predictive patterns for the schizophrenia and affective disorder groups.

Conclusions—These findings illustrate how drug use may show a cyclical pattern for those with serious mental illness, in which more severe use - characterized by greater frequency of use and associated problems - is followed by decreased use over time.

Keywords

schizophrenia; serious mental illness; substance abuse; patterns; predictors

Substance use disorders are a critical problem for people with schizophrenia. Rates of substance use disorders are high (Regier et al., 1990) and confer negative consequences in almost every domain of functioning (Bennett & Gjonbalaj, 2007). While the consequences

Corresponding Author Information: Melanie E. Bennett, Ph.D., Department of Psychiatry, University of Maryland School of Medicine, 737 West Lombard Street, Suite 551, Baltimore, Maryland, 21201, Phone: 410-706-0722, Fax: 410-706-0934, mbennett@psych.umaryland.edu.

DISCLOSURES

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and correlates of substance use disorders in schizophrenia are well-established in cross-sectional studies, we know less about how individuals with schizophrenia move into and out of substance use and remission. Overall prevalence rates of substance use disorders in individuals with serious mental illness (including but not limited to schizophrenia diagnoses) appear to be fairly stable; many with serious mental illness are able to achieve remission from substance use disorders (Bartels, Drake, & Wallach, 1995; Bell et al., 2002; Dixon, McNary, & Lehman, 1998; Rollins et al., 2005; Xie, McHugo, Fox, & Drake, 2005). In a longitudinal study of participants with serious mental illness and substance use disorders (68% with schizophrenia spectrum diagnoses), Rollins and colleagues (2005) found that of participants who were remitted at baseline, over 50% maintained remission after one year. In two longitudinal studies of relapse rates among individuals with dual disorders (over 70% with schizophrenia diagnoses) that each spanned 10 years, Xie and colleagues (Xie, McHugo, Fox, & Drake, 2005; Xie et al., 2010) found that approximately one-third of each sample achieved remission and sustained it over the study period.

Research has also examined predictors of use, relapse, and remission in individuals with serious mental illness. Predictors of continued use include male gender, younger age, lack of high school education, history of cocaine use, and symptoms of depression (Bell et al., 2002; Cuffel & Chase, 1994; Rollins et al., 2005; Xie et al., 2005). Clinical and social predictors include lack of substance abuse treatment, lack of social support for nonuse, living in high-risk areas, and mental illness symptoms (Drake et al., 2005; Rollins et al., 2005; Xie et al., 2005). In terms of non-use and remission, female gender, more years of education, living in psychiatric residential program, and outpatient substance abuse treatment have been identified as predictors (Cuffel & Chase, 1994; Rollins et al., 2005). Maintenance of remission is associated with older age, being married, working, and better social competence (Rollins et al., 2005; Xie et al., 2005).

While this literature has facilitated our understanding of longitudinal patterns in substance use in schizophrenia, important questions remain. First, there is evidence of individual variability in use and remission in schizophrenia. Cuffel and Chase (1994) analyzed data from 168 participants with schizophrenia from the Epidemiological Catchment Area Study who were assessed twice over one year and found that stability of rates of substance use disorders was due to equal numbers of individuals moving into and out of active substance use. A prospective study of veterans with schizophrenia spectrum disorders and lifetime substance use ($n=177$) found that 34% of the sample showed movement between use and nonuse over 12 months (Bell et al., 2002). Other short- and long-term follow-up studies of substance use relapse rates for people with serious mental illness have found that 48–66% do not maintain remission over time (Rollins et al., 2005; Xie et al., 2005). Variability in use may depend on the substance used, with findings indicating greater chance for relapse with cocaine than for other substances (Bell et al., 2002; Chouljian et al., 1995). Variability in the course of substance use and disorders in schizophrenia may be obscured in studies which include only two time points. More contemporary longitudinal analytic methods may help to characterize individual variation and nonlinearity in changes over time (Peer et al., 2007). Second, studies have generally combined diagnostic groups and substance types within samples, making it difficult to determine if there are patterns specific to schizophrenia or to a particular substance. Cross-sectional research has found diagnostic differences in patterns of substance use and abuse (Bennett, Bellack, Brown, & DiClemente, 2009; Ringen et al., 2008). Longitudinal research must compare individuals with schizophrenia to those in other diagnostic groups to explore diagnostic differences. In addition, few studies have evaluated patterns of use of a specific substance, despite evidence that some drugs, such as cocaine, are particularly debilitating in schizophrenia (Bell et al., 2002; Chouljian et al., 1995; Swartz et al., 2006). Studying longitudinal patterns of a single substance such as cocaine (rather than a combination of substances) can help clarify patterns of change and treatment

engagement for those individuals who experience more severe consequences from drug use. Third, research with primary substance abusers finds that readiness to change (Carbonari & DiClemente, 2000; Schumann et al., 2005) and service utilization (Grella et al., 2010) are related to changes in substance use. There is evidence that readiness to change can be reliably measured and may be correlated with behavior change in dually diagnosed samples (Carey, Carey, Maisto, & Purnine, 2002; Carey, Purnine, Maisto, & Carey, 2001; DiClemente, Nidecker, & Bellack, 2008; Nidecker et al., 2008). To date there have been no longitudinal investigations of these variables in schizophrenia.

