



## Examining differential effects of psychosocial treatments for cocaine dependence: An application of latent trajectory analyses

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### ABSTRACT

**Background:** The NIDA Collaborative Cocaine Treatment Study yielded different efficacies for different psychosocial treatments for cocaine dependence. However, substantial heterogeneity of patient outcomes was evident. Longitudinal data analysis techniques can be helpful in examining differential effects of psychosocial interventions on specific subpopulations of patients.

**Methods:** Overall drug and cocaine use of 346 patients diagnosed with DSM-IV cocaine dependence and treated with one of four psychosocial interventions were assessed monthly during 6-month treatment. Growth mixture models were used to identify patient subgroups based on typical patterns of change in substance use during treatment and to evaluate differential treatment effects within these subgroups.

**Results:** Three patient subgroups following different change patterns in cocaine and overall drug use were identified irrespective of the treatment type: (a) those with moderate baseline severity of drug use and very rapid reduction of drug use during treatment, (b) those with moderate baseline severity of drug use and moderate reduction of drug use during treatment, and (c) those with severe levels of baseline drug use with moderate reduction of drug use during treatment. Patient baseline characteristics enabled discrimination between these subgroups. Individual drug counseling was most efficacious among those patients with moderate baseline severity and moderate treatment response. There were no differential treatment effects in the two other patient subgroups.

**Conclusions:** The population of treatment-seeking cocaine dependent individuals is heterogeneous. Research on patient subgroups with different change patterns revealed its potential to enable classifications of patients that indicate which treatment is most effective for which type of patient.

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### 1. Introduction

Psychosocial interventions form the basis of the treatment of cocaine dependence (Carroll, 2005; Vocci and Montoya, 2009). However, there is an ongoing debate about the optimal type of psychosocial treatment for cocaine dependence and whether different treatment approaches might be best suited for different subgroups of cocaine dependent patients (Carroll et al., 1994a; Maude-Griffin et al., 1998).

So far two main lines of research have been followed in cocaine treatment research: on the one hand, there has been research that primarily focused on outcomes of treatments to establish their efficacy. To compare the efficacy of different treatment approaches,

this kind of research usually compared samples of patients treated with different interventions in terms of their mean outcomes. Findings from these studies have been variable, with some suggesting that specialized professional psychosocial treatments are superior to drug counseling approaches (Higgins et al., 1993; Maude-Griffin et al., 1998), other studies indicating no differences between different treatment approaches (Carroll et al., 1998), whereas in the largest study done to date, in the National Institute on Drug Abuse (NIDA) Collaborative Cocaine Treatment Study (CCTS), a combination of individual drug counseling and group drug counseling produced statistically and clinically superior outcomes compared with two types of professional psychotherapy in terms of reducing cocaine use as well as overall drug use (Crits-Christoph et al., 1999).

However, the mean effects of various treatments for a specific disorder in samples of patients usually used to evaluate treatments in randomized controlled trials may mask differential treatment effects on individuals or subgroups within a sample (Cuijpers et al., 2005). Psychotherapy research, e.g., has shown that comparisons of aggregated pre-to-post treatment change between patient

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samples, relying on the assumption of linear and steady change over the course of treatment, may mask potentially meaningful differences in individual treatment courses (Krause et al., 1998) or different patterns of change that are shared by many individual patients (Lutz et al., 2009; Stulz and Lutz, 2007; Stulz et al., 2007), and that this interindividual variation in treatment outcomes may be clinically important (Barkham et al., 1993).

By shifting the focus from mean outcome differences between patient samples to predictors of treatment outcomes, a second line of research was giving more attention to individual differences in treatment outcomes of cocaine dependent patients (e.g., Crits-Christoph et al., 2003, 2007; Siqueland et al., 2004, 1998). For example, by reanalyzing the data of the NIDA CCTS, Crits-Christoph et al. (2007) identified 4 baseline characteristics (craving, acuity of biomedical problems, belief in the 12-step philosophy, and expectations for improvement) that predicted interindividual differences in sustained abstinence from drug use irrespective of the type of treatment. Also, research on mediators and moderators of treatment outcome increasingly shows that some subpopulations of psychotherapy patients do benefit less than others do from psychosocial treatments (Shadish and Sweeney, 1991).

Overall, these research findings underscore the significance of heterogeneity among psychotherapy patients in general and among cocaine users in particular, and they point to the possible need to develop and use specialized treatments for clinically distinct subgroups of cocaine abusers (Carroll et al., 1994a). Although the two lines of research discussed just before (the one focusing on comparisons of mean outcomes of different treatments and the other focusing on predictors of individual differences in outcomes) usually also looked for predictor  $\times$  treatment  $\times$  outcome-interactions, modern techniques for longitudinal data analysis provides an alternative that brings together these two research traditions via the identification of patient subgroups with typical patterns of change during treatment. These *growth mixture models* (GMMs) permit the identification of distinct groups of individuals who differ in the initial level and the course of a specific behavior (e.g., drug use) through the empirical identification of developmental trajectories (Muthén, 2001). Furthermore, these GMMs also allow examination of whether the effects of different interventions differ for these subpopulations, ascertain which characteristics predict membership to these subpopulations, and establish whether outcomes are different for each of these subpopulations (Muthén, 2001; Muthén et al., 2002). In contrast to cluster analytic approaches, which have also been used to identify typical growth trajectories in outpatient psychotherapy (Barkham et al., 1993) and in substance abuse treatment (Morrall et al., 1997; Waldron et al., 2005), GMMs allow simultaneous estimation of subgroup-specific treatment effects, which makes them a promising approach to examine differential treatment effects in patient subgroups. Concerning the examination of moderators of treatment outcomes, there is yet another advantage of GMMs: a fundamental problem inherent in traditional research studies on moderators of treatment outcomes is that these studies are looking for subpopulations who benefit more or benefit less from an intervention, but actually examine only characteristics which may be indicative of these subpopulations (Cuijpers et al., 2005). By contrast, if using the GMM approach, the identification of patient subpopulations within a sample is based on the target behavior itself (e.g., on changes in drug use over time).

