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ORIGINAL ARTICLE

Multidimensional Predictors of Treatment Outcome in Usual Care for Adolescent Conduct Problems and Substance Use

Aaron Hogue[1] · Craig E. Henderson[2] · Adam T. Schmidt[2]

Abstract This study investigated baseline client characteristics that predicted long-term treatment outcomes among adolescents referred from school and community sources and enrolled in usual care for conduct and substance use problems. Predictor effects for multiple demographic (age, sex, race/ethnicity), clinical (baseline symptom severity, comorbidity, family discord), and developmental psychopathology (behavioral dysregulation, depression, peer delinquency) characteristics were examined. Participants were 205 adolescents (52 % male; mean age 15.7 years) from diverse backgrounds (59 % Hispanic American, 21 % African American, 15 % multiracial, 6 % other) residing in a large inner-city area. As expected, characteristics from all three predictor categories were related to various aspects of change in externalizing problems, delinquent acts, and substance use at one-year follow-up. The strongest predictive effect was found for baseline symptom severity: Youth with greater severity showed greater clinical gains. Higher levels of co-occurring developmental psychopathology characteristics likewise predicted better outcomes. Exploratory analyses showed that change over time in developmental psychopathology characteristics (peer delinquency, depression) was related to change in delinquent acts and substance use. Implications for serving multiproblem adolescents and tailoring treatment plans in routine care are discussed.

Keywords Outcome predictors · Adolescent mental health treatment · Adolescent substance use treatment · Usual care

✉ Aaron Hogue
ahogue@casacolumbia.org

[1] The National Center on Addiction and Substance Abuse, 633 Third Avenue, 19th floor, New York, NY 10017, USA

[2] Department of Psychology, Sam Houston State University, Huntsville, TX, USA

Introduction

This study investigated baseline client characteristics that predicted conduct and substance use outcomes among adolescents treated in usual care settings that featured either family therapy or non-family interventions. Research on predictors of treatment outcome is highly valuable for at least two related reasons. With regard to advancing intervention science, outcome predictor research supplies programmatic data about which treatments are most effective for which clinical populations (Kazdin 1994). With regard to informing clinical practice, outcome predictor research supplies an archive of knowledge to support individual treatment planning, including tailoring treatment focus and delivery to fit the presenting problems of a given client (Chorpita and Daleiden 2014). In both cases, predictor studies offer important guidelines about potential client responsiveness to available care. Note that the current study focused on *non-specific predictors*, which refer to baseline characteristics that have a main effect on outcome, that is, predict response equivalently across treatment groups (Kraemer et al. 2002). In contrast, *moderators* have an interactive effect on outcome, that is, predict different response levels for different treatment groups.

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Context of the Current Study: The Parent Randomized Trial

This study tested key baseline variables for predictor effects, but not moderator effects, within a comparative trial of usual care interventions for adolescent behavior problems (Hogue et al. 2014a, b). The parent trial randomly assigned 204 teens referred for conduct or substance use problems to either usual care family therapy (UC-FT) or non-family treatment (UC-Other). Main outcomes at one-year follow-up included externalizing symptoms, delinquent activities, and combined alcohol and drug use. One variable was tested for moderator effects: baseline diagnosis, dichotomized as mental health versus substance use. Across the full sample, adolescents showed significant declines in youth-reported externalizing, caregiver-reported externalizing, and delinquency. In addition, UC-FT produced greater reductions than UC-Other in youth-reported externalizing. Two moderator effects were found: Among substance-using youth only, UC-FT had greater reductions than UC-Other in both delinquency and substance use.

The parent trial offers a compelling context for examining predictor effects. Research on the common practices, expectable range of outcomes, and boundary conditions for treatment effectiveness in usual care settings is a top priority in behavioral intervention science (Garland et al. 2013), with very little reliable data available on treatment outcomes among youth populations treated in routine practice (Garland et al. 2010). The parent trial enrolled a sample of inner-city adolescents that was predominantly ethnic minority and half female, groups underrepresented in studies of conduct-disordered youth (Huey and Polo 2008), with the possible exception of clinical trials of manualized family-based treatments, which have recruited samples with admirable ethnic diversity (see Baldwin et al. 2012). Also, the parent trial recruited from a network of school- and community-based referral sources rather than existing clinical referral streams. This strategy yielded a sample of "unmet need" adolescents: teens with significant behavioral health impairments who are not involved in the treatment system (Garland et al. 2001; Kataoka et al. 2002; Ozechowski and Waldron 2010). Understanding the clinical needs of adolescents with behavioral problems who do not typically cross the treatment threshold is critically important for designing inclusive and responsive behavioral care (Institute of Medicine 2006).

Multidimensional Predictor Effects for Adolescent Behavior Problems: Demographic, Clinical, and Developmental Psychopathology Characteristics

This study takes a multidimensional approach to analyzing predictor effects for adolescent behavior problems that includes three categories of predictor variables: demographic, clinical, and developmental psychopathology characteristics (Sotsky et al. 1991). Of these, demographic variables have by far the largest research portfolio. Collective findings to date for age, sex, and ethnicity predictor effects are not consistent across populations and studies. For example, one meta-analysis of 22 studies of aftercare programs for juvenile offenders (James et al. 2013) found stronger treatment outcomes for older youth and ethnic minorities. In contrast, a meta-analysis of 24 studies of ecological family therapy for conduct and substance use disorders (Baldwin et al. 2012) found no substantial predictor effects for any demographic variable, although it should be pointed out that meta-analyses are typically underpowered for testing such moderator effects (Cooper and Patall 2009). Whereas some individual studies have reported superior outcomes for Hispanic Americans with conduct (Clair et al. 2013) or drug use problems (Robbins et al. 2008), others find evidence-based treatment to be equally effective across ethnic groups (see Henggeler and Sheidow 2012). Of note, Evans-Chase et al. (2013) persuasively argue that modeling age as a continuous variable when testing age-outcome correlations effectively masks the normative spike in risk-taking that occurs during mid-adolescence, when self-regulation is comparatively underdeveloped (see Steinberg, 2010). Their review of 117 studies of juvenile diversion programs suggests that when age variables are properly stratified, outcomes are stronger for participants in late-teenage years than for those in mid-teenage years.