The present study examined patterns and predictors of changes in cocaine use in individuals with schizophrenia and affective disorders who met DSM-IV criteria for current cocaine dependence or cocaine dependence in early or sustained full remission ($N=240$) and were assessed five times over twelve months. Participants were recruited from outpatient mental health treatment centers but were not seeking substance abuse treatment. Having groups who were either dependent or in remission allowed us to maximize the likelihood of capturing both increases and decreases in cocaine use over time. We focused on cocaine dependence both because its use confers a pronounced negative impact on outcomes (Bell et al., 2002; Chouljian et al., 1995; Swartz et al., 2006), and because it allowed for an in-depth evaluation of processes related to patterns of use of a specific substance. By including individuals with both schizophrenia and affective disorders, we could examine whether there were predictors of change that were unique to schizophrenia. We addressed the following hypotheses: (1) Rates of cocaine use would decrease over time for both diagnostic groups; (2) Baseline readiness to change and substance abuse treatment variables would predict continued cocaine use, with high readiness and greater treatment involvement predicting lower use; (3) Readiness to change and substance abuse treatment variables would predict transitions into and out of cocaine use, with lower readiness and less treatment involvement predicting transition into use, and high readiness and greater treatment involvement predicting transitions out of use; (4) Cocaine use and readiness to change variables would predict transitions into and out of substance abuse treatment, with lower use and greater readiness predicting transition into treatment, and greater use and lower readiness predicting transition out of treatment.

METHODS

Participants

Detailed information on participant screening, eligibility, and consenting are published elsewhere (Bennett et al., 2009). Briefly, participants were recruited from outpatient mental health clinics affiliated with a Veterans Administration Medical Center and a division of community psychiatry at a public university. Individuals with either affective or schizophrenia/schizoaffective disorders and a DSM-IV diagnosis of current cocaine dependence or cocaine dependence in early full or sustained full remission (indicating remission for between 1–12+ months) were eligible. Additional inclusion criteria were age between 18 and 65 years and ability and willingness to provide consent. Exclusion criteria were: 1) documented history of neurological disorder or head trauma with loss of consciousness, 2) mental retardation as indicated by chart review, and 3) inability to participate due to intoxication or escalation of psychiatric symptoms at the time of the assessment resulting in disruptive or aggressive behavior. Of the 397 people who signed consent, 73 did not return for the baseline assessment, 11 completed only part of the baseline assessment, and 73 were ruled ineligible during the diagnostic interview, yielding a sample of 240 participants who met inclusion criteria and completed the baseline assessment.

Participants were 62.9% male and 79.2% African-American, with a mean age of 43.20 ($SD=7.20$) and a mean of 11.90 years of education ($SD=2.20$). Participants comprised four

groups: (1) 72 with schizophrenia/schizoaffective disorder + current cocaine dependence; (2) 48 with schizophrenia/schizoaffective disorder + cocaine dependence in remission, (3) 65 with non-psychotic affective disorder + current cocaine dependence; and (4) 55 with non-psychotic affective disorder + cocaine dependence in remission. The groups did not differ on gender, percentage unmarried, or years of education. The schizophrenia groups had higher percentages of African-American participants (90.28% in schizophrenia/dependent; 85.42% in schizophrenia/remitted) than the affective disorder groups (63.08% in affective/dependent; 69.09 in affective/remitted) ($X^2=18.19$, $df=3$, $p=.0004$). The mean age for the schizophrenia/remitted group (45.38, $SD=6.20$) was higher than the other study groups (mean age schizophrenia/dependent =41.14, $SD=7.23$; mean age affective/dependent=43.77, $SD=7.89$; mean age affective/remitted=43.15, $SD=6.75$) ($F=3.59$, $df=3$, $p=.014$). Study groups did not differ on mean years of drinking to intoxication, mean years of heroin use, mean years of cocaine/crack use, or mean years of marijuana use. In terms of recent (last 90 days) treatment for substance abuse, 43.3% of the total sample reported talking with a mental health professional about their drinking (range of 29.8% in the schizophrenia/remitted group to 52.7% in the affective/remitted group), and 84.1% reported some recent discussion about their drug use (range of 74.5% in the schizophrenia/remitted group to 89.2% in the affective/dependent group). Overall, 60.5% of the sample reported recent outpatient treatment for alcohol problems; the affective/remitted group was more likely to report this (74.5%; schizophrenia/dependent=54.2%; schizophrenia/remitted=48.9%; affective/dependent=64.1%) than the other groups ($X^2=8.72$, $df=3$, $p=.033$). In addition, 85.4% of the sample reported recent outpatient treatment for drug problems; there were no group differences (range of 77.8% in the schizophrenia/dependent group to 92.7% in the affective/remitted group).

