Drug and Alcohol Dependence 101 (2009) 115–123

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Construct, concurrent and predictive validity of the URICA: Data from two multi-site clinical trials

Craig A. Field[a,*], Bryon Adinoff[b,c], T. Robert Harris[d], Samuel A. Ball[e], Kathleen M. Carroll[f]

[a] University of Texas at Austin, School of Social Work, Center for Social Work Research, Health Behavior Research and Training Institute, 1717 West 6th Street Ste 295, Austin, TX 78703, USA
[b] Department of Psychiatry, UT Southwestern Medical Center at Dallas, 5323 Harry Hines Blvd, Dallas, TX 75390-8564, USA
[c] VA North Texas Health Care System, 4500 S. Lancaster Dr., Dallas, TX 75216, USA
[d] University of Texas School of Public Health, Dallas Regional Campus, 6011 Harry Hines Blvd., v8.112, Dallas, TX 75390-9128, USA
[e] Yale School of Medicine, The APT Foundation, 1 Long Wharf, Suite 321, New Haven, CT 06511, USA
[f] Yale University, Psychotherapy Development Center, NIDA CTN New England Node, VA Connecticut Healthcare System (151D), 950 Campbell Avenue, West Haven, CT 06516, USA

ARTICLE INFO

Article history:
Received 20 December 2007
Received in revised form 1 December 2008
Accepted 2 December 2008
Available online 20 January 2009

Keywords:
URICA
Motivation to change
Substance dependence
Readiness to Change
Committed Action
Motivational interviewing
Motivational enhancement therapy

ABSTRACT

Background: A better understanding of how to measure motivation to change and how it relates to behavior change in patients with drug and alcohol dependence would broaden our understanding of the role of motivation in addiction treatment.
Methods: Two multi-site, randomized clinical trials comparing brief motivational interventions with standard care were conducted in the National Institute on Drug Abuse Clinical Trials Network. Patients with primary drug dependence and alcohol dependence entering outpatient treatment participated in a study of either Motivational Enhancement Therapy ($n = 431$) or Motivational Interviewing ($n = 423$). The construct, concurrent, and predictive validity of two composite measures of motivation to change derived from the University of Rhode Island Change Assessment (URICA): Readiness to Change (RTC) and Committed Action (CA) were evaluated.
Results: Confirmatory factor analysis confirmed the *a priori* factor structure of the URICA. RTC was significantly associated with measures of addiction severity at baseline ($r = .12–.52$, $p < .05$). Although statistically significant ($p < .01$), the correlations between treatment outcomes and RTC were low ($r = -.15$ and -18). Additional analyses did not support a moderating or mediating effect of motivation on treatment retention or substance use.
Conclusions: The construct validity of the URICA was confirmed separately in a large sample of drug- and alcohol-dependent patients. However, evidence for the predictive validity of composite scores was very limited and there were no moderating or mediating effects of either measure on treatment outcome. Thus, increased motivation to change, as measured by the composite scores of motivation derived from the URICA, does not appear to influence treatment outcome.

Published by Elsevier Ireland Ltd.

1. Introduction

Motivation to change is considered an important indicator of treatment readiness and response among patients with addictive disorders. Motivation is also thought to play a key role in substance abuse treatment, from recognizing the need for change, seeking treatment, responding to treatment and sustaining changes in behavior following treatment. The assumptions surrounding this construct are also thought to provide some explanation for the effectiveness of motivational interviewing (Miller and Rollnick, 2002) and its manualized version, motivational enhancement therapy (Miller et al., 1992). Such interventions regard the patient's readiness and commitment to change as an essential mechanism of action (Miller and Rollnick, 2002).

An extensive literature assessing motivation to change among people with alcohol problems is not matched by a similar literature in patients with drug dependence (DiClemente et al., 2004). Patients who are drug dependent differ in clinically significant ways from patients who are alcohol dependent (Brower et al., 1994). For example, patients who use drugs are more often mandated to treatment due to illegal behaviors and may differ in regard to the severity of their substance abuse problems or their level of psychosocial impairment. As a result, it has been suggested that drug abuse patients have a poorer prognosis in treatment than alcohol abuse

* Corresponding author. Tel.: +1 512 232 0624; fax: +1 512 232 0626.
E-mail address: craig.field@austin.utexas.edu (C.A. Field).

0376-8716/$ – see front matter Published by Elsevier Ireland Ltd.
doi:10.1016/j.drugalcdep.2008.12.003

patients (Weisner, 1992). A better understanding of how to best measure motivation to change and how motivation relates to successful behavior change among both drug and alcohol dependent patients would broaden our understanding of the role of motivation in the treatment of addictions.