A second category of predictors, baseline clinical functioning, has demonstrated more consistent effects on treatment response. Three commonly examined clinical predictors are symptom severity, comorbidity status, and family functioning (Lindhiem et al. 2014). Severity, usually modeled as the pre-treatment level of functioning for the targeted outcome, has shown a strong negative correlation with outcome for disruptive behaviors (Masi et al. 2011), alcohol use (Gmel et al. 2012), and co-occurring drug use and attention-deficit/hyperactivity disorder (ADHD; Tamm et al. 2013), though at least one study found that greater drug use severity predicted greater improvement (Brunelle et al. 2013). Similarly, having one or more co-occurring psychiatric disorders predicts worse

outcomes among youth treated for conduct problems (e.g., Riosa et al. 2011) and substance use (Brunelle et al. 2013; Hogue et al. 2014c). To examine family functioning, predictive effects studies often model family-level constructs using measures of parent psychopathology (e.g., Lindhiem et al. 2014) or family conflict (e.g., Henderson et al. 2010).

A third category of predictors, developmental psychopathology, captures individual variations in psychological and developmental functioning associated with current or future onset of specific behavior problems (Sroufe and Rutter 1984). The current study focused on three predictors of delinquency and substance use in adolescence: behavioral dysregulation, depressive symptoms, and peer antisocial behavior. These developmental psychopathology characteristics were considered "co-occurring disorders" in this study because they were not primary reasons for referral nor primary targets of treatment planning for any study case.

Although several studies have examined whether youth diagnosed with ADHD show differential treatment outcomes from non-ADHD peers (e.g., Bukstein et al. 2005; Kolko and Pardini 2010), few have investigated whether facets of behavioral regulation itself predict outcome. One intriguing study reported that treatment-induced increases in self-regulation were associated with subsequent decreases in antisocial behavior, delinquent peer affiliations, and substance use a year later (Fosco et al. 2013). In contrast, depressive symptoms have proven to be robust predictors of outcome among adolescents, though not always in a consistent manner. For example, lower baseline depression predicted greater gains in cognitive-behavioral therapy for anxiety disorders (O'Neil et al. 2010) and family therapy for bulimia (Le Grange et al. 2008), but higher depression predicted greater improvements in quality of life following substance use treatment (Becker et al. 2011). Finally, the evidence on moderating effects of maintaining deviant peer relationships is both robust and consistent: greater peer delinquency tends to attenuate treatment gains (Dishion and Dodge 2005; Dishion and Tipsord 2011; Van Ryzin and Leve 2012), whereas positive peer influences appears to facilitate treatment improvement by promoting a prosocial peer culture (Dishion and Dodge 2005).

Study Aims

The chief aim of the current study is to inform the delivery of treatment services for adolescent behavior problems in community settings by examining predictors of treatment responsiveness. The study addresses the urgent need for rigorous research on usual care outcomes, particularly among clinically impaired adolescents who do not enter traditional clinic referral streams (Ozechowski and Waldron 2010). The study examined key predictor effects (predictive strength of baseline client characteristics for treatment outcome) on previously reported outcomes from a randomized trial of routine care options for inner-city, community-referred male and female adolescents with defiant behavior and substance use disorders.

One study innovation is the inclusion of multiple categories of outcome predictors that potentially inform evidence-based treatment planning for this underserved population: demographic (age, sex, race/ethnicity), clinical (symptom severity, comorbidity, family discord), and developmental psychopathology (behavioral dysregulation, depression, peer delinquency) characteristics. Categories were first tested separately to identify all potential predictor effects, with significant results for each predictor subsequently tested in a combined model to examine the significance of each effect while controlling for all others (e.g., Kolko and Pardini 2010). A second innovation is the use of longitudinal, parallel process analyses to explore whether trajectories of change in predictor variables are related to change in outcomes (Greenbaum and Dedrick 2007). Of the three predictor categories, developmental psychopathology characteristics are potentially most sensitive to treatment interventions intended to affect outcomes.

In line with previous outcome predictor studies, we hypothesized modest and inconsistent predictor effects for demographic variables, with the possible exception that older youth would benefit more from treatment. We anticipated substantial effects for all three clinical variables. Though a very limited literature exists on predictor effects for developmental psychopathology characteristics, we hypothesized that the two "externalizing" variables, behavioral dysregulation and peer delinquency, would show the strongest effects on conduct and substance use outcomes, with higher baseline deficits dampening treatment gains. Finally, analyses of concurrent change in developmental psychopathology variables and main outcomes were considered exploratory.

As stated above we did not test for *moderator* effects (differential strength of prediction for family versus non-family treatment), for two reasons: Our multidimensional approach to testing for non-specific predictor effects is already quite complex; and there is a lack of strong theoretical justification for expecting predictors to show differential strength across conditions. Also, we did not include baseline referral problem (mental health vs. substance use) as a clinical predictor because this predictor was previously examined in this sample (Hogue et al. 2014a, b), as described above.

Method

Eligibility Criteria for the Parent Trial

Study eligibility criteria were: (1) adolescent age 12–18; (2) caregiver expressed desire, and adolescent expressed willingness, to initiate counseling; (3) primary caregiver willing to participate in treatment sessions; (4) adolescent met criteria either Oppositional Defiant Disorder or Conduct Disorder based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association 2000), or met ASAM criteria for needing outpatient treatment for a substance use disorder (American Society on Addiction Medicine 2001); (5) adolescent not enrolled in any other behavioral treatment; (6) family had health benefits that met the requirements of study treatment sites, all of which accepted a broad range of insurance plans including Medicaid. Exclusion criteria were: mental retardation or autism-spectrum disorder, current psychotic symptoms, or active suicidal ideation.

Participants

Demographics, psychiatric diagnoses, delinquent activities and substance use, and other characteristics of the study sample (N = 205) are presented in Table 1. Adolescents included both males (52 %) and females and averaged 15.7 years of age (SD 1.5). Self-reported ethnicities were Hispanic (59 %), African American (21 %), multiracial (15 %), and other (6 %). Caregivers who completed research interviews were 171 biological mothers, 7 biological fathers, 4 adoptive parents, 1 stepparent, 2 foster parents, 12 biological grandmothers, and 8 other relatives; household composition included 66 % single parent, 26 % two parents, 6 % grandparents, and 2 % other. The only between-condition difference was that UC-Other adolescents were more likely to have a household member involved in illegal activities.

