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Mediators of telephone-based continuing care for alcohol and cocaine abuse

Janell Lynn Mensinger,
State University of New York Downstate Medical Center

Kevin G. Lynch,
University of Pennsylvania School of Medicine

Thomas R. TenHave, and
University of Pennsylvania School of Medicine

James R. McKay
University of Pennsylvania School of Medicine

Abstract

A previous randomized trial with 224 alcohol and/or cocaine addicts who completed an initial phase of treatment indicated 12-weeks of telephone-based continuing care yielded higher abstinence rates over 24-months than group counseling continuing care. In this article we examined mediators of this treatment effect. Results suggested that self-help involvement during treatment, and self-efficacy and commitment to abstinence 3 months after treatment, mediated subsequent abstinence outcomes. These analyses controlled for substance use prior to the assessment of mediators. Conversely, there was no evidence that self-help beliefs or social support mediated the treatment effect. These results are consistent with a model in which treatment effects are first accounted for by changes in behavior, followed by changes in self-efficacy and commitment to abstinence.

Keywords

substance abuse; aftercare treatment; continuing care; telephone monitoring; mediation analyses; longitudinal mediation

Given the chronicity of substance use disorders for many sufferers, continuing care (also known as aftercare) has become recognized as an important step in the effective management of drug and alcohol addiction (ASAM, 2001; Lash, Peterson, O'Conner, & Lehmann, 2001; McKay et al., 1997). Accordingly, there has been an increased emphasis on the development of evidence-based continuing care treatments for individuals who have completed a more intensive initial phase of treatment (Dennis, Scott, & Funk, 2003; Godley, Godley, Dennis, Funk, & Passetti, 2002; McKay et al. 1999; O'Farrell, Choquette, Cutter, & 1998).

The most commonly used approach to continuing care, as provided in typical community-based programs, is group counseling with a 12-step focus (Donovan, 1998; McKay, 2001). Cognitive-behavioral relapse prevention (Carroll, 1998) is another well-regarded continuing care intervention, although thus far it has been used more often in research studies than in community-based treatment programs. Recently, we conducted a randomized controlled trial comparing telephone-based continuing care to standard group counseling and cognitive-behavioral relapse prevention approaches. Although results indicated no omnibus treatment

differences across the three groups compared, specific group contrasts showed that the telephone-based condition (TEL) produced significantly higher abstinence rates over a 2-year follow-up than standard group counseling (STND) (McKay, Lynch, Shepard, & Pettinati, 2005). Outcomes in the relapse prevention condition (RP) fell between those in the other two conditions, and did not significantly differ from either one. Therefore, in the present paper, we seek to identify possible mechanisms accounting for the higher rates of abstinence in telephone-based continuing care compared to standard group counseling. Due to a lack of significant effects, participants assigned to the RP condition will not be considered in the analyses performed for the present paper.

Mediation effects have been understudied in the substance abuse treatment literature relative to the number of studies examining main and moderator effects of treatment. Although there are a number of approaches to testing for mediation effects, in most cases mediation is thought to be present when the experimental condition causes greater change on the purported mediator than the control condition (i.e., path α), and, the mediator is predictive of subsequent outcome (i.e., path β) (e.g., Kraemer, Wilson, Fairburn, & Agras, 2002; MacKinnon, Taborga, & Morgan-Lopez, 2002). Of those studies that have examined potential mediation models in the initial phase of treatment, many have failed to support the relationship between the treatment and the mediator, or path α (e.g., Dunn, Deroo, & Rivara, 2001; Litt, Kadden, Cooney, & Kabela, 2003; Longabaugh & Wirtz, 2001; Morgenstern & Longabaugh, 2000). However, the therapeutic factors that promote the *maintenance* of behavior change may differ to some extent from the factors that promote the *initiation* of change (Annis & Davis, 1991; Rothman, 2000). Therefore, studies of mediation effects in continuing care for addictive disorders are needed to better understand therapeutic processes in this stage of treatment.

In the addictions, a considerable amount of work has been done to identify proximal outcomes or process measures that predict substance use (i.e., path β). There is compelling evidence that greater self-efficacy, commitment to abstinence, positive mood, coping skills, social support, involvement in self-help, and employment assessed after the end of treatment all predict better substance use outcomes at subsequent follow-ups (Connors, Longabaugh, & Miller, 1996; Hall, Havassy, & Wasserman, 1991; Longabaugh, Wirtz, Zweben, & Stout, 1998; McKay, Merikle, Mulvaney, Weiss, & Koppenhaver, 2001; McKay et al., 2005; McLellan et al., 1994; Miller, Westerberg, Harris, & Tonigan, 1996; Morgenstern, Labouvie, McCrady, Kahler, & Frey, 1997; Tonigan, Toscova, & Miller, 1996). In many cases, even when other variables have been added to the analyses, including current substance use, these variables have still predicted outcome, albeit not as strongly (Connors, Maisto, & Zywiak, 1996; Hall et al., 1991; McKay et al., 2001). Therefore, the lack of stronger evidence for mediation in addiction treatment studies does not seem to reflect difficulty in identifying predictors of outcome.