The use of valid measure of motivation to change is critical to understanding the potential impact of this construct on treatment outcomes. Although several measures have been developed (i.e., SOCRATES, Change Ladder, and Stages of Change Algorithm), the University of Rhode Island Change Assessment (URICA) is one of the most commonly used measures of motivation to change (Carey et al., 1999; DiClemente et al., 1999; DiClemente and Hughes, 1990). The URICA is based on the stages of change model and has four subscales: precontemplation, contemplation, action and maintenance. The psychometrics of the URICA have been assessed in a wide variety of individuals with substance-related disorders including alcohol, drug, and polysubtance dependence with mixed results (Abellanas and McLellan, 1993; Belding et al., 1997; Belding et al., 1995; Carbonari and DiClemente, 2000; DiClemente and Hughes, 1990; DiClemente et al., 1999; Edens and Willoughby, 1999; Edens and Willoughby, 2000; el-Bassel et al., 1998; Willoughby and Edens, 1996). One of the more common approaches to evaluating the URICA is to define groups of patients across the spectrum of motivation using cluster analysis. Using cluster analysis, the URICA has been found to reflect anywhere between two and eight subgroups of patients (Blanchard et al., 2003; DiClemente and Hughes, 1990; DiClemente et al., 1991; el-Bassel et al., 1998; McConnaughy et al., 1983, 1989; Pantalon and Swanson, 2003; Prochaska and DiClemente, 1983; Siegal et al., 2001). Construct validity is more commonly evaluated using factor analysis. However, few studies have evaluated the URICA's construct validity using factor analysis and these typically rely on principal components analysis, a more exploratory approach to examining factor structure. Four studies using principal components analysis, including two among substance abuse populations, supported a four-factor solution that accounted for 39–58% of the variance (Carney and Kivlahan, 1995; DiClemente and Hughes, 1990; McConnaughy et al., 1989, 1983). Another study identified a five-factor solution among incarcerated drug users (el-Bassel et al., 1998). Using confirmatory factor analyses with polysubstance abusers, one study failed to confirm the four-factor structure (Belding et al., 1996) while another supported the four factor structure (Pantalon et al., 2002). There are currently no studies comparing the *a priori* four-factor structure of the URICA using confirmatory factor analysis across substances of abuse which may, in part, account for these mixed findings.

Results regarding the predictive validity of the URICA have been as equally mixed as those examining its construct validity (Belding et al., 1997; Blanchard et al., 2003; Carey et al., 2001; DiClemente, 1999; Edens and Willoughby, 1999; Pantalon et al., 2002; Pantalon and Swanson, 2003; Siegal et al., 2001; Willoughby and Edens, 1996). Among polydrug dependent patients in methadone maintenance, Belding et al. (1997) found that the contemplation score was modestly associated ($r = -.29$, $p < .05$) with drug free urine one month after admission but observed a non-significant association between the action stage and treatment retention ($r = -.22$). Edens and Willoughby (1999) found inpatients with polysubstance abuse in the contemplation and action cluster were significantly more likely to complete treatment than those in the precontemplation cluster (69% vs. 53%, $p = .03$). However, Pantalon and Swanson (2003) found that dually diagnosed, polysubstance dependent inpatients with low readiness to change attended a greater proportion of therapy session while hospitalized (54% vs. 39%, $p < .05$) and clinic appointments one month post-discharge (77% vs. 53%, $p < .05$) than those with high readiness to change. In another study of predominately alcohol and cocaine dependent patient in the outpatient and community setting, readiness to change failed to predict treatment adherence, percent days abstinent or negative consequences at three or six-month follow-up (Blanchard et al., 2003).

While the predictive validity among patients with drug abuse and dependence has generally been considered more difficult to establish than patients with alcohol problems, there are equally mixed results for the predictive validity among patients with alcohol dependence (Belding et al., 1997; Blanchard et al., 2003; Carey et al., 2001; DiClemente, 1999; Pantalon et al., 2002; Pantalon and Swanson, 2003; Siegal et al., 2001). For example, in one study Edens and Willoughby (1999) found that patients in the contemplation and action cluster were more likely to complete treatment than those in the precontemplation cluster (75% vs. 54%, $p = .004$) while another study found no such association (Willoughby and Edens, 1996). Given the mixed and relatively modest results across substances of abuse, a comparison of the predictive validity of motivation to change in a representative sample of outpatients treated by an evidence-based treatment, specifically designed to increase readiness to change (i.e., motivational interviewing or motivational enhancement therapy), may clarify existing research.