Measures

The Structured Clinical Interview for DSM-IV (SCID –I; First, Spitzer, Gibbon, & Williams, 1994) was used to establish diagnosis. Interviews were completed by doctoral or masters level psychologists who were trained via viewing videotapes of interviews from our laboratory, observing live interviews conducted by trained interviewers, and completing reliability ratings on multiple cases randomly selected from our ongoing studies. Diagnoses were achieved utilizing all available information (participant report, medical records, treatment providers). Inter-rater reliability (Kappa) for SCID diagnoses (psychiatric and substance use disorders) was greater than 0.80. To prevent rater drift, interviewers received bi-monthly supervision during which videotapes of study interviews were reviewed; checks occurred at a rate of approximately one interview for every five completed for the study. The Addiction Severity Index (ASI; McLellan et al., 1992a; 1992b) is a semi-structured interview that was used to assess drug use frequency and severity. We administered the drug, alcohol, family/social, and legal sections of the ASI, as they are the most reliable sections for this population (Carey et al., 1997; Hodgins and el-Guebaly, 1992). Assessors received training and supervision that included watching videotaped ASI interviews, administering supervised interviews, and attending twice monthly supervision during which videotaped interviews were reviewed and interview skills were monitored. To increase the likelihood of more valid self-reports of last 30-day substance use (Sobell & Sobell, 1995), we employed urinalysis when the ASI was administered to detect recent use of cocaine, opioids, or marijuana using the Syva RapidTest (formerly called Accusign), which provides results on site within 5 minutes. We also utilized the Time Line Follow-Back method (Sobell & Sobell, 1992) which requires an individual to reconstruct their substance use on a day-to-day basis using a calendar. The 30-day time period was evaluated to provide an index of recent substance use and to enhance accuracy of recall for those with serious mental illness (Carey, 1997). ASI variables used in the present analyses included: 1) lifetime years of cocaine, alcohol, and poly drug use (cocaine, heroin, and marijuana), defined as total

number of years of regular use of drug/alcohol/poly drug minus total number of years of abstinence from drug/alcohol/poly drug; 2) number of days of cocaine, alcohol, and poly drug use in the last month; 3) number of days with drug problems in the last month; and 4) rating of being bothered by drug problems in the last month (likert scale ranging from 0=Not at all to 4=extremely).

The Substance Use Event Survey for Severe Mental Illness (Bennett, Bellack, & Gearon, 2006) was used to assess recent (last 90 days) inpatient and outpatient treatment for mental health and substance abuse, and the type of outpatient treatment attended (i.e., discussion with a professional, outpatient groups, individual sessions). This measure has demonstrated favorable test–retest reliability. Average percentages of exact agreement for Alcohol Treatment (90.13%), Drug Treatment (88.83%), and Psychiatric Treatment (87.0%) domains were high, and congruency with other sources (i.e., medical charts, urinalysis results) was similarly good (Bennett et al., 2006). Readiness to change was assessed with the University of Rhode Island Change Assessment-Maryland (URICA-M). The original URICA is a 32-item self-report questionnaire which asks respondents to rate their degree of agreement (on 5-point Likert scales) with items that tap thoughts about change related to drug use (DiClemente & Hughes, 1990) and includes four subscales: Precontemplation, Contemplation, Action, and Maintenance (DiClemente & Prochaska, 1998). The URICA-M is a modified version designed to suit the needs of people with serious mental illness (see Nidecker et al., 2008). A readiness score is calculated by subtracting the Precontemplation score from the sum of the Contemplation, Action, and Maintenance scores (Carbonari, DiClemente, & Zweben, 1994). Higher scores represent greater readiness. Factor analytic research has validated this single continuous readiness to change score (Carbonari et al., 1994). The Temptation to Use Drugs Scale and the Drug Abstinence Self-Efficacy Scale (DiClemente, Carbonari, Montgomery, & Hughes, 1994) are 20-item scales that assess the degree to which subjects feel "tempted" to use drugs in different situations and confident in their ability to abstain in those situations. Scores have been found to have good psychometric properties (DiClemente et al., 1994; Hiller, Broome, Knight, & Simpson, 2000; Velicer, DiClemente, Rossi, & Prochaska, 1990). In these analyses, readiness (from the URICA-M), temptation, and abstinence self-efficacy are referred to as "readiness to change" variables.

Procedures

Study procedures were approved by the University of Maryland Institutional Review Board. Participants completed a standardized informed consent process with trained recruiters, were advised that a Federal Certificate of Confidentiality would protect their information, and signed an informed consent document. Informed consent procedures included a complete discussion of the study with potential participants, and written informed consent was obtained after this discussion. The study was conducted in accordance with the Declaration of Helsinki.

Medical records of new intakes at recruitment sites were reviewed weekly to determine preliminary eligibility. Final eligibility was determined during the baseline assessment. Study procedures were reviewed prior to each assessment and participants were queried to ensure their continued understanding and desire to participate. Participants completed the diagnostic interview first, generally completed the remaining baseline assessments within one week, and subsequently completed assessments at 3-, 6-, 9-, and 12-month intervals. Overall, 83.75% of the sample completed the 3-month assessment, 77.50% completed the 6-month assessment, 73.75% completed the 9-month assessment, and 77.92% completed the 12-month assessment.