Table 1 also contains DSM-IV diagnostic rates, which were assessed by research staff using the Mini International Neuropsychiatric Interview (MINI, Version 5.0; Sheehan et al. 1998), a brief structured diagnostic interview that assesses DSM-IV diagnoses in adolescent and adult populations. The MINI has demonstrated solid interrater and test–retest reliability on two international samples of psychiatric and non-psychiatric patients (Lecrubier et al. 1997), and has shown excellent convergent validity with both the SCID and the CIDI (Lecrubier et al. 1997; Sheehan et al. 1997, 1998). The parent study collected data on the seven diagnoses most commonly reported in the sample: major depressive disorder and dysthymia (combined into one depressive disorder category: DEP); generalized anxiety disorder (GAD); posttraumatic stress disorder (PTSD); alcohol abuse/dependence and substance abuse/dependence (combined into one category: SUD); conduct disorder (CD); oppositional defiant disorder (ODD); ADHD. Adolescent and caregiver reports were collected for CD, ODD, and ADHD; diagnoses were confirmed using the conventional "Or" principle of counting either positive adolescent or positive parent report (see Valo and Tannock

Table 1 Sample demographic and clinical characteristics (N = 205)

Male	52 %
Adolescent age (M/SD)	15.7 (1.5)
Ethnicity	
Hispanic	59 %
Black	21 %
More than one race	15 %
Other race	6 %
Family composition	
Single parent	66 %
Two parents	26 %
Grandparent	6 %
Other	3 %
Family characteristics	
Caregiver graduated high school	71 %
Caregiver employed	64 %
Caregiver income greater than $15 K	55 %
Caregiver receiving public assistance	17 %
Ever investigated by child welfare	51 %
Household member drug use	32 %
Household member illegal activity	19 %
Adolescent participation in services	
Past year individualized education program	30 %
Past year educational intervention	41 %
Past year mental health treatment	17 %
Adolescent psychiatric diagnoses	
Oppositional defiant disorder	87 %
Conduct disorder	53 %
Attention-deficit/hyperactivity disorder	74 %
Depression diagnosis	42 %
Substance use disorder	28 %
Generalized anxiety disorder	17 %
Posttraumatic stress disorder	17 %
More than one diagnosis	89 %
Adolescent legal issues	
Picked up by police past year	31 %
Probation/parole past year	7 %
Number of delinquent acts past month (M/SD)	3.1 (3.0)
Days used substances past month (M/SD)	3.2 (7.3)

All data reported are column percents, unless otherwise indicated

2010). Diagnoses of DEP, GAD, PTSD, and SUD were based on adolescent reports only. There were no between condition differences in DSM-IV diagnoses.

Study Procedures

Study procedures are summarized below; for a full description see Hogue et al. (2014a, b, c). The study was conducted under approval by the governing Institutional Review Board.

Participant Recruitment

Research staff developed a referral network of high schools, family service agencies, and community programs serving youth in inner-city areas of a large northeastern city. Referral sources made referrals to research staff during site visits and also by phone and confidential email. Staff then contacted referred families by phone and offered them an opportunity to participate in a home-based screening interview to assess the reason for study referral and, if desired, to discuss enrollment in local treatment services.

Assessment, Randomization, and Linking to Treatment

Pre-treatment assessment consisted of one eligibility screening interview and one baseline interview; each was conducted primarily in the home but also in other locations upon request. Caregivers and adolescents were consented and interviewed separately. Assessment measures consisted of a structured clinical interview and audio computer-assisted self-report measures. Caregiver assessments were administered in the preferred language: 77 % English, 23 % Spanish. Each member received an honorarium in vouchers for completing interviews, which typically lasted 60–90 min. At the completion of baseline interviews, follow-up interviews were scheduled for 3, 6, and 12 months after the baseline date. Randomization to study condition was then revealed. Urn randomization promoted balance between conditions on four variables: ethnicity (Hispanic, African-American, Other), sex, juvenile justice involvement (Yes, No), and referral problem (mental health, SU).

Each family was assisted in completing its first intake session at the assigned treatment site using family linkage strategies (see McKay and Bannon 2004) to counteract common barriers to enrollment. Linkage included several elements, implemented as needed: supporting the family via frequent phone calls or texting, brokering initial appointments directly with sites, ushering clients to first appointments, and helping to solve insurance problems. Linkage continued for every family until it completed the initial site intake session or dropped from the linkage process.

Participant Flow and Interview Completion Rates

Adolescents were referred to the study from schools (82 %), family service agencies (11 %), juvenile justice or child welfare sources (4 %), and other sources (3 %). A total of 434 completed a screening interview; of these, 32 % were study ineligible. Of the remaining 297, 16 % refused to complete the baseline interview and 15 % could not be contacted further. The remaining 205 adolescents were randomized, 104 to UC-FT and 101 to UC-Other. Follow-up rates at each timepoint were: 72 % of UC-FT and 78 % of UC-Other completed a 3-month interview; 74 % of UC-FT and 72 % of UC-Other completed a 6-month interview; and 75 % of UC-FT and 80 % of UC-Other completed a 12-month interview. The analyzed sample (all randomized participants who completed a least one follow-up interview) contained 193 participants, including 91 % of those assigned to UC-FT and 97 % assigned to UC-Other; these rates of inclusion were not significantly different.