On the other hand, work in the area of action theory (MacKinnon et al., 2002a), which involves the link that extends from the intervention to the mediator (i.e., path α), has not yielded consistent effects. According to action theory, an intervention should be designed to include therapeutic components that will produce positive change on the processes that have been shown to predict outcome (MacKinnon et al., 2002a). Unfortunately, experimental conditions in studies of behavioral treatments for alcohol and drug use disorders have frequently failed to bring about greater change on the hypothesized process or mediator variables than control conditions (see reviews by Longabaugh & Wirtz, 2001; Morgenstern & Longabaugh, 2000).

With regard to action theory and the present study, the telephone-based continuing care intervention placed greater emphasis on the patient's need to develop and make use of both internal and external resources for recovery relative to standard group counseling, in which the therapist and the group took more active roles as change agents. This was communicated directly in the treatment manual and workbook given to the patients, and it was reinforced

through the more limited contact between patients and counselors. Therefore, we hypothesized that the telephone condition would yield better scores on self-efficacy, commitment to abstinence, and self-help beliefs (internal resources) relative to standard group counseling, as well as higher levels of self-help involvement and general social support (external resources) as compared to the standard intervention. We also predicted that these factors would mediate the treatment effect favoring telephone continuing care over standard group counseling. It should be noted however that given this was a continuing care study as opposed to a treatment intervention, we did not necessarily expect an increase in our mediator variables. Rather, we expected that the telephone condition would more successfully sustain the levels achieved during IOP, whereas scores would decline more rapidly in standard group counseling.

Methods

Participants

The participants of this study were 224 adults, average age of 42 years, who met Diagnostic and Statistical Manual version IV (DSM-IV) criteria for either cocaine and/or alcohol dependence when they entered an intensive outpatient (IOP) treatment program. Patients were recruited from two 4-week IOP programs. One operated within a clinical research unit modeled after a community-based program and the other at the Philadelphia Veterans Administration Medical Center. For a full description of the inclusion and exclusion criteria see McKay et al. (2004).

The majority of the participants were male (82%), African American (76%), and not currently married (88.8%). They had an average of 12.5 years of education, 8.2 years of regular cocaine use, 18.1 years of regular alcohol use, 2.8 prior drug abuse treatments, and 3 prior alcohol treatments. During the 4-month period preceding the IOP program, the participants reported an average of 38.5% days abstinent ($SD=32.21$).

Continuing Care Treatments Compared

Telephone monitoring and brief counseling (TEL) consisted of one initial face-to-face contact in order to orient the participants to the protocol. Using a workbook to focus the structure of telephone contacts, patients were expected to complete one 15-minute phone call with their counselor each week for a total of 12 weeks. During the first four weeks of treatment, patients were also offered the option of attending a support group in order to assist in the transition to less intensive care. If the patient had relapsed during this time, or was at great risk of relapsing, the counselor had the option of retaining the patient in the support group beyond the four weeks. Overall, the participants in TEL received an average of six telephone contacts, one individual session, and four group sessions throughout the intervention.

Standard continuing care (STND) consisted of two group therapy sessions per week for a period of 12 weeks combining addictions counseling with a 12-step approach. This continuing care model is typical of that used in many outpatient substance abuse clinics. Patients in the STND group received an average of 14 group sessions throughout the intervention. For a more detailed description of the treatment conditions, data on sessions received, and information on procedures to monitor adherence to treatment protocols, see McKay et al. (2004).

Therapists

All of the participating therapists were experienced substance abuse counselors, many of whom have been working as staff at the University of Pennsylvania Center for Studies of Addiction in previous controlled trials. A core group of three therapists were trained in all of the interventions at both sites in order to control for therapist effects. Rotations were set up so that that these therapists would deliver the three interventions at both sites at some point throughout

the study. In addition to the core group of therapists there were seven regular clinic therapists between the two sites who also delivered the various aftercare programs. A minimum of three therapists had delivered each condition at both sites by the end of the trial.

Procedures

As stated above, participants became eligible for the study if they met inclusion and exclusion criteria, completed IOP treatment and could provide at least one cocaine-free urine test and alcohol-free breath test in the final week of IOP. Urn randomizations (Wei, 1978) were conducted separately at each site due to the community site including female participants and not having programmatic treatment for co-occurring psychiatric conditions. Treatment conditions were balanced on several potential prognostic factors. At the community site stratifications were based on: marital status, employment status, gender, substance use during IOP, length of IOP, and psychiatric medication status. At the VA Center we stratified on marital status, employment status, cocaine dependence, substance use during IOP, race, and completion of IOP within the standard 4-week period. Although randomization procedures were successful in balancing the prognostic factors between the groups, skewed distributions on several of the stratification variables led to unequal sample sizes across the groups.