Data Analysis

To examine changes in “occurrence” and “intensity” of cocaine use over the 1-year time period, we used a mixed effects two-part model (Tooze, Grunwald, & Jones, 2002). The response variable was number of days of cocaine use in the last 30 days; the distribution of this variable had substantial zero-inflation. The two-part model was designed to accommodate response variables with an inflated number of zeros. It assumes that zeros are observed both for individuals who have achieved some unobserved ‘quit’ status and for individuals who have not achieved this status, but who nonetheless did not use cocaine in the last 30 days. Two regression models are simultaneously fit in two-part models: an unconditional occurrence model and a conditional intensity model. To characterize change per month in cocaine use, the occurrence model is a logistic regression model that estimates a time-trend slope in the probability (or odds) that individuals used cocaine at least 1 day out of the past 30 days. The intensity model is a lognormal regression model that estimates a time-trend slope in the log mean number of days of use over time among those who used at least 1 day. The log-normal regression model was used because the distribution of the non-zero values indicated a right-skewed distribution. The independent variable was time (baseline, 3, 6, 9, and 12 months). In the two-part model, a random individual effect is specified for both parts of the model which accounts for within-individual correlation of the response variable over time. In subsequent analyses, diagnostic group and the group-by-time interaction terms were added to estimate time-trend slopes separately for these two groups and whether they were significantly different. The linear assumption of these models was checked by adding a time-squared term, but no nonlinear trends were identified. The dropout process underlying this model is assumed to be random (i.e., conditional on the observed data, dropout is independent of the unobserved measurements) (Verbeke & Molenberghs, 2000).

To examine whether background, readiness to change, and treatment variables assessed at baseline predicted continued cocaine use, we fit a series of two-part regression models with time, a single baseline predictor, and the interaction between time and the baseline predictor as independent variables for both the occurrence and intensity models. The interaction terms represent relative increases or decreases in occurrence or intensity time trend slopes per unit increase in the predictor value (or from 0 to 1 for binary predictor). Baseline predictor variables we assessed included demographics (age, gender, race), substance use (lifetime years of cocaine, alcohol, and poly drug use; days of cocaine and alcohol use in the last month; days with drug problems and bothered by drug problems in the last month, and urinalysis results), and readiness to change variables. Evidence that a baseline variable predicted change in cocaine use over time occurred when the predictor-by-time interaction term was statistically significant at the .05 level. In addition, to assess whether there were differences between the diagnostic groups in baseline predictors of continued cocaine use, we ran the models after adding the three-way interaction between group, predictor, and time, as well as all two-way interactions among these variables.

Finally, to examine predictors of transitions into and out of cocaine use and substance abuse treatment, we fit a series of transition models (Crum, Brown, Liang, & Eaton, 2001; Heagerty, 2002) by constructing a dataset of dyad records where the outcome (dependent variable) in each of periods 2, 3, 4, and 5 was combined with the outcome status and predictors (independent variables) from the prior period (periods 1, 2, 3, and 4, respectively). Outcomes for these two series of regressions were binary – any cocaine use versus no cocaine use in the prior 30 days, and any substance abuse treatment versus no substance abuse treatment in the past 90 days. For each predictor of interest we used generalized estimating equations (GEE; Liang & Zeger, 1986) to fit a logistic regression model to examine predictors of transition or continuing status from the prior period. We also included a three-way interaction (prior period outcome, predictor, diagnostic group) to

examine differences in transition/continuation in cocaine use and substance abuse treatment between diagnostic groups. The dropout process underlying this GEE model is assumed to be completely random (i.e., dropout is independent of observed and unobserved data) (Verbeke and Molenberghs, 2000).

P-values were adjusted upward using the procedure of Benjamini and Hochberg (1995) to control the false discovery rate to 5% for the sequence of models for prediction of change in occurrence and intensity, transition from cocaine use and non-use, and transition from use and non-use of substance abuse treatment. All analyses were conducted using SAS 9.2.

RESULTS

Patterns of Cocaine Use

Descriptive data for days of cocaine use in the past month by time point are presented in Table 1. Results from the two-part models showed that there was no change over time in either the odds of at least one day of cocaine use in the past 30 days [$\beta = -.022$, odds ratio (*OR*)=0.98, standard error (*SE*)=.023, $z = -.94$, $p = .35$] or in the mean number of days of cocaine use among those with at least one day of use ($\beta = -.0068$, *SE*=.009, $z = -.76$, $p = .45$). At baseline, the odds of having had at least one day of cocaine use were higher in the schizophrenia group [$\beta = 1.19$, *OR*=3.29, *SE*=.55, $z = 2.18$, $p = .031$]. There was no change over time in average number of days of cocaine use among users in either diagnostic group (schizophrenia group: $\beta = -.0053$, *SE*=.012, $z = -.45$, $p = .65$; affective disorder group: $\beta = -.009$, *SE*=.014, $z = -.64$, $p = .52$).