In a majority of studies that use the URICA with patients seeking treatment, the four subscale scores are significantly skewed such that the contemplation, action, and maintenance scores are typically high and precontemplation scores are usually low. As a result, a sophisticated method of clustering individuals based on their patterns of scores across the four subscales is sometimes employed to create stage-based subgroups (Carney and Kivlahan, 1995; Miller, 1985). However, clustering patients into stage-based subgroups is complicated and impractical in a clinical setting. Cluster analysis is often sample-specific, making it difficult to interpret an individual's score prior to data analysis for a given sample (Carey et al., 1999). To address these concerns, a single composite score was developed to measure motivation to change. A second order factor structure of the four subscales was used to create a continuous measure of motivation to change, Readiness to Change (RTC), from the URICA subscales (DiClemente et al., 2001). RTC is calculated by subtracting scores on the precontemplation subscale from the sum of the contemplation, action and maintenance subscales. In Project MATCH, RTC was predictive of percent days abstinent and drinks per drinking day among aftercare patients during treatment and at each of the follow-up periods (Project MATCH Research Group, 1998a; Project MATCH Research Group, 1998b). Observed effect sizes for readiness to change, as measured by Cohen's *d*, ranged from .06 to .35 for percent days abstinent and 0 to .26 for drinks per drinking day (Cohen, 1988; DiClemente et al., 2001; Rosnow and Rosenthal, 1996). In addition, a significant interaction between motivation and treatment was identified during the final month of a one-year follow-up period among outpatients (Project MATCH Research Group, 1997). Therefore, the use of RTC as a composite measure may inform clinical practice and research investigating potential mechanisms of action.

Committed Action (CA) is an alternative composite measure of motivation to change among patients seeking treatment for substance abuse problems (Pantalon et al., 2002). Many of the items from the contemplation subscale of the URICA reflect ambivalence about change and endorsement of these items may reflect a decreased likelihood of taking action to change substance use. As a result, CA is calculated by subtracting the contemplation subscale from the action subscale. Pantalon et al. (2002) demonstrated that CA had stronger predictive validity than RTC among this treatment seeking population. In that study, patients with higher CA at baseline had significantly more percentage days abstinent from both alcohol and cocaine use at follow-up than those with lower baseline levels of CA (86% vs. 73%, respectively). Although CA was a significant predictor of percent days abstinent from both alcohol and cocaine, this association was modest ($r = .22$). Nevertheless, CA

may be an alternative to RTC among treatment seeking populations who are less likely to endorse items related to the precontemplation or maintenance subscales (Pantalon et al., 2002).

Field et al. (2007) recently examined the concurrent validity of RTC and CA among patients seeking outpatient treatment for substance use disorders and concluded that RTC and CA may represent different constructs related to motivation to change. Linear regression indicated that RTC and CA were associated with different baseline characteristics. RTC was associated with anger expression ($B = -.28$; 95% CI = −.6, −.01) and recent life events ($B = 1.1$; 95% CI = .01, 2.2). CA was associated with alcohol problems ($B = -.33$; 95% CI = −.62, −.05) and state anxiety ($B = -.13$; 95% CI = −.21, −.04). On the basis of these findings, Field et al. (2007) hypothesized that RTC may reflect a patient's desire to change or seek help and CA may reflect the patient's long term commitment to behavior change. Thus, RTC may be more likely to predict concurrent problems at the time of admission but CA may be more likely to predict treatment outcomes. RTC was significantly associated with baseline and pretreatment characteristics in another study (Blanchard et al., 2003). This is also consistent with recent findings demonstrating that CA (Pantalon et al., 2002), but not RTC, predicted treatment outcome among patients seeking treatment for substance dependence. Examination of the ability of RTC and CA to predict patient outcomes across substances of abuse may shed light on potential mechanisms of change involved in the effective treatment of drug and alcohol problems. It may also clarify the utility of RTC which was derived statistically using the factor structure of the URICA and CA which was derived based on theoretical assumptions related to the underlying theory of ambivalence and motivation to change.