Treatment Conditions

All six treatment sites were outpatient clinical settings that accepted study cases as standard referrals. No external training or financial support of any kind was provided to treat study cases, and therapists were not required to alter their clinical practices in any way. Each site routinely prescribed weekly treatment sessions and offered in-house psychiatric support. Therapists at each site routinely received a comparable amount of weekly supervision. There were two study conditions: (1) Usual Care-Family Therapy (UC-FT) consisted of a single community mental health clinic that featured family therapy as the standard-of-care approach for behavioral interventions with youth. All therapists (n = 14) received regular in-house training and supervision in structural-strategic family therapy (Minuchin and Fishman 1981) to promote family-based case conceptualization and use of structural-strategic FT treatment techniques. Participating therapists ranged in age from 28 to 59 years; seven were female, seven were Hispanic American, one was European American, and one from another racial background (note: demographic information was not collected on 5 UC-FT therapists). (2) Usual Care-Other (UC-Other) included a set of five clinics in order to sample the full spectrum of outpatient treatment options widely available for adolescent behavior problems, including two community mental health clinics, two outpatient child psychiatry clinics, and one addiction treatment clinic. UC-Other therapists (n = 20) ranged in age from 24 to 45 years; 13 were female, 12 were European American, 2 were Hispanic American, 3 were Asian American, and 1 from another racial background

(demographic information was not collected on two UC-Other therapists). Treatment fidelity and condition differentiation data are detailed in Hogue et al. (2014a, b).

Predictor Measures

Demographic Variables

The adolescent's *age*, *sex*, and *racial/ethnic background* were self-reported at the start of the baseline interview. Male served as the reference code in a dichotomous variable representing sex, and racial/ethnic background was represented by three dummy-coded variables representing African American, Hispanic, and multiple ethnicities respectively, with the reference category represented by all other ethnicities.

Clinical Variables

Symptom severity was operationalized by the baseline value of the given outcome measure (described below) in each analysis. *Comorbidity level* was creating by summing the total number of the seven DSM-IV-TR diagnoses (described above) that were positive at baseline for each adolescent. *Family discord* was measured using the family conflict subscale of the Family Environment Scale (FES: Moos and Moos 1986), a well-validated self-report scale in which independent responses by the adolescent and caregiver are averaged to create family-level data. The FES family conflict scale measures characteristic family patterns related to anger and conflict management and has been frequently used to capture discord within families of clinical adolescents (e.g., Hogue et al. 2006).

Developmental Psychopathology Variables

Behavioral dysregulation was assessed via the Behavior Rating Inventory of Executive Function, a caregiver-report measure of behavioral problems that are linked to executive functioning and commonly observed in ADHD youth (Gioia et al. 2000). This measure has been validated on ADHD outpatient samples (Mares et al. 2007) and teens with mixed clinical diagnoses (Gioia et al. 2002). This study used the Behavioral Regulation Index scale comprised of the Inhibition, Behavioral Shift, and Emotional Control subscales; internal consistency in our sample was $\alpha = 0.93$. *Depressive symptoms* were measured using the well-validated Center for Epidemiologic Studies-Depression Scale for children (CES-DC) (Weissman et al. 1980), a 20-item self-report scale adapted from the CES-D for adults (Radloff 1977) to evaluate the general child and adolescent population. The items assess emotional, cognitive, and physiological symptoms over the previous 2-week period; internal consistency in our sample was $\alpha = 0.76$. *Peer delinquency* was assessed using the well-validated National Youth Survey Self-Report Delinquency Scale (SRD; Elliott et al. 1985; see also Huey et al. 2000). Adolescents reported on the number of times peers engaged in various overt and covert delinquent acts during 30 days prior to baseline.

Outcome Measures

All outcome measures were administered at baseline and 3, 6, and 12 months follow-up.

Externalizing Problems

Adolescent reports of youth externalizing behaviors were assessed via the youth self report (YSR). The YSR is a measure of youth behavioral problems supported by extensive evidence of reliability, validity, and clinical utility (Achenbach and Rescorla 2001) and used with a wide range of adolescent samples. Total scores on the externalizing summary scale (oppositionality, aggression) were analyzed in this study.

Delinquent Acts

Adolescent delinquency was assessed also with the SRD (Elliott et al. 1985), which has been used extensively to capture long-term outcomes with adolescent clinical samples (e.g., Hogue et al. 2014a, b; Sibley et al. 2011). For this variable, adolescents reported on the number of times that they themselves engaged in various overt and covert delinquent acts since the previous assessment timepoint.

Substance Use

Substance use was measured with the timeline follow back method (TLFB; Sobell and Sobell 1996), which assesses quantity and frequency of daily consumption of substances using a calendar and other memory aids to gather retrospective estimates. It is reliable and valid for alcohol and illegal drug use (Sobell and Sobell 1996) and has proven sensitive to change in numerous studies with diverse adolescent samples. Adolescents reported on the number of days they had used any alcohol or illegal drugs in each month of the follow-up period.

Statistical Analyses

Latent growth curve (LGC) modeling using robust maximum likelihood estimation (Curran and Hussong 2003) under an intent-to-treat model was the primary analytic strategy for testing study hypotheses. The primary

outcomes were the same youth-report measures reported in Hogue et al. (2014a, b, c): externalizing behavior, self-reported delinquency, and substance use. Missing data were handled with full information maximum likelihood (FIML) estimation, under the assumption that the data were missing at random (MAR; Little and Rubin 1987). To evaluate the MAR assumption we correlated our predictor variables with a variable reflecting missingness in any of our outcome variables at any assessment point; these correlations were uniformly small (range $r = 0.009$–0.12). LGC modeling was conducted using Mplus (Version 7; Muthén and Muthén 1998–2015). As was true in the original trial analyses, we did not account for Site in the present study because the number of participants in each Site subgroup was relatively small (range 15–104, with three sites having fewer than 20); incorporating Site as a covariate under these conditions would have hampered our power to find the predictor effects of interest (see Study Limitations section).

As described in Hogue et al. (2014a, b), for the normally distributed outcome (externalizing problems), we used conventional LGC models for continuous outcomes. For the two outcomes that deviated substantially from normality (delinquent acts and substance use), we used two-part growth curve models (Brown et al. 2005), which allow for the simultaneous estimation of separate but correlated continuous and categorical LGC models. Two-part models were selected because the non-normal outcome data were caused by a substantial number of participants reporting absence of the outcome variable (i.e., no delinquent activities or drug use). In two-part models, the original distribution of the outcome is separated into categorical and continuous parts, each modeled by separate but correlated growth functions. In the categorical part of the model, a binary indicator variable is created to indicate any versus none of the outcome in question. The continuous part models the frequency of occurrence of the outcome, given that the outcome had taken place (i.e., number of delinquent acts among those who reported any acts at all; number of days of use for those who used substances at all). The intercept was set at baseline in all LGC models.