Predicting Cocaine Use

The two-part analyses examining predictors of cocaine use (in the total sample) and days of cocaine use (among active cocaine users) over time are presented in Table 2. Results from the occurrence model indicated that more days of cocaine use and more days of alcohol use at baseline predicted a decreased probability of using cocaine over time. Having a positive urinalysis for cocaine, heroin, or marijuana at baseline predicted a decreased likelihood of cocaine use over time.

Results from the intensity model indicated that several baseline variables predicted a decrease in days of cocaine use over time among cocaine users, including baseline days of cocaine use, days of alcohol use, days of drug problems, and degree of being bothered by drug use. In addition, cocaine users with higher baseline temptation scores showed a trend ($p = .08$) towards a decrease in the number of days of cocaine use over time. In contrast to the occurrence model results, having a positive urinalysis at baseline did not predict a decreasing number of days of cocaine use over time.

We added the 3-way interaction term [schizophrenia group indicator, predictor, time] to assess differential prediction by diagnostic group of change in 30-day occurrence and 30-day intensity of cocaine use. Interaction terms for occurrence trends (log odds scale) were significant for baseline drug abstinence self-efficacy ($\beta = -.20$, *SE*=.055, $z = 3.61$, $p = .0004$) and temptation to use drugs ($\beta = 0.12$, *SE*=.050, $z = 2.41$, $p = .017$) total scores, indicating a difference in the relationship between these variables and change over time between the diagnostic groups. In the affective disorder group, those with high abstinence self-efficacy at baseline had an observed increasing trend in likelihood of having at least one day of use over the year; those with low abstinence self-efficacy at baseline had an observed decreasing trend in likelihood of having at least one day of use. This pattern was reversed in the schizophrenia group - those who had high abstinence self-efficacy at baseline were observed to have a decreasing trend in likelihood of having at least one day of use over the 1-year period; those with low abstinence self-efficacy at baseline were observed to have an

increasing trend in likelihood of having at least one day of use. The association between baseline abstinence self-efficacy and change in occurrence over time in the affective disorders group had the stronger influence in the interaction, with the beta coefficient significantly different than zero ($\beta=.134$, $SE=.038$, $z=3.50$, $p<.001$), whereas the beta coefficient for the schizophrenia group was not significant ($\beta=-.067$, $SE=.040$, $z=-1.69$, $p=.093$). Temptation to use drugs at baseline showed a similar pattern. In the affective disorder group, those with higher temptation scores were observed to have a decreasing likelihood of at least one day of use and those with lower temptation scores were observed to have an increasing likelihood of having at least one day of use. The pattern was again reversed in the schizophrenia group. As above, the association between baseline temptation to use and change in occurrence over time for the affective disorders group had the stronger influence in the interaction, with the beta coefficient being significantly different than zero ($\beta=-.094$, $SE=.035$, $z=2.70$, $p=.007$) whereas for the schizophrenia group it was not significant ($\beta=.027$, $SE=.036$, $z=0.74$, $p=.46$).

The three-way interaction for prior years of poly drug use (i.e., sum of years that cocaine, heroin, and marijuana were each used regularly, range: 0–88) was significant for intensity of cocaine use ($\beta=.0027$, $SE=.001$, $z=2.70$, $p=.0065$). In the schizophrenia group, those with a high number of poly drug years did not exhibit a change in number of days of cocaine use whereas those with a low number of poly drug years exhibited a slight decreasing trend. In contrast, in the affective disorders group, those with a high number of poly drug years exhibited an increasing trend in days of cocaine use whereas those with a low number of prior poly drug years exhibited a significant decreasing trend in cocaine use.

Predicting Transitions in Cocaine Use

After adjustment for multiple tests, none of the treatment utilization variables or scores on the readiness to change measures predicted transition to or continued use of cocaine in the following period. This was true among those using cocaine and those not using cocaine in the prior period. There were no differences in prediction between the schizophrenia and affective disorder groups.

Predicting Transitions in Substance Abuse Treatment

Results from the logistic regression transition models for use of outpatient substance abuse treatment (yes/no for each time period) are presented in Table 3. Among those with substance abuse treatment in the prior period, those with a positive urinalysis for marijuana had 72% lower odds of continuing substance abuse treatment in the following period compared to those who did not have a positive urinalysis for marijuana in the prior period [$OR=.28$, 95% CI: (.13, .61), $p=.008$]. No predictive relationship was found for heroin-positive or cocaine-positive urinalysis and continued participation in substance abuse treatment. Among those with no substance abuse treatment in the prior period, the odds of transitioning into substance abuse treatment use was lower for those with a positive urinalysis for cocaine and for those who self-reported cocaine use. Specifically, those with a positive urinalysis for cocaine in the prior period had 65% lower odds of transitioning into substance abuse treatment use compared to those who were not positive for cocaine use in the prior period [$OR=.35$, 95% CI: (.17, .76), $p=.035$]. Similarly, those who self-reported using cocaine in the prior period had 76% lower odds of transitioning into substance abuse treatment use compared to those who did not self-report cocaine use in the prior period [$OR=.24$, 95% CI: (.11, .50), $p=.003$].