Trained research assistants began conducting baseline assessments during the final week of the IOP program. Those who completed this initial part of the baseline assessment were considered to be enrolled in the study. The remaining portion of the baseline assessment was collected the following week after the statistician randomized the participants to their treatment condition and prior to the beginning of continuing care. Research personnel conducting the interviews were blind to the hypotheses but not the treatment conditions assigned. Follow-up assessments were held 3, 6, 9, 12, 18, & 24 months post-randomization. Thus, the 3-month follow-up occurred at the end of the continuing care intervention, which was 3 months after participants were randomized to specific intervention groups. Rates for follow-up on substance use outcomes were 90% or greater during the first year, and 85% or greater during the second year¹. Missing data were regarded as ignorable in the present paper on the grounds that a thorough analysis of attrition for prior articles found no effect of missing data on estimates of treatment effectiveness, particularly between STND and TEL (McKay et al., 2004, 2005).

Alcohol breath tests were given at each interview to ascertain zero blood alcohol content (BAC). In the few cases where BAC was greater than zero, the patient was allowed to remain in the office for a few hours until their BAC dropped below .04 in order to complete the interview. If they were unable to do this, the appointment was rescheduled. For more detail on research procedures see McKay et al. (2004).

Measures

Drug and alcohol use was assessed using timeline follow-back methods (TLFB; Sobell, Maisto, Sobell, & Cooper, 1979). Trained research personnel asked participants to report their alcohol and cocaine use during the 6 months prior to beginning continuing care (for the baseline assessment) and during each follow-up period thereafter. This was done in the context of a structured interview that occurred for each assessment wave, and involved the use of calendars to aid the participants in remembering their alcohol and drug use episodes. TLFB data from the 24 month follow-up period was segmented into eight 3-month periods. For each of these eight periods, participants were categorized according to whether they had been completely abstinent from alcohol and drugs during that period (yes/no)². Prior studies with alcoholics

¹Note that the follow-up rates for the mediator data were lower, as reflected in the sample sizes for the analyses presented in this paper.

²This outcome was used on the basis that total abstinence was the primary treatment goal and prior publications from the study revealed significant treatment differences for this outcome (McKay et al., 2004, 2005)

and drug users have demonstrated test-retest reliabilities of .80 or greater using the TLFB techniques (e.g., Ehrman & Robbins, 1994; Sobell, Sobell, Leo & Cancilla, 1988). Validity studies have shown that TLFB data highly correlate with cocaine urine toxicology data (Ehrman & Robbins, 1994; Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000) and collateral reports of use (Maisto, Sobell, & Sobell, 1979).

For the present study, we obtained urine samples at baseline and at each follow-up point in order to corroborate the cocaine usage data. Blood samples were also obtained at baseline, 12, and 24 months and examined for biological indicators of heavy and sustained alcohol use. In addition, collateral reports of substance use were gathered at the 12 and 24-month follow-ups in order to corroborate the TLFB self-reports. Agreement across the sources of data was good. For more details and specific information on corroborating measures and agreement rates refer to McKay et al., 2004. All participants were informed that the information they provided during the research interviews was confidential and would not be provided to the clinical staff.

Self-help beliefs were assessed using McKay, Alterman, McLellan, & Snider's (1994) 5-item self-report measure of the extent to which the participant has adopted the AA belief system. Four items surrounding the individual's belief in a higher power, sense of spirituality, belongingness to AA, and fellowship with other AA members were scored on a 5-point Likert scale ranging from 'not at all' (0) to 'complete' (4). The alpha for this scale has been .73 or greater when used in research with this population (McKay et al., 1994).

Self-help behaviors were measured using an 8-item self-report questionnaire (McKay et al., 1994). This instrument gives a count of the number of times the participant performed a number of self-help related behaviors in the prior 30 days, such as attending AA/NA/CA meetings, speaking at AA/NA/CA meetings, or calling a sponsor or a fellow member. This measure has been shown to have good internal consistency ($\alpha > .80$) and good predictive validity of subsequent alcohol and cocaine use (McKay et al., 1994; McKay et al., 2001).

Self-efficacy was measured with the Drug-taking and Alcohol-taking Confidence Questionnaires (DTCQ & ATCQ, respectively; Annis & Martin, 1985). Eight domains of self-efficacy are assessed with 50 items; they are then averaged to produce one score. Internal consistency ratings for both of these scales are very high, with alphas equal to .98. For participants with only alcohol dependency, their ATCQ score was used, and for those only using cocaine, their DTCQ score was used. The average of the ATCQ and DTCQ was applied for individuals with both alcohol and cocaine addictions.

Social support was assessed with Procidano & Heller's 20-item scale (1983) of perceived social support from friends and family. This is not an abstinence related social support measure but rather a questionnaire inquiring about the general quality of the individual's relationships. Internal reliability ratings with this scale in previous studies have been excellent ($\alpha = .95$) (Windle, 1991), and it has been shown to have predictive validity of substance use outcomes with cocaine addicts (McKay et al., 2001.)

Commitment to abstinence was assessed using the Thoughts About Abstinence Scale (Hall et al., 1991). This is a single-item questionnaire using 6 response categories to differentiate the participant's goals surrounding abstinence. Following Hall's method (1991), we dichotomized the measure into complete abstinence versus less stringent goals surrounding abstinence. Prior research has successfully validated this particular measure of an individual's motivation to achieve total abstinence from substance use (e.g., Hall, Havassy, & Wasserman, 1990; Morgenstern, Frey, McCrady, Labouvie, & Neighbors, 1996; McKay et al., 2001).