Recent studies performed in the Clinical Trials Network (CTN) funded by the, National Institute on Drug Abuse (NIDA), provided an excellent opportunity to explore mechanisms of action and further examine the construct, concurrent and predictive validity of composite measures of motivation to change derived from the URICA among primary drug abusers and primary alcohol abusers. Randomized trials conducted in the CTN emphasize generalizability by conducting effectiveness trials in community-based treatment centers using heterogeneous samples of substance users. To date, there have been no other studies large and diverse enough to compare the validity of composite measures of change among different substance use groups. Results from two relevant multi-site trials conducted by the CTN have recently been reported; one evaluated a single session of Motivational Interviewing (MI) and the other evaluated three-sessions of Motivational Enhancement Therapy (MET) (Ball et al., 2007; Carroll et al., 2006). Both studies found a differential effect of treatment among drug and alcohol abusers. In the trial evaluating MI, Carroll et al. (2006) found that primary alcohol users, but not primary drug users, assigned to the single session of MI subsequently completed significantly more counseling sessions during outpatient treatment [ANOVA: $F(1,175) = 8.1$, $p = .01$, $d = .56$]. The positive effect of MI on treatment retention was also significant at the 84-day follow-up [$F(1,154) = 3.79$, $p = .05$, $d = .32$] (Carroll et al., 2006). This study also examined the effect of treatment on motivation as a potential outcome, although no treatment effect was observed (Carroll et al., 2006). In the trial evaluating MET, Ball et al. (2007) found that MET resulted in sustained reductions of substance use among primary alcohol users, but not primary drug users [Therapy × Weeks, $F(4, 1632)$ 7.26, $p = .01$; Therapy × Phase, $F(1, 1636)$ 15.88, $p = .001$; and Therapy × Weeks × Phase, $F(4, 1632)$ 13.92, $p = .001$]. We hypothesized that the composite measures of motivation to change derived from the URICA, including RTC and CA, may account for the differential effectiveness of MI and MET among primary drug and alcohol users and possibly clarify findings from these two studies.

The aims of this study, therefore, were to examine the construct, concurrent and predictive validity of RTC and CA among primary drug users and primary alcohol users participating in the aforementioned CTN studies (Ball et al., 2007; Carroll et al., 2006). Specifically, it was hypothesized that RTC would be associated with pretreatment characteristics and CA would predict treatment outcome (Field et al., 2007). Given the findings of differential effectiveness of MI and MET, we further hypothesized that motivation to change, as measured by CA, would predict treatment outcome for primary alcohol users but not primary drug users. In addition, we examined the potential moderating effect of motivation measured at baseline on treatment outcome. Finally, we also examined the potential mediating effect of changes in motivation following intervention on treatment outcome. Treatment outcomes of interest were the primary outcomes of interest from the two clinical trials; primary substance use and treatment retention (Ball et al., 2007; Carroll et al., 2006).

2. Methods

Two multi-site, randomized clinical trials conducted in the National Institute on Drug Abuse Clinical Trials Network were used for this secondary analysis. The first study compared the effect of three sessions of Motivational Enhancement Therapy (MET) to three sessions of counseling-as-usual on retention and substance use among individuals seeking treatment at five community-based outpatient treatment programs (Ball et al., 2007). The second study compared the effect of one session of Motivational Interviewing (MI) integrated into the standard intake evaluation to the standard intake interview at four outpatient treatment programs (Carroll et al., 2006).

Following initial contact with the outpatient program, prospective participants met with a research assistant who explained the study and obtained written informed consent. After completing the baseline assessment, participants were randomized to treatment condition (MI vs. standard assessment; MET versus standard counseling) and then received study therapy sessions (1 in MI; 3 in MET) within a 28-day time period. All participants were re-assessed at the end of this 28-day period (one-month) and again 84-days (three-months) later.

2.1. Participants

A total of 461 outpatients were evaluated in the MET study and 423 in the MI study. The baseline demographic characteristics and substance use of the two study samples has been described elsewhere (Ball et al., 2007; Carroll et al., 2006). For this secondary analysis examining differences between primary drug users and primary alcohol users, data from 831 participants with primary drug ($n = 495$, 60%) or alcohol disorders ($n = 336$, 40%) were included in the analysis; 408 from the MET protocol and 423 from the MI protocol. The total sample was predominately single or never married ($n = 674$, 81%), unemployed ($n = 496$, 60%), male ($n = 530$, 64%) and Caucasian ($n = 493$, 59%) or African American ($n = 187$, 23%). The average age of the sample was 33.5 (SD = 10.3) and the average education was 12 years (SD = 2.3). The common study protocols, informed consent procedures, and the consent forms were all approved by the corresponding Institutional Review Board of the academic center with which each community treatment program was affiliated.