Because Hogue et al. had already determined the growth curve models that best represented individual change trajectories for these outcomes (quadratic for externalizing; two-part linear for delinquency and substance use[1]), we bypassed this step and began model testing that incorporated covariates/predictors of growth to examine the impact of intervention type on initial status and change over time (i.e., the intercept and slope growth parameters). Significant covariate effects were demonstrated by a statistically significant slope parameter, as tested by the pseudo-z test (slope parameter estimate for covariate divided by its standard error).[2] When model fit statistics were available, we report χ^2, CFI, and RMSEA values as is common practice in reporting results of structural equation modeling (McDonald and Ho 2002). These fit statistics are not provided by Mplus for two-part models.

We utilized a two-stage strategy for examining covariate effects. First, we classified them in groups (per above: demographics, clinical variables, developmental psychopathology variables) and examined the three classes separately as predictors of change. Second, we tested a multivariate predictor model that included all significant individual predictors from the first stage of testing. We used this two-stage approach because we did not want to overlook any potentially important predictors, capitalizing on the chance features of the unique characteristics of this sample, analogous to the stepwise regression approach (Judd et al. 2008). At the same time, we were interested in which covariates were the most important predictors, controlling for other significant predictors identified in the first-stage models. For predictors that remained significant in multivariate models, we report effect sizes in the form of standardized regression coefficients associated with the predictor variable; these can be interpreted roughly in line with Cohen's (1988) benchmarks of 0.1, 0.3, and 0.5 for small, medium and large, respectively.

Note that interaction effects between various categories and levels of predictor variables were not tested, for several reasons: research in this area is not sufficiently advanced to generate directional hypotheses; the large number of predictor variables would create a multiplicity of interaction terms that would stress the statistical tolerance of the data and inflate family-wise error; and as one of the first studies

[1] For completeness, we compared model fit for two-part models with linear growth in the multivariate delinquency and substance use two-part models to model fit for quadratic terms for both parts of these models. In both cases, the linear models indicated superior fit: BIC for the linear model for delinquency = 1120.850; BIC for the quadratic model for delinquency = 1132.177; BIC for the linear model for substance use = 1670.006; BIC for the quadratic model for substance use: 1689.973.

[2] To condense space, and to keep focus on primary outcomes, we have focused results on predictors of change over time. However, there were some significant findings for associations between covariates and model intercepts, an effect that reflects the degree to which the given covariate predicts baseline variability, which we summarize here. For the multivariate model for externalizing problems, delinquency was significantly related to the baseline externalizing values, with more delinquency being associated with more externalizing ($b = 1.89$, SE 0.18, pseudo z 10.64, $p < 0.001$). For delinquency, other than the baseline values of delinquency, there were no significant predictors of the multivariate model intercept. Finally, for substance use, peer delinquency was significantly associated with the categorical part of the multivariate model ($b = 1.41$, SE 0.57, pseudo z 2.49, $p = 0.013$).

of predictor effects in this usual-care adolescent population, testing main effects was the analytic priority.

Finally, to test exploratory hypotheses about change in developmental psychopathology characteristics predicting change in main outcomes, we used a parallel process growth curve model (Greenbaum and Dedrick 2007). These analyses were restricted to the covariates for which we had longitudinal data: peer delinquency and depression (the parent trial considered executive functioning to be a moderator variable only and thus did not collect post-baseline data). Parallel process models extend standard LGCs by simultaneously modeling two growth processes and regressing the slope of one of the growth models on the slope of the other. Figure 1 depicts the analytic model for the peer delinquency predictor and delinquency outcome; the analytic models for other peer delinquency analyses, and all depression predictor analyses, were identical.

Results

Table 2 displays means and standard deviations for each outcome at each assessment point, along with means and standard deviations for peer delinquency and depression. Outcome results are presented below by covariate class (demographics, clinical, developmental psychopathology, multivariate) for each outcome variable. To simplify reporting of the two-part modeling, results apply to both categorical (presence vs. absence of outcome) and continuous (amount of outcome behavior among those reporting any) parts of the model, unless otherwise noted.

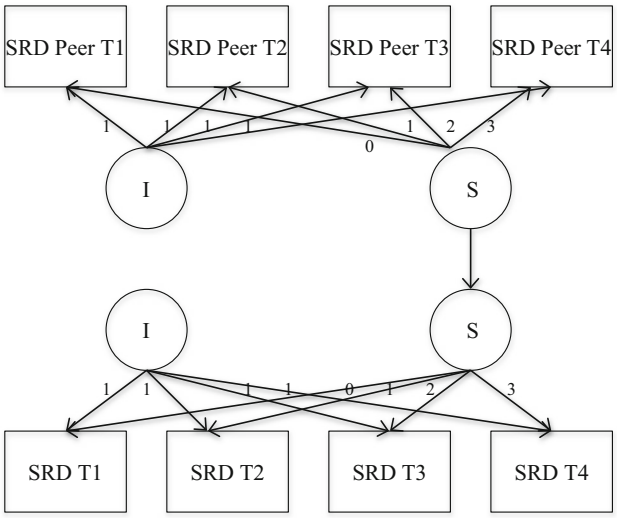

Fig. 1 Parallel process growth curve model for peer delinquency predictor and delinquency outcome. *I* intercept, *S* slope, *SRD* self-report delinquency, *T1* baseline, *T2–T4* 3-month, 6-month, and 12-month follow-up assessments, respectively. The figure is a simplification of the actual LGC model, as a single slope represents change in the delinquency trajectories, which were fit in the actual model by two-part growth models

Externalizing Problems

Results indicated good model fit for a quadratic model for externalizing problems (χ^2 [4] 3.72, *ns*; CFI >0.99; RMSEA <0.01); results displayed in Table 3. Adolescent age significantly predicted quadratic change trajectories such that older adolescents were less likely to show a return to baseline functioning ($b = -0.16$, standard error [SE] 0.08, pseudo z -1.92, $p = 0.055$). Among the developmental psychopathology predictors, peer delinquency also predicted quadratic change trajectories ($b = -0.73$, SE 0.22, pseudo $z = -3.24$, $p < 0.001$) with those reporting more peer delinquency less likely to return to baseline functioning. However in the multivariate model, neither variable significantly predicted change in externalizing.