These characteristics make GMMs specifically appropriate to examine the following research questions in the NIDA CCTS dataset that go beyond previous reports of average treatment outcomes and predictors of average outcomes: (1) Are there different trajectory classes (i.e., patient subgroups following different patterns of change) of drug and cocaine use during psychosocial treatments for cocaine dependence?; (2) Are there patient baseline characteristics

that allow allocation of patients to these trajectory classes?; and (3) Do different psychosocial treatments have differential effects on drug and cocaine use in different trajectory classes (i.e., in different patient subgroups)?

## 2. Methods

### 2.1. Design and procedures

The design and procedures of the NIDA CCTS have already been detailed elsewhere (Crits-Christoph et al., 1997, 1999). In brief, the NIDA CCTS was a multi-site randomized clinical trial that compared the efficacy of four psychosocial treatments for cocaine dependence: in two of these treatments, professional psychotherapy, either cognitive therapy (CT; Beck et al., 1993) or supportive-expressive psychodynamic therapy (SE; Luborsky, 1984; Mark and Luborsky, 1992), was added to group drug counseling (GDC; Mercer et al., 1994). A third treatment combined individual drug counseling (IDC; Mercer and Woody, 1992) with GDC, and the fourth consisted of GDC alone. All treatments were planned to include 6 months of active phase treatment and a 3-month booster phase. Individual treatment sessions were held twice per week during the first 12 weeks, weekly during weeks 13–24, and monthly during the booster phase. Group drug counseling sessions were held weekly during the active phase treatment and patients in the GDC alone condition met with the group counselor individually once per month during the booster phase.

### 2.2. Patients

A total of  $N = 487$  outpatients, all of them having a principal diagnosis of cocaine dependence according to the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association, 1994) and all of them using cocaine during the past 30 days, were randomly assigned to one of the four treatment conditions. Exclusion criteria (e.g., current psychotropic medication) are reported in detail elsewhere (Crits-Christoph et al., 1999). Of these 487 patients who actually began treatment, only those 346 patients who had at least five monthly assessments during the 6-month active phase treatment were included in the current analyses. This is the minimum number of measurement points needed to estimate cubic latent growth curves (see below). By type of treatment, the number of patients excluded was 35 (24.8%) in IDC+GDC, 29 (20.6%) in CT+GDC, 42 (29.8%) in SE+GDC, and 35 (24.8%) in GDC alone ( $\chi^2(3, N = 487) = 2.688, n.s.$ ). Of the 346 patients in the final sample, 86 (24.9%) were treated with IDC+GDC, 90 (26.0%) with CT+GDC, 82 (23.7%) with SE+GDC, and 88 (25.4%) with GDC alone. The average number of individual treatment sessions differed significantly between treatment conditions ( $F(2,255) = 4.12, p < .05$ ), with patients in IDC+GDC attending significantly less sessions ( $M = 14.72, SD = 10.67$ ) than patients in SE+GDC ( $M = 18.98, SD = 10.49$ ) but not less than patients in CT+GDC ( $M = 18.31, SD = 10.09$ ). The mean number of group treatment sessions attended was 10.74 (7.24) in IDC+GDC, 11.42 (7.14) in CT+GDC, 10.37 (6.86) in SE+GDC, and 10.60 (7.30) in GDC alone ( $F(3,342) = 0.35, n.s.$ ).

The modal patient in our final sample was male (76%), Caucasian (55%; African-American: 43%; other: 2%), lived alone (72%), had children (59%), was employed outside the home (60%), and smoked crack cocaine (82%). The mean age at the beginning of treatment was 34.6 years ( $SD = 6.3$ ) and the mean duration of cocaine use at baseline was 6.9 years ( $SD = 4.8$ ). Except for a somewhat higher age (34.6 years vs. 32.2 years,  $p < .001$ ) and a marginally lower ASI–Drug Use Composite Score at baseline (0.23 vs. 0.25,  $p < .05$ ; see below), the patients included in our final sample did not differ significantly from those excluded in all of these characteristics as well as in the number of days using cocaine during the past month. Details on therapies and therapists can be found in previous publications on the NIDA CCTS (Crits-Christoph et al., 1997, 1999).

### 2.3. Instruments and data collection

Patients were assessed on a battery of instruments at baseline, monthly during the 6-month active phase treatment, and at quarterly follow-up assessments conducted at months 9, 12, 15, and 18 after randomization. Those instruments analyzed in our study will be presented.

**2.3.1. Addiction Severity Index (ASI; McLellan et al., 1992).** As in the original trial (Crits-Christoph et al., 1999), the Drug Use Composite Score of the interview-based ASI (which assesses the use of alcohol, heroine, opiates, barbiturates, sedatives, cocaine, amphetamines, cannabis, hallucinogens, and inhalants) was the primary outcome measure of this study. Additionally, outcomes on one specific item from the ASI drug use scale, the number of days using cocaine in the past 30 days, were also examined.

To determine measurable change in the ASI–Drug Use Composite Score until treatment termination, we used the *reliable change* (RC) criterion (Jacobson and Truax, 1991). The RC criterion of an instrument depends on its reliability and equals the minimal amount of change in the score between two repeated assessments that is unlikely ( $p < .05$ ) to occur if no actual change beyond measurement error has happened. In the present data, the RC criterion for the ASI–Drug Use Composite Score was 0.09 (using  $r_{xx} = .93$  and  $SD = 0.12$ ; Zanis et al., 1994).

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