Data Analysis

As noted in MacKinnon and colleagues' simulation study of indirect effects (MacKinnon, Lockwood, Hoffman, West, & Sheets 2002), numerous methods exist for establishing the presence of a significant mediation effect. Although most are familiar with the widely cited Baron and Kenny (1986) article detailing the multiple steps to supporting a mediation model, simulations have shown their method to have low statistical power (MacKinnon et al., 2002b). Researchers have begun to focus more exclusively on the relationships between the independent variable and the mediator (known as α) and the mediator and the outcome (known as β). This is evidenced by authors arguing for the elimination of the test for the relationship between the independent variable and outcome (Kenny, Kashy, & Bolger, 1998; Frazier, Tix, & Barron, 2004). Furthermore, MacKinnon and colleagues (2002b) recommend the test of joint significance (TJS) as a powerful alternative to Baron and Kenny's (1986) approach. The TJS simply tests the path from the independent variable to the mediator (α) for significance, and then the path from the mediator to the outcome (β) for significance. If both paths significantly differ from zero, the mediation effect is significant.

Despite the accurate Type I error rates of the TJS (MacKinnon et al., 2002b), formally testing the significance of the mediated effect has become more standard in rigorous mediation studies. One method popularized in psychology by Kenny et al. (1998) and later referred to as the normal theory (NT) approach (Frazier et al., 2004; Mallinckrodt, Abraham, Wei, & Russell, 2006), involves taking the product of α and β and dividing it by Sobel's formula (1982) for the standard error³. The value yields a z-statistic that is evaluated for statistical significance using the probabilities on the standard normal distribution⁴. However, as discussed by other researchers (e.g., MacKinnon, Lockwood, & Hoffman, 1998; Mallinckrodt et al., 2006), the confidence intervals derived from the NT approach have not performed well in terms of statistical power for detecting true nonzero mediation effects. Since the product of two normal random variables is not generally normally distributed, MacKinnon, Lockwood, and Williams (2004) derived a test to improve the performance of confidence limits around the indirect effect. Their test is referred to as the asymmetrical confidence limit (ACL) test and, as demonstrated in MacKinnon et al. (2002b), has more appropriate levels of power and Type I error rates in comparison to the NT approach. In order to demonstrate methodological variation and a comprehensive analysis of mediation, we will provide results from each of these methods: the TJS, the NT approach, and the ACL test.

The putative mediators modeled were self-efficacy, commitment to abstinence (high versus low), self-help beliefs, self-help behaviors, and social support. Since the objective of both the TEL and STND treatments was to maintain the behavior changes initially targeted in the primary IOP treatment (which took place immediately prior to the continuing care interventions), we decided to assess post-treatment scores at the 3-month time point (as the interventions were ending) and at then again 3 months later at the 6-month time point. In fact, given the goal of sustaining positive behaviors and resources after the interventions were over, scores on the mediators at the 6-month assessment might be seen as better indicators of whether this objective had been achieved than scores at the 3-month assessment. However, there was also a greater possibility with the 6-month mediator scores that initial substance use outcomes could be influencing the mediators, rather than the other way around.

Once again, we did not include the participants in the relapse prevention condition. Since earlier publications using the data from this randomized trial indicated no treatment differences with

³ $\sqrt{\alpha^2 \text{se}\beta^2 + \beta^2 \text{se}\alpha^2}$ (where $\text{se}\beta$ is the standard error of the regression coefficient β , and $\text{se}\alpha$ is the standard error for the regression coefficient α).

⁴Note that this test is also reviewed in MacKinnon et al. (2002b) under the product of coefficients tests, titled Sobel's first order solution.

respect to relapse prevention, we chose to focus the present paper specifically on understanding what mechanisms might have accounted for the significant beneficial effect of TEL in comparison to standard group counseling. Data were analyzed on an intent-to-treat basis; thus regardless of whether or not the participant received the treatment assigned, they were included in that group for the analyses. A series of longitudinal logistic mediation models were tested. Multiple regression analyses were used to test path α , which modeled the relationship between the treatment condition and the mediator candidate after covarying the baseline values for the mediator. Logistic regressions were utilized when modeling path α for commitment to abstinence, since the outcome is binary. Path β , which longitudinally modeled the effect of the mediator candidate on the binary outcome 'total abstinence from cocaine and alcohol', while controlling for treatment condition, was fit with Generalized Estimating Equations (GEE) using SAS PROC GENMOD.

Several additional covariates were included in the analyses for both paths: 1) treatment site, 2) whether or not the individual came to treatment with one or two dependence diagnoses, 3) baseline levels of substance use, which were measured as the percentage of days abstinent during the 6 months prior to beginning the continuing care program, and 4) a binary variable for total abstinence (which involved the time period from 1 to 3 months for the 3-month models and 1 to 6 months for the 6-month models). This covariate was added to control for substance use during the period that preceded the assessment of the mediator, in order to reduce the likelihood that initial outcomes during treatment and immediately after would confound the results of the mediation tests. Finally, we also controlled for days of additional treatment during the follow-up period, which varied for each time point in the longitudinal models⁵. For the longitudinal models we also included terms to capture linear trends across time. Terms for quadratic and higher-order trends were not necessary to achieve a good fit to the data⁶.