Delinquency

Results of the LGC modeling for delinquency are displayed in Table 4. Among demographic predictors, African American youth showed a greater decrease in delinquency than youth of other ethnicities (Categorical part of two-part model: $b = -0.90$, SE 0.43, pseudo z -2.11, $p = 0.035$; Continuous: $b = -0.23$, SE 0.08, pseudo z -2.97, $p = 0.003$). In addition, findings for the Categorical part showed that older youth were more likely to report no delinquent behavior over time ($b = -0.13$, SE 0.06, pseudo z -2.25, $p = 0.024$); and for adolescents reporting some delinquency (continuous part), males showed greater decreases than females ($b = -0.07$, SE 0.04, pseudo z -1.95, $p = 0.051$), although females were more likely to abstain from delinquency overall. Among clinical predictors, baseline severity was the only significant variable (Categorical Part: $b = -0.31$, SE 0.06, pseudo z -5.60, $p < 0.001$; Continuous: $b = -0.06$, SE 0.01, pseudo z -8.63, $p < 0.001$), with those higher in baseline delinquency showing greater decreases. Peer delinquency was the only significant predictor among developmental psychopathology variables, and only for the Continuous part ($b = -0.11$, SE 0.03, pseudo z -3.84, $p < 0.001$), with those reporting more peer delinquency at baseline also reporting greater decreases in self-reported delinquency over the 12 month follow-up. With the exception of peer delinquency, these variables all subsequently predicted delinquency change in the multivariate model: African American (Categorical effect size [ES] = 0.13 [small]; Continuous ES = 0.36 [medium]); age (Categorical ES = 0.13 [small]); gender (Categorical ES = 0.13 [small]); baseline delinquency (Categorical ES = 0.96 [large]; Continuous ES = 0.95 [large]).

Table 2 Descriptive statistics (means and standard deviations) for outcome variables and developmental psychopathology characteristics measured over time

	Full sample			
	BL	3-mo	6-mo	12-mo
Externalizing problems	15.89 (9.14)	13.30 (9.65)	12.53 (9.25)	11.27 (8.83)
Any delinquency [n (%)]	36 (19)	48 (37)	49 (41)	31 (48)
Number of delinquent acts	3.09 (3.09)	2.06 (2.55)	1.59 (1.99)	1.36 (2.24)
Any substance use [n (%)]	39 (20)	49 (25)	77 (40)	82 (43)
Substance use days[a]	6.50 (8.91)	7.71 (9.21)	7.48 (9.39)	6.83 (9.26)
Peer delinquency	1.62 (0.74)	1.49 (0.65)	1.49 (0.79)	1.41 (0.55)
Depression	17.34 (8.27)	16.57 (8.65)	16.08 (9.05)	15.56 (8.71)

[a] Data on substance use days (number of days consuming any alcohol or illegal substances) were assessed at each month, using the timeline follow back method. However, for purposes of calculating descriptive statistics, monthly data were compressed to fit the timetable of the other primary outcome measures. Thus, substance use days reported at baseline = average days of use per month in the 3 months prior to baseline; number of days reported at 3-month follow-up = average days of use per month in months 1–3 post-baseline; number of days reported at 6-month follow-up = average days of use per month in months 4–6 post-baseline; and number of days reported at 12-month follow-up = average days of use in months 7–12 post-baseline

Table 3 Tests for relations between covariates and latent growth factors for externalizing behavior

Covariate	Linear slope	Quadratic slope
Demographics		
Intercept	−2.73	2.21
Gender	−1.79	0.37
Age	0.11	−0.16*
African American	−0.79	0.47
Hispanic	1.15	0.03
Multiethnic	2.60	−0.19
Clinical functioning		
Intercept	−1.05	0.78
Baseline severity	0.36	−0.12
Number of diagnoses	−0.80	0.18
Family discord	−1.12	0.24
Developmental psychopathology		
Intercept	−7.45**	2.91**
Depression	−0.05	−0.01
Behavioral dysregulation	0.08	−0.02
Peer delinquency	0.97	−0.73***
Multivariate		
Intercept	−4.79	3.46
Age	0.17	−0.18
Peer delinquency	−0.15	−0.07

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Table 4 Tests for relations between covariates and latent growth factors for delinquent acts

Covariate	Categorical slope	Continuous slope
Demographics		
Intercept	1.42	−0.01
Gender	0.20	−0.07*
Age	−0.13*	<−0.01
African American	−0.90*	−0.23**
Hispanic	−0.37	−0.04
Multiethnic	−0.44	−0.04
Clinical functioning		
Intercept	0.08	0.01
Baseline severity	−0.31***	−0.06***
Number of diagnoses	0.01	0.02
Family discord	−0.04	<0.01
Developmental psychopathology		
Intercept	0.35	0.03
Depression	−0.02	<−0.01
Behavioral dysregulation	−0.01	<0.01
Peer delinquency	−0.27	−0.11***
Multivariate		
Intercept	1.21	−0.06
African American	−0.38*	−0.19***
Age	−0.10*	0.01
Gender	0.29*	−0.03
Baseline severity	−0.35***	−0.06***
Peer delinquency	−0.07	0.02

Categorical Slope = linear slope coefficient for categorical part of two-part model. Continuous Slope = linear slope coefficient for continuous part of two-part model

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Substance Use (SU)

Results of the LGC modeling for substance use are displayed in Table 5. There were no significant demographic

predictors of change in SU. The only significant clinical predictor was baseline severity, but only for the Categorical part ($b = -0.02$, SE 0.01, pseudo z -3.19, $p = 0.001$). Teens reporting more SU in the previous 30 days were more likely to report abstaining from SU over time. Among developmental psychopathology predictors, depression (Categorical part: $b = -0.01$, SE <0.001, pseudo z -2.14, $p = 0.033$; Continuous part: $b = -0.01$, SE <0.001, pseudo z -2.01, $p = 0.045$), peer delinquency (Categorical part: $b = -0.12$, SE 0.03, pseudo $z = -3.80$, $p < 0.001$), and behavioral dysregulation (Continuous part: $b = -0.01$, SE <0.001, pseudo z -4.09, $p < 0.001$) were all significant. In each case, those reporting more impairment were more likely to abstain from SU and/or (among those reporting any SU) decrease their SU over time. Within the multivariate model baseline severity (Categorical ES = 0.72 [large]), depression (Categorical ES = 0.36 [medium]; Continuous ES = 0.49 [medium]), and behavioral dysregulation (Categorical ES = 0.41 [medium]; Continuous ES = 0.46 [medium]) all predicted future abstinence and/or declines in use.