There was one diagnostic difference. Among people who reported participation in substance abuse treatment in the prior period, those in the schizophrenia group who reported use of heroin in the last month had greater odds of continuing in substance abuse treatment in the

following period than those who did not report heroin use ($OR=3.08$); whereas in the affective disorders group, those who had used heroin in the prior period had lower odds ($OR=0.28$) of continuing in substance abuse treatment compared to those who had not used heroin (interaction $\beta=3.68$, $SE=1.28$, Wald $\chi^2=8.27$, $p=.004$).

DISCUSSION

This study examined patterns and predictors of cocaine use over one year in individuals with schizophrenia and affective disorders. On average, rates and intensity of cocaine use did not change over the year. These findings are consistent with research that has found relatively stable rates of substance use over time in samples of individuals with serious mental illness (Bartels et al., 1995; Bell et al., 2002; Dixon et al., 1998; Rollins et al., 2005; Xie et al., 2005). The odds of using cocaine were higher in the schizophrenia group at baseline, but those with schizophrenia who used cocaine were no more likely to increase their number of days of use than cocaine users in the affective disorder group. Such findings suggest that individuals with schizophrenia and affective disorders may show similarity in their patterns of cocaine use over time. It is important to note that our samples were drawn from individuals receiving mental health treatment at outpatient mental health clinics in the community. Individuals with affective disorders in such settings have been found to be more functionally impaired than those with affective disorders in the general population (Luty, Joyce, Mulder, & McKenzie, 2002).

Baseline variables tapping substance use were the strongest predictors of trends in both the likelihood of cocaine use and the amount of cocaine used over the year among users. Days of cocaine and alcohol use in the past month and a positive urinalysis for cocaine were found to be significant predictors of a *decreasing* likelihood of cocaine use over the year. There was a similar pattern predicting the amount of cocaine used over time: variables indicating greater use and associated problems at baseline - more self-reported days of cocaine and alcohol use, more days of problems related to drug use, and feeling more troubled or bothered by drug use - were predictive of *decreasing* use at subsequent time points. The baseline temptation to use drugs score showed a trend in significance towards predicting change in the amount of cocaine use over the following year, with greater temptation at baseline predicting a *reduction* in cocaine use over time. These findings illustrate the ways in which drug use may show a somewhat cyclical pattern for those with serious mental illness, in which more severe use - characterized by greater frequency of use and associated problems - is followed by decreased use over time. These findings mirror those from our analysis of the baseline data (Bennett et al., 2009), which found that individuals in remission reported more lifetime drug-related consequences and highlights a pattern of greater drug-related problems being associated with subsequent reductions in use. It may be that for individuals with serious mental illness, an awareness of drug use and the problems it causes are concrete and salient factors that lead people to reduce drug use. From a clinical perspective, assisting individuals with serious mental illness in monitoring their substance use (both cocaine and alcohol) over time and identifying personal consequences may be useful strategies for engaging them in the process of change. While this might be a more internal process for primary drug abusers, it may be beneficial to help those with serious mental illness think through these relationships as a way to move them to decrease their drug use.

There were diagnostic differences in how the readiness to change variables predicted trends in the likelihood of cocaine use over time. In the affective disorder group, high abstinence self-efficacy and low temptation to use were both associated with a *greater* likelihood of cocaine use, while low abstinence self-efficacy and high temptation were associated with a lower likelihood of use. The reverse was found in the schizophrenia group (high self-

efficacy and low temptation were associated with lower use), although the patterns in this group were not significant. These findings in the affective disorder group were surprising. In samples of primary substance abusers, research has found that the combination of high self-efficacy and low temptation is related to decreased substance use (Penberthy et al., 2011; Project MATCH Research Group, 1997). We have found low self-efficacy and high temptation in a sample of smokers with schizophrenia starting a smoking cessation program; during the course of participation in the intervention, self-efficacy to quit increased while temptation to smoke decreased (Mann-Wrobel, Bennett, Weiner, Buchanan, & Ball, 2011). One interpretation of these findings is that low self-efficacy is linked to more severe depressive symptoms which may interfere with subsequent efforts to procure drugs. Or, individuals with affective disorders with high self-efficacy and low temptation may feel able to experiment with limited or recreational use of drugs, only to find that this use develops into more sustained abuse and problems. Likewise, it is possible that affective symptoms impact temptation to use drugs in different ways, thus obscuring the relationship between temptation and subsequent drug use. These results support the need to compare diagnostic groups, as patterns may differ. Clinically, it would be important to assess readiness to change but not to assume that high self-efficacy and low temptation signals reduced use for all individuals. Rather, review of and problem solving around specific situations of temptation can be part of mental health treatment, highlighting that even low temptation situations can at times lead to drug use. It should be noted that while these readiness to change variables predicted the occurrence of drug use, which in our model was interpreted as using cocaine one or more days, they did not predict the amount of cocaine used during that time period among users. The one variable that predicted intensity of cocaine use was prior years of poly drug use. For both diagnostic groups, fewer years of poly drug use was associated with decreasing trends in days of cocaine use over time. The fact that only one variable was associated with days of cocaine use suggests that further work needs to be done to identify variables that predict finer distinctions in drug use.