Results

The raw means for each proposed mediator at baseline, 3, and 6 months for the STND and TEL treatment conditions are presented in Table 1. First, in accordance with the steps for performing the TJS (for which all results appear in Table 2), we tested for the significance of path α for each potential mediator at the 3-month assessment. This is the path leading from the treatment condition to the mediator candidate. The results indicated that there were significant differences between treatment groups on self-help beliefs and self-help behaviors. Although scores declined from the end of IOP to the end of continuing care for both groups, participants in the TEL condition had higher scores than STND on both the self-help beliefs and behaviors scales. No differences between those treated in TEL and STND were evident on 3-month scores for self-efficacy, commitment to abstinence, or social support.

Path β , which longitudinally modeled the effect of the 3-month putative mediators on total abstinence, was tested next. After controlling for the variables mentioned earlier, only two of the putative mediators yielded significant 3-month effects on total abstinence during months 4 to 24. Higher scores on self-help behaviors led to a greater likelihood of achieving total abstinence across follow-up. Given the significant path α for self-help behaviors, using the

⁵Given that the additional treatment received by the patients was not specific to the experimental design, but rather offered by the host agency, we controlled for its effect on the outcome in order to not confound the contribution of the mediating processes being tested as products of the intervention.

⁶In a previous paper utilizing this dataset (McKay et al., 2005), there was a significant interaction effect between a risk composite score and treatment condition. This interaction was not included in the present revision because it was a compilation of whether or not the individual came to treatment with one or two dependence diagnoses (i.e., alcohol, cocaine, or both) and high versus low scores (derived using a median split) on each of our mediator candidates. Since it made little sense to try and mediate a moderator that was composed of the mediator candidates themselves, we tried to see if we could achieve a moderator effect using only the double dependence diagnosis. This however was not successful. Instead we added the double dependence diagnoses as a main effect in our equations in order to control for its effect on treatment outcome scores.

TJS, the data suggest that the treatment effect was indeed mediated by the differential maintenance of 3-month self-help behaviors. Commitment to abstinence measured at 3-months was also a positive predictor of total abstinence from months 4 to 24. However, since there was no difference between the treatments for 3-month rates of commitment to abstinence (i.e., path α) a mediation mechanism was not supported using the TJS.

We performed the same series of analyses for the TJS substituting the 6-month putative mediator scores into all of the models. In these analyses, path α was significant for self-efficacy scores and commitment to abstinence scores. Individuals treated in the TEL condition reported higher self-efficacy scores at 6 months than individuals treated in STND. The same pattern was demonstrated for commitment to abstinence. Significantly more individuals treated in TEL reported being 100% committed to abstinence than individuals treated in STND. No significant treatment differences were found for social support, self-help beliefs, or self-help behaviors at the 6-month assessment.

For path β in the 6-month models, self-help behaviors, self-efficacy, social support, and commitment to abstinence were all positive predictors of long term substance use outcomes in their individual models. That is, the higher the score on the putative mediator variable, the more likely they were to report total abstinence at the follow-up points from 7 to 24 months. Self-help beliefs was the only putative mediator that did not reach statistical significance in predicting total abstinence from 7 to 24 months. Pairing these results with those from path α , according to the TJS, the data suggest that self-efficacy and commitment to abstinence at 6 months are mediators of treatment effect for subsequent abstinence outcomes (7 to 24 months).

As mentioned in the data analysis section, in order to add rigor to the results found using the TJS, two product-of-coefficients tests were performed next. All results associated with these tests can also be found in Table 3. The NT test, which gives a z-score for the mediation effect, was conducted by dividing the product of α and β by the standard error using Sobel's formula (1982). Using a one-tailed test⁷ with α set at .05, the NT test yielded significant mediation effects for the 6-month self-efficacy scores ($p = .03$) and commitment to abstinence ($p = .05$). The z-score for 3-month self-help behaviors approached statistical significance ($p = .06$). Due to the NT approach's poor performance in terms of statistical power for detecting a significant mediation process, we also conducted the asymmetrical confidence limit (ACL) test. In congruence with the TJS, the results for the ACL test indicated that 3-month self-help behavior scores were a significant mediator of the treatment effect on subsequent outcomes (months 4-24). Also, as seen in both prior tests, the ACL test supported a mediation effect for 6-month self-efficacy scores and commitment to abstinence⁸.

Supplementary Analyses

Given the results suggested that 3-month self-help behaviors mediated treatment effects from 4-24 months and 6-month self-efficacy and commitment to abstinence mediated treatment effects from 7-24 months and beyond, we tested a post hoc explanation for these findings. We suspected the presence of a complex sequence of events in which positive changes in self-help activities yielded improvements in self-efficacy and commitment to abstinence. To model this hypothesis we regressed 6-month self-efficacy and commitment to abstinence scores (in two separate equations) onto self-help behaviors at 3-months while controlling for treatment site,

⁷A one-tailed test for significance is most appropriate here given that the sign of the effect is already known and determined according to the product of $\alpha\beta$, the numerator of the z. We simply need to determine the distance from zero of the existing effect which makes the direction irrelevant and a 2-tailed test overly conservative.