Table 5 Tests for relations between covariates and latent growth factors for substance use

Covariate	Categorical slope	Continuous slope
Demographics		
Intercept	−0.06	0.16
Gender	−0.06	−0.03
Age	<0.01	−0.01
African American	0.17	0.03
Hispanic	0.11	−0.05
Multiethnic	0.13	−0.04
Clinical functioning		
Intercept	0.11	0.02
Baseline severity	−0.02***	<−0.01
Number of diagnoses	−0.01	−0.03
Family discord	0.02	0.01
Developmental psychopathology		
Intercept	0.58***	0.32**
Depression	−0.01*	−0.01*
Behavioral dysregulation	−0.01	−0.01***
Peer delinquency	−0.12***	0.01
Multivariate		
Intercept	0.59***	0.31**
Baseline severity	−0.02***	<−0.01
Depression	−0.01***	−0.01***
Behavioral dysregulation	−0.01*	−0.01**
Peer delinquency	−0.05	0.03

Categorical Slope = linear slope coefficient for categorical part of two-part model. Continuous Slope = linear slope coefficient for continuous part of two-part model

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Parallel Process Models

Descriptive statistics on the two developmental psychopathology variables measured over time, peer delinquency and depression, are contained in Table 2; results of parallel process models involving these variables are included in Tables 6 and 7. To save space, we have not included a table for the externalizing results, which were not significant. These results are available from the first author by request. Decreases in peer delinquency significantly predicted decreases in the Continuous part of the delinquency outcome ($b = 0.89$, SE 0.37, pseudo z 2.39, $p = 0.017$). Likewise, decreases in peer delinquency predicted decreases in SU (Categorical part: $b = 2.61$, SE 0.71, pseudo z 3.68, $p < 0.001$; Continuous part: $b = 0.76$, SE 0.36, pseudo z 2.13, $p = 0.033$). Changes in depression also predicted changes in SU, with decreases in depression also predicting decreases in SU (Continuous part: $b = 0.09$, SE 0.04, pseudo z 2.40, $p = 0.016$). However, the associations between change in depression and change in delinquency differed for the different parts of the two-part model. Whereas decreases in depression predicted increases in abstaining from delinquency overall (Categorical part: $b = 1.18$, SE 0.14, pseudo z 8.28, $p < 0.001$), among those who persisted in some delinquent behavior, youth who had larger decreases in depression showed smaller decreases in delinquency (Continuous part: $b = -3.45$, SE = 0.36, pseudo $z = -9.64$, $p < 0.001$).

Table 6 Tests of slope main effects for parallel process growth curve modeling for peer delinquency and depression on delinquent acts

Parameter	Estimate	SE	pseudo z
Peer delinquency (S1)	−0.05	0.02	−2.73**
Delinquent acts categorical (S2a)	−0.53	0.14	−3.69***
Delinquent Acts continuous (S2b)	−0.14	0.03	−4.71***
S1 → S2a	3.71	2.53	1.47
S1 → S2b	0.89	0.37	2.39*
Depression (S1)	−0.57	0.24	−2.36*
Delinquent acts categorical (S2a)	<0.01	0.22	0.01
Delinquent acts continuous (S2b)	−2.15	0.63	−3.42**
S1 → S2a	1.18	0.14	8.28***
S1 → S2b	−3.45	0.36	−9.64***

SE standard error. Pseudo z = Estimate/SE S1 = linear slope for peer delinquency. S2a = linear slope for categorical part of delinquent acts two-part model. S2ba = linear slope for continuous part of delinquent acts two-part model

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 Tests of slope main effects for parallel process growth curve modeling for peer delinquency and depression on substance use

Parameter	Estimate	SE	pseudo z
Peer delinquency (S1)	−0.05	0.03	−1.71
Substance use categorical (S2a)	0.17	0.07	2.53*
Substance use continuous (S2b)	0.03	0.02	1.58
S1 → S2a	2.61	0.71	3.68***
S1 → S2b	0.76	0.36	2.14*
Depression (S1)	−0.76	0.25	−3.06**
Substance use categorical (S2a)	0.18	0.16	1.11
Substance use continuous (S2b)	0.03	0.05	0.54
S1 → S2a	0.26	0.15	1.73
S1 → S2b	0.09	0.04	2.40*

SE standard error. Pseudo z = Estimate/SE S1 = linear slope for peer delinquency. S2a = linear slope for categorical part of substance use two-part model. S2ba = linear slope for continuous part of substance use two-part model

* $p < 0.001$

Discussion

Main Findings

Study findings indicate that multiple categories of client factors predict treatment outcome among community-referred adolescents with behavioral health problems enrolled in routine outpatient care. Demographic, clinical, and developmental psychopathology characteristics at baseline predicted various aspects of response to treatment for externalizing problems, delinquent acts, and substance use at one-year follow-up. The overall pattern of findings indicated that greater impairment in clinical and developmental functioning at treatment entry was associated with greater improvement over time. This pattern held true for the initial severity levels of outcome variables as well as for co-occurring depression, behavioral dysregulation, and peer delinquency (though this last variable did not retain significance in multivariate models for any outcome), with effects that were medium to large in size. The study also found that change over time in developmental psychopathology predictors was related to change in delinquent acts and substance use.