None of the substance abuse treatment or readiness to change variables predicted transitions into and out of cocaine use over the year in the total sample. In terms of predicting transitions into and out of substance abuse treatment, both objective (positive urinalysis for both marijuana and cocaine) and subjective (self-reported cocaine use) findings of drug use were associated with transitions out of substance abuse treatment. Importantly, leaving treatment during a period of drug use can reflect the choice of the individual with serious mental illness but may also be related to some drug abuse treatment program policies that require individuals who use drugs to leave treatment. Unfortunately, these data cannot speak to individuals' reasons for leaving treatment, and how choice and program policies impact these transitions.

There was one diagnostic difference here: individuals with schizophrenia with a positive urinalysis for heroin were more likely to *remain in* substance abuse treatment, while those with affective disorders and a positive urinalysis for heroin were more likely to transition out of substance abuse treatment. This finding provides a good example of how similar behavior (heroin use) can impact diagnostic groups differently; in this case being associated with a greater likelihood of continued treatment in schizophrenia group and a greater likelihood of discontinued treatment in the affective disorder group. In addition, this finding may signal that some individuals with schizophrenia and substance use may be given more chances to remain in treatment even during periods of use or relapse.

Readiness to change variables predicted cocaine use in the affective disorder group but were not useful predictors of transitions in drug use or substance abuse treatment use. This lack of concordance warrants comment. Importantly, this was not a sample of individuals who were seeking substance abuse treatment. For such individuals (in contrast to those who are

seeking substance abuse treatment), readiness to change may be less of a factor in determining patterns of use and non use than are factors such as availability of drugs, money, housing issues, or medical issues. Our findings that variables tapping actual substance use were better predictors of both transitions in drug use and in substance abuse treatment would fit with the idea that, for this group of substance users, readiness to change may signal a process that comes into play after significant use and consequences disrupt basic functioning, and perhaps even after substance abuse treatment has been initiated. In such cases, focusing efforts on treatment engagement, even for individuals who are still using drugs or who are not committed to stopping, may be useful as a way to impact internal readiness to change. Furthermore, transition into and out of substance use (i.e., relapse and remission) is a highly variable and heterogeneous process (Witkiewitz & Marlatt, 2007). Some research has analyzed longitudinal data from individuals with serious mental illness and found subgroups with different baseline risk factors for use and treatment use profiles (Xie, McHugo, & Drake, 2009). Given the variability inherent in this process over time, the current study design, with “snap shots” taken at 3 month intervals on a circumscribed set of variables, may not have been detailed enough to detect predictors of behavior change. In addition, there are other variables - including individual (reasons for use), psychiatric (symptoms, neurocognitive functioning), and social (family history, substance using network, access to drugs, deficits in social functioning) factors - that may be related to transitions into and out of use that were not included here.

This study had several strengths, including use of well-characterized diagnostic samples, a prospective design in which data were collected at regular 3 month intervals over a year, and a moderately large sample with good follow-up rates. There were, however, several limitations. The study sample included individuals with current drug dependence at baseline. Given this high level of use at baseline, we cannot rule out regression to the mean as a possible factor influencing findings that indicators of increased drug use at baseline predict lowered drug use at follow-up. In addition, longitudinal models such as those used here necessarily make assumptions about the unknowable dropout processes in the sample. This limitation is mitigated by the study's strong follow-up rates. Both diagnostic groups had similar drug use histories characterized by chronic substance use over many years and poly substance use and abuse. The severity of this substance use may have eclipsed any differences between groups in functional or readiness status, and may be one reason that few differences were found between the schizophrenia and affective disorder samples. In addition, we examined individuals with serious mental illness and cocaine dependence or remission. While participants reported other drug use, all had a current or previous cocaine use disorder. It is unclear how findings would be different if participants were selected on the basis of their dependence on other substances. As noted above, we did not include many variables that may be related to transitions into and out of use that should be part of future longitudinal research. In the present study, substance use frequency data (i.e., days of use) was collected for the preceding 30 days at each assessment point. Expanding that assessment window to 90 days would have allowed for data spanning the entire year rather than snapshots of recent use. More evidence has accumulated about the accuracy of substance use frequency self-reports for individuals with serious mental illness (Carey, Carey, Maisto, & Henson, 2004; DeMarce et al., 2007), and future longitudinal research could assess longer periods of recent use with increased confidence. Future research could also test mediational relationships among predictors and outcomes that would more fully describe the ways that variables interact to determine outcomes. In addition, investigators should consider including newer assessment technologies such as ecological momentary assessment, text messaging, or interactive voice technology to collect “real time” substance use, craving, motivation, and treatment utilization data (Berkman, et al., 2011; McKay et al., 2006; Shiffman, 2009). Such data have the potential to illuminate complex longitudinal relationships between clinical and motivational changes and subsequent changes in drug use

and ultimately identify new intervention targets. Future studies could also include schizophrenia and affective disorder samples who are actively engaged in treatment in order to help clarify whether there are key differences between these diagnostic groups once they have entered treatment.