⁸It should be noted that commitment to abstinence and self-efficacy are not significantly correlated to one another, indicating that they are two distinct psychological constructs. In fact, the point bi-serial correlation was only equal to .08; thus the shared variance between the two constructs is very limited.

having 2 addiction diagnoses, percent of days abstinent prior to continuing care, and baseline scores of self help behaviors and self-efficacy or commitment to abstinence (depending on which dependent variable was used). Results indicated that 3-month self-help behaviors scores predicted 6-month self efficacy scores ($\beta = .084$; $SE = .035$, $t = 2.40$, $p = .018$). Individuals reporting more self-help behaviors at 3-months also reported higher levels of self-efficacy at 6-months. The effect of 3-month self-help behaviors on 6-month commitment to abstinence scores was in the same direction, but was not significant ($\beta = .004$; $SE = .0037$, $t = 1.21$, $p = .27$).

Discussion

This study sought to find mediating mechanisms of a previously demonstrated positive treatment effect for a telephone-based continuing care intervention (McKay et al., 2004, 2005). Evidence of longitudinal mediation was found with three variables: self-help behaviors during the last month of treatment (i.e., assessed at 3-months), and self-efficacy and commitment to abstinence assessed 3 months later (i.e., 6-months). The telephone condition sustained higher levels of self-help involvement during continuing care than standard group counseling, and a longitudinal model indicated that this self-help involvement predicted better abstinence outcomes across the 4 to 24-month follow-up. A significant mediation effect was supported by the test of joint significance. Only marginal support however, was shown for 3-month self-help behaviors mediating treatment outcomes for 4 to 24 months using the asymmetrical confidence limit test and normal theory method.

Similarly, the telephone condition led to higher self-efficacy scores and higher rates of commitment to abstinence at the 6-month follow-up, compared to standard group counseling, and scores on these two measures predicted abstinence outcomes over months 7 to 24. Moreover, self-efficacy and commitment to abstinence at 6 months both passed the test of joint significance, the normal theory test, and the asymmetrical confidence interval test, indicating that they mediated the treatment effect on abstinence outcomes during months 7 to 24.

Since significant treatment differences between TEL and STND care were evident as early as the 6-month time-line-follow-back assessment (i.e., 4 to 6 months) we suspected that the mediating effects of self-efficacy and commitment to abstinence were part of a complex sequence of events and processes. We tested this post hoc explanation in supplementary analyses and found support for one of the two mechanisms examined. Self-help behaviors assessed at 3-months were associated with 6-month self-efficacy scores, but not 6-month commitment to abstinence scores. Perhaps this was due to the method of measuring commitment to abstinence (i.e., a dichotomous measure as opposed to continuous). Nevertheless, the mediation effect of commitment to abstinence should be interpreted with caution. Although there is presumably a chain of events occurring, it is difficult to determine the nature of the causal effects. It is possible that early outcomes were driving commitment to abstinence as opposed to the other way around. However, it should be noted that all the mediation models controlled for abstinence either during continuing care (i.e., for the 3-month mediator models) or during continuing care and the subsequent 3 months (i.e., for the 6-month mediator models). This strengthens the likelihood that mediation effects are in fact present.

Overall, these results suggest that initially, the greater therapeutic effect of the telephone condition compared to the standard group counseling approach is partially accounted for by a differential change in behavior. Namely, telephone participants indicated more involvement in self-help meetings and related activities during the period of the intervention than their standard care counterparts. After the continuing care intervention ended, a difference also emerged on self-efficacy, once again favoring the telephone condition over standard care. Therefore, the treatment first yielded differences in behavior, which were then followed by

differences in efficacy beliefs. These results are generally in agreement with models in the addictions (Marlatt & Gordon, 1985) and other areas (Bandura, 1997), in which successful coping (i.e., behavior change) is thought to produce increases in self-efficacy, which in turn influences subsequent outcomes. Therefore, our data imply the presence of sequential effects with self-help and self-efficacy. Determining if sequential effects are also present with commitment to abstinence will require further study.

Perhaps the most notable finding of the study is that the telephone-based continuing care, which provided approximately half the minutes of therapeutic contact as the other two conditions (McKay et al., 2005) and considerably less face-to-face contact (average of 5 versus 14 sessions) produced higher scores on three mediators (e.g., self-help behaviors, self-efficacy, and commitment to abstinence) than the comparison condition. This could be in part due to the content of the TEL intervention, which placed greater emphasis on the need for patients to be the active change agents in their recoveries. By comparison, patients in the STND condition may have relied more on the therapist and other group members for making progress in recovery. Because the patient who received telephone continuing care may have more strongly attributed the changes in behavior to his or her own efforts, the patient's self-efficacy and commitment to abstinence were maintained, and in fact improved somewhat. It should be noted that this effect may not have been related to the content of the telephone intervention, per se, but rather to the fact that this more minimal intervention might have prompted recipients to do more to support their recoveries, including participating more actively in self-help programs.