As hypothesized, demographic characteristics produced relatively few significant effects effects, with some indication that older adolescents benefitted more from treatment (see Evans-Chase et al. 2013). Also as hypothesized, baseline symptom severity was the strongest predictor overall, the only one to show large effect sizes in the multivariate models for both delinquency and substance use. However, the direction of effect was surprising: Whereas most studies report that more symptomatic youth have poorer outcomes (e.g., Masi et al. 2011), the current study found that youth with greater baseline severity showed greater clinical gains (see also Brunelle et al. 2013). Higher levels of co-occurring developmental psychopathology characteristics likewise predicted better outcomes. This general effect could be interpreted as clinically counterintuitive—shouldn't more severe youth be more difficult to treat?—or instead as statistically expectable—youth with larger initial deficits have more room to improve. Further research is needed to determine whether these results for baseline severity are generalizable or aberrational among the study population of teens with unmet behavioral health needs, and whether they are durable over time. Contrary to hypotheses, neither of the clinical predictors other than baseline severity (comorbidity profile, family discord) was related to outcome.

Effects for individual predictors were robust (i.e., remained sizable and statistically significant in highly controlled multivariate models) only for the two more acute outcomes, delinquency and drug use. For delinquent acts, demographic and clinical variables emerged. African Americans, and youth reporting higher delinquency at baseline, showed relatively greater declines across the board. Also, older and male teens showed increasing abstinence from delinquency over time compared to younger and female teens, respectively (as in Evans-Chase et al. 2013). For SU outcomes, developmental psychopathology variables were prevalent, with greater levels of baseline depression and behavioral dysregulation predicting greater reductions in use across the board. Also, more severe SU at baseline was related to increased abstinence over time (as in Brunelle et al. 2013). Overall, this concentration of effects for the two outcome variables with non-normal distributions underscores the utility of a two-part modeling strategy (Brown et al. 2005), which makes it possible to test effects separately for categorical (abstinence rate) versus continuous (problem severity among the non-abstinent) formulations of outcomes with modest base rates but high clinical significance.

(Surprising) Findings for Developmental Psychopathology Characteristics

For developmental psychopathology characteristics that frequently co-occur with adolescent behavior problems, this study examined both predictive effects and concurrent change with outcomes. Individuals with more delinquent peer affiliations at baseline exhibited relatively greater reductions in externalizing problems, delinquent acts, and SU, results that diverged from study hypotheses (see also Boxer 2011). In contrast, with regard to change over time, decreases in peer delinquency predicted decreases in

delinquent acts and SU, a finding in keeping with longitudinal studies of behavior problem development (e.g., Monahan et al. 2014), and intriguingly, a handful of treatment mediator studies suggesting that treatment-induced reductions in delinquent peer affiliation directly precipitate long-term reductions in targeted clinical problems (e.g., Huey et al. 2000).

This general pattern held true for the effects of depressive symptoms on SU: Greater baseline depression predicted better outcomes (as in Becker et al. 2011), and over-time declines in depression were related to declines in SU among the non-abstinent. But the picture was more complex for concurrent change between depression and delinquency. Teens whose mood improved were more likely to abstain from delinquent behavior altogether. Conversely, among adolescents who persisted in delinquent behavior, improved mood was associated with increased delinquency. This finding supports behavioral activation theories, which contend that remitting depression opens the door to higher levels of externalizing behavior, especially in girls (Diamantopoulou et al. 2011).

Finally, it was somewhat surprising that greater behavioral dysregulation predicted better SU outcomes. On the one hand, this result lines up perfectly with the overall pattern of study findings. On the other, extant research almost uniformly indicates that co-occurring ADHD interferes with treatment progress among adolescents enrolled in SU services (e.g., Bukstein et al. 2005). Ongoing advances in treatment neuroscience focused on behavioral regulation and related executive functioning characteristics among substance-involved teens (e.g., Clark et al. 2012) are sure to shed light on this important issue.

Study Strengths and Limitations

A main study strength was high ecological validity that affirms the generalizability of findings to real-world practice: Adolescent participants had diverse backgrounds (though virtually all were inner-city residents), presented an array of clinical disorders with comorbidity being the norm, and were treated in usual care settings. Multiple levels of predictor variables and multiple outcomes were assessed over one-year follow-up, and intent-to-treat analyses were used to alleviate outcome inflation that occurs when restricting analyses to those receiving a specified treatment dose. Results do not appear substantially biased by regression to the mean given that (1) predictor effects were observed for demographic (categorical) variables as well as clinical/developmental (continuous) variables and (2) most predictors showed equivalent results for both Categorical and Continuous outcomes for delinquency and SU, respectively.

A main study limitation is the correlational study design: Because predictor variables were not experimentally manipulated, it is impossible to rule out that unidentified "third variables" (i.e., unmeasured individual, family, or treatment delivery characteristics) accounted for some or all of the effects attributed to measured predictors. Due to power limitations, it was not possible to control for the differential impact of the six treatment sites on study results; this impact is expected to be minimized given that participants were recruited by research staff from non-clinic sources (rather than culled from existing clinic referral streams) and assigned to site after randomization. Also, predictor effects were tested for adolescent-report outcomes only, a weakness inherited from the parent trial. And because most study referrals were actively recruited from school sources, this "unmet need" sample may differ in important but unknown ways from typical clinic referral streams.

Clinical Implications

This study offers compelling evidence that adolescents presenting to outpatient care with more severe problems generally exhibit the most favorable treatment response. This trend runs counter to clinical wisdom suggesting that highly impaired teens are more resistant to treatment, though to be sure, numerous studies have found that worse baseline functioning portends greater long-term improvement. If this trend is replicated within the growing wave of youth treatment research on usual care (Garland et al. 2013), it should buoy the outlook for families of multi-problem adolescents as well as for providers who treat them. Study findings also contribute to a nascent roadmap for individually tailored treatment planning in community-based settings. Predictive and concurrent change effects differed meaningfully among the various levels of predictors (e.g., demographic characteristics were related to delinquency outcomes only) and among predictor variables within each level (e.g., changes in depression, but not peer delinquency, were related to SU outcomes). As similar studies accumulate, a portfolio of reliable predictor trends should emerge to guide decisions about treatment fit and intensity and to inform monitoring of clinical progress (Chorpita et al. 2008).

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