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Table 1

Descriptive Data for Days of Cocaine Use (Past Month) by Time Point

Time point	Total Sample		Schizophrenia		Affective Disorders	
	Mean (SD)	Mdn	Mean (SD)	Mdn	Mean (SD)	Mdn
Baseline	3.46 (6.51)	0	3.98 (7.07)	1	2.96 (5.92)	0
3 months	2.83 (5.96)	0	3.34 (6.15)	1	2.30 (5.75)	0
6 months	3.11 (6.38)	0	4.60 (7.59)	1	1.73 (4.64)	0
9 months	2.83 (5.77)	0	3.49 (6.23)	0	2.17 (5.23)	0
12 months	3.17 (6.79)	0	3.64 (6.71)	1	2.72 (6.87)	0

Mdn = Median

Table 2

Baseline Predictors of Change in Cocaine Use, Total Sample ($N = 240$)^a

Predictor Variables	Occurrence Model ^b			Intensity Model ^b		
	Interaction ^c Estimate	<i>p</i>	Adj ^d <i>p</i>	Interaction ^c Estimate	<i>p</i>	Adj ^d <i>p</i>
Age	-.0008	.79	ns	.001	.36	ns
Gender	.077	.11	ns	.032	.08	ns
Race	-.003	.93	ns	.022	.22	ns
Years cocaine use (lifetime)	-.004	.23	ns	-.0003	.83	ns
Years alcohol use (lifetime)	-.0005	.83	ns	.0004	.65	ns
Years drug use* (lifetime)	-.002	.14	ns	-.0005	.31	ns
Days cocaine use (past 30 days)	-.012	.005	.024	-.001	.37	ns
Days alcohol use (past 30 days)	-.013	<.001	.004	-.003	.009	.039
Days w/drug problems (past 30 days)	-.004	.08	ns	-.003	<.001	.005
How bothered by drug use (past 30 days)	-.010	.51	ns	-.017	.005	.025
Days outpatient drug treatment (last 90 days)	.0008	.34	ns	.0005	.18	ns
Drug abstinence self-efficacy scale score	.038	.14	ns	.010	.35	ns
Readiness to change scale score	.0036	.79	ns	-.006	.19	ns
Temptation to use drugs scale score	-.0039	0.11	ns	-.0022	0.02	.08
Positive Urinalysis**	-.022	<.001	.001	-.0015	0.44	ns

^a Separate model fit for each baseline predictor variable.

^b Occurrence model = logistic regression model for predicting at least 1 day of use. Intensity model = lognormal regression model for predicting average number of days among people who have at least 1 day of cocaine use.

^c Interaction estimate = the time by predictor variable interaction (estimates difference in change by value of the predictor variable)

^d *p*-values adjusted to control the false discovery rate (Benjamini and Hochberg, 1995).

* Years lifetime drug use = Years use of cocaine + years use of marijuana + years use of heroin.

** Positive urinalysis for cocaine, heroin, or marijuana.

Table 3
Predictors of Substance Abuse Treatment Utilization Conditional on Substance Abuse Treatment Utilization Status in the Prior Period (N=240)

Model	Predictor (from prior period)	OR	Lower Limit	Upper Limit	Wald χ^2	p-value	Adjusted p-value
Participants who reported substance abuse treatment in the prior period							
1	Used cocaine (yes/no)	0.61	0.37	1.00	3.82	0.051	ns
2	Temptation to use drugs (total score)	1.06	0.79	1.42	0.14	0.71	ns
3	Abstinence self-efficacy (total score)	1.25	0.91	1.71	1.94	0.16	ns
4	Readiness score (URICA-M)	0.96	0.80	1.16	0.17	0.68	ns
5	Positive urinalysis (marijuana)	0.28	0.13	0.61	10.46	0.001	0.008
6	Positive urinalysis (opiates)	0.80	0.37	1.70	0.35	0.55	ns
7	Positive urinalysis (cocaine)	0.63	0.37	1.06	3.06	0.08	ns
Participants who reported no substance abuse treatment in the prior period							
1	Used cocaine (yes/no)	0.24	0.11	0.50	13.90	0.0002	0.003
2	Temptation to use drugs (total score)	0.93	0.56	1.55	0.07	0.79	ns
3	Abstinence self-efficacy (total score)	1.25	0.73	2.16	0.67	0.41	ns
4	Readiness score (URICA-M)	0.90	0.67	1.21	0.51	0.47	ns
5	Positive urinalysis (marijuana)	0.59	0.23	1.50	1.24	0.27	ns
6	Positive urinalysis (opiates)	1.02	0.40	2.59	0.002	0.96	ns
7	Positive urinalysis (cocaine)	0.35	0.17	0.76	7.17	0.007	0.035