The present findings were equivocal with respect to the effects of the process measures (i.e., the putative mediators) on substance use outcomes. At the 3-month assessment, only commitment to abstinence and self-help behaviors predicted subsequent abstinence outcomes, whereas at 6 months, all putative mediators except self-help beliefs predicted outcome. These findings are at least in part contradictory to previous research where post-treatment measures of self-help beliefs, self-efficacy, and social support predicted treatment outcomes (Connors et al., 1996b; Hall et al., 1991; Longabaugh et al., 1998; McKay et al., 2001; Miller et al., 1996; Morgenstern et al., 1997). However, the fact that our models included current substance use at the time the mediator was assessed likely reduced the predictive power of these process measures.

With regard to social support, we had hypothesized that the relative lack of direct social support provided in the TEL intervention, compared to that provided through twice-weekly group counseling, would lead patients who received TEL to more actively seek out other sources of social support. Although this occurred to some extent during the treatment intervention, the difference in scores was not statistically significant from those in the group counseling condition. The failure to generate support for this hypothesis could indicate a failure of action theory with respect to the effect of the telephone intervention on this construct, or limitations in the measure of social support. The Procidano and Heller scale (1983) measures perceived general support, but it does not provide a more objective measure of actual social support or an indication of the amount of abstinence-oriented social support provided by peers. There is some evidence that measures which assess social support specifically for abstinence, such as Longabaugh, Wirtz, Beattie, Noel, & Stout's Important Peoples and Activities Inventory (1995) are better predictors of outcome than more general social support measures (Beattie & Longabaugh, 1999). Further work with better measures is needed to more fully understand the possible impact of the TEL condition on social support.

Limitations and Concluding Remarks

The mediation methods applied in this study have been tested most thoroughly with continuous measures. We used a binary outcome, and one of our mediators (commitment to abstinence) was binary as well. Further simulation studies are needed to determine the range of validity of

the methods when variables with distributions from other exponential families are included as mediators or outcomes, particularly in the longitudinal mediation setting. This paper provides an initial step in the process of extending these more advanced models by using three methods to test the mediation models. Notably, while demonstrating rigor on the one hand, it also introduced complexity and underscored the differential levels of power to detect significant effects among the various methods. Hence, a significant mediation effect for 3-month self-help behaviors was obtained with the test of joint significance, while more marginal results were found for the mediation effect of 3-month self-help behaviors using the asymmetrical confidence limit test and the normal theory approach.

In a recent publication, Kazdin and Nock (2003) recommended assessing values on putative mediators early and often in treatment. This approach is particularly applicable to studies of treatment for disorders such as depression, anxiety, or conduct problems, in which patients begin treatment with high levels of problem severity, and improve over the course of treatment. In the addictions however, many patients stop using prior to entering treatment, or in the case of our study, during the phase of treatment that precedes continuing care. Therefore, it is not generally possible to show that improvements in mediators precede improvements in symptoms. Nevertheless, our design would have been stronger if we had also assessed scores on the mediators at repeated points during the first six months of the follow-up (e.g., monthly or perhaps even weekly), in order to demonstrate more conclusively that declining scores on the mediators preceded any return to substance use during continuing care.

Another limitation involves the generalizability of the results to a more heterogeneous population. Our participants were mostly middle-aged, unmarried, African American men with long histories of substance abuse. Future studies should examine the TEL intervention with a different population in order to see if the therapeutic processes operate in a similar fashion.

Missing data on the mediator variables and covariates also produced sample sizes that were slightly smaller than for the general outcomes results. Follow-up rates on these variables were not as strong due to the priority given to gathering the substance use data in interviews where phone contacts, which were typically more limited in time, were utilized for data collection. Nevertheless 74-82% follow-up rates (the rates our final longitudinal models yielded once all covariates were included) over a period of two years is standard in community-based substance use research. As with any study of this kind, loss to follow-up is a notable limitation. It is possible we would have seen different results without the missing data.

Finally, it is difficult to judge the clinical significance of the mediation effects. However, as shown in the raw data presented in Table 1, the fact that the telephone condition produced increases in self-efficacy (during the intervention) and commitment to abstinence (immediately following the intervention), whereas there were decreases on these measures in standard care, may be salient to patients and therefore important clinically.

In conclusion, our results suggest that the greater therapeutic effects of telephone-based continuing care are partially accounted for by participation in self-help meetings and related activities during the continuing care phase of treatment, and by subsequent increases in commitment to abstinence and the maintenance of self-efficacy. Furthermore, we were able to establish a chain of events to help elucidate the processes leading to the 6-month mediation models. Our results revealed that increases in self-help behaviors are associated with increases in self-efficacy, which accounted for the treatment differences from 7-24 months.

With more sophisticated analytic methods we are now able to fully utilize longitudinal datasets in order to answer questions about mechanisms of change over time. Since the 1986 publication of the widely adopted Baron and Kenny mediation model, understanding causal mechanisms became of growing interest and treatment processes a common theme in psychological

research. Using several tests of mediation based on MacKinnon's and colleagues work (2002b, 2004), the present paper was able to successfully demonstrate several longitudinal mediation models within the context of a logistic modeling framework. Further work is needed on study designs in addictions treatment research to facilitate more specific guidelines and criteria for mediation with complex analyses using binary outcomes as recommended by Kazdin and Nock (2003).

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Table 1**Mediator means by treatment condition**

Mediator		Baseline			3-months		6-months	
Treatment	N*	Mean (SD) or %			Mean (SD) or %		Mean (SD) or %	
Self-help beliefs								
STND	101	17.92 (2.99)			17.00 (3.80)		16.23 (4.62)	
TEL	83	17.69 (3.42)			17.49 (3.54)		16.64 (3.84)	
Self-help behaviors								
STND	101	64.95 (52.43)			50.31 (45.11)		35.81 (39.56)	
TEL	83	71.76 (55.67)			65.01 (60.18)		42.89 (43.7)	
Self-efficacy								
STND	99	78.33 (23.35)			76.54 (22.68)		72.63 (25.91)	
TEL	83	75.96 (23.08)			79.66 (20.84)		80.29 (22.22)	
Social Support								
STND	100	34.05 (12.64)			36.48 (12.14)		36.13 (11.87)	
TEL	77	34.12 (12.16)			38.84 (10.11)		36.01 (12.66)	
Commitment to Abstinence								
STND	100	48.00%			47.00%		40.00%	
TEL	84	52.38%			45.24%		54.76%	

* The n's reflected in this table include only individuals for whom data was available on all 3 time points, thus the rates are somewhat lower than our true follow-up rates for mediators

Table 2

Mediation tests of putative mediators

Mediator Candidate	3-months			6-months		
	Beta (SE)	ES ^f	t or χ^2	Beta (SE)	ES	t or χ^2
Self-help beliefs	(N = 173) ²			(N = 175)		
Path α^3	.837 (.428)	.291	1.96 [*]	.636 (.544)	.018	1.17
Path β^4	.066 (.041)	1.27	1.61	.045 (.032)	1.20	1.40
Product of $\alpha\beta$	.056			.029		
NT mediation test	z = 1.25			z = .906		
ACL mediation test ^(.95)	(-.009, .106)			(-.019, .107)		
Self-help behaviors	(N = 183)			(N = 175)		
Path α	13.7 (6.42)	.319	2.13 [*]	4.95 (5.27)	.137	0.94
Path β	.007 (.003)	1.44	2.67 ^{**}	.020 (.004)	2.10	5.22 ^{***}
Product of $\alpha\beta$	.096			.099		
NT mediation test	z = 1.58			z = .925		
ACL mediation test ^(.95)	(.004, .235) [§]			(-.121, .316)		
Self-efficacy	(N = 170)			(N = 174)		
Path α	2.53 (2.29)	.173	1.10	9.15 (2.99)	.450	3.06 ^{**}
Path β	.006 (.008)	1.14	0.75	.017 (.007)	1.51	2.69 ^{**}
Product of $\alpha\beta$	.015			.156		
NT mediation test	z = .625			z = 1.90 [*]		
ACL mediation test ^(.95)	(-.023, .075)			(.025, .341) [§]		
Social support	(N = 166)			(N = 169)		
Path α	2.16 (1.43)	.227	1.51	-.427 (1.6)	-.040	-0.27
Path β	0.0 (.012)	1.00	0.00	.023 (.011)	1.33	2.04 [*]

Mediator Candidate	3-months			6-months		
	Beta (SE)	ES ¹	t or χ^2	Beta (SE)	ES	t or χ^2
Product of $a\beta$	0					
NT mediation test	$z = 0$					
ACL mediation test ^(.95)	(-.057, .057)					
Commitment to abstinence	(N = 172)			(N = 175)		
Path α	-.147 (.35)	.932	0.18	.679 (.327)	1.40	4.31 *
Path β	.582 (.256)	1.34	2.28 *	.687 (.256)	1.41	2.68 **
Product of $a\beta$	-.086			.466		
NT mediation test	$z = .415$			$z = 1.64$ *		
ACL mediation test ^(.95)	(-.348, .520)			(.341, .651) §		

* $p \leq .05$,
** $p \leq .01$,
*** $p \leq .0001$,
§ significant result indicated by .95 CI not crossing 0
¹ ES = Effect Size. Effect Sizes for the models with binary outcomes are represented as odds ratios for a 1 standard deviation unit change in the predictor variable.
² The slightly decreased N's reflected in these analyses in comparison to those seen in Table 1 are due to the loss of subjects who had missing data on the covariates included in the models.
³ Path α for every variable refers to the relationship where treatment condition is the independent variable and the mediator is the outcome variable (all of the test statistics are t's, except for commitment to abstinence where it is a chi-square because it is a binary variable)
⁴ Path β represents the relationship where the mediator is the independent variable and total abstinence is the outcome variable (the test statistics are chi-squares because total abstinence is a binary variable)