2.2. Measures

2.2.1. Motivation to change

The University of Rhode Island Change Assessment Scale (URICA) is a 32-item, self-report inventory yielding four summary scores assessing participants' attitudes on the precontemplation, contemplation, action and maintenance stages of change originally proposed by DiClemente and Prochaska (McConnaughy et al., 1983; Prochaska and DiClemente, 1992; Prochaska et al., 1992a). There are eight Likert-type items per stage or subscale, each ranging from 1 to 5, with higher scores indicating greater endorsement of particular attitudes or behaviors. In both MET and MI studies, the URICA was used to assess global substance use change rather than readiness to change a specific substance.

The URICA provides four discrete stage scores which were used to calculate the two composite scores. The RTC composite score was obtained by subtracting the precontemplation score from the sum of the contemplation, action and maintenance scores (Connors et al., 2000; Project MATCH Research Group, 1997). Total discrete stage scores range from 8 to 40 whereas RTC scores range from −16 to 112 and CA scores range from −32 to 32. Both the RTC and CA scores were centered at zero. For CA, the contemplation score is seen as an indicator of the patient's ambivalence about change and is, therefore, subtracted from the action score (Pantalon et al., 2002). The URICA was measured at baseline and four weeks after completing the single session MI or three sessions of MET.

Motivation to change was also assessed by the therapist during the session using a single item asking how motivated to change the patient was using a rating system ranging from not at all, very weak, weak, adequate, strong, very strong and extremely strong. The intra-class correlation coefficient for measur-

ing motivation at the beginning and end of sessions was .96 (Martino et al., 2008).

2.2.2. Substance use and treatment retention

Substance use and treatment retention were the two primary outcomes of interest for the two clinical trials. Self-reports of substance use (marijuana, cocaine, alcohol, methamphetamines, opioids, benzodiazepenes, and other illicit drugs) were collected via a substance use calendar using the timeline follow-back procedures. This method assesses substance use on a daily basis, allows for a flexible, continuous evaluation of substance use, and has been shown to be reliable and valid for monitoring substance use and other outcomes in longitudinal studies (Fals-Stewart et al., 2000; Miller and Delboca, 1994; Sobell and Sobell, 1992). Urine analyses for drugs closely corresponded with participants' self-reported drug use (Ball et al., 2007; Carroll et al., 2006). The primary outcome for the two published studies and this secondary analysis was primary substance of abuse as reported by the client at admission. Treatment retention data were collected by research assistants three months following completion of the study protocol and were based on self-report which were confirmed using client records.

2.2.3. Addiction severity

Frequency and severity of substance use and substance-related problems was measured using a brief version of the Addiction Severity Index (ASI) (McLellan et al., 1992). The ASI is the most widely used instrument for the assessment of substance use and related problems and its psychometric properties are well established (Alterman et al., 1994, 2001; Cacciola et al., 1997). Composite scores were also calculated as measures of the severity of medical, employment, alcohol, drug, legal, family, or psychiatric problems. The ASI was collected at baseline, therapy termination, and three-month follow-up and was completed independently of the URICA.

2.2.4. Therapeutic alliance

Therapeutic alliance has proven to be a promising variable for predicting outcome from psychotherapy for substance abuse (Connors et al., 1997) and other disorders (Horvath and Luborsky, 1993). This concept has been defined by Bordin (1979) as therapist and client agreement on goals, agreement on tasks, and the development of a bond between therapist and client. The working alliance was measured with the revised Helping Alliance Questionnaire (HAq-II), a well-validated measure, from both the therapist and participant perspectives. The therapist and patient versions of the HAq-II have two factors, positive and negative therapeutic alliance, which account for 54% of the variance, and have high internal consistency ($\alpha > .90$) and test retest reliability ($r = .56, .78$, respectively) (Luborsky et al., 1996). In the MET study, therapeutic alliance was measured during the second session (Luborsky et al., 1996). In the MI study, therapeutic alliance was measured during the first (and only) session.

2.3. Statistics

2.3.1. Construct validity and internal consistency of the URICA

The internal consistency of the URICA subscales in patients with primary drug use and primary alcohol use from the two studies was estimated using Cronbach's alpha from SPSS 15.0. Factor structure was evaluated with confirmatory factor analysis (CFA) using AMOS, version 7.0 (Arbuckle, 2006). CFA tests the fit of the data to the *a priori* structure of the four (i.e., precontemplation, contemplation, action and maintenance) latent variables or factors (Bartko et al., 1988). The model fit was tested using the four factor structure with correlations among the four latent variables. Each item was constrained to load only on its hypothesized factor and error variances between items within a factor were allowed to correlate.

In confirmatory factor analysis, a non-significant chi-square indicates that the data fit the model well. However, a non-significant chi-square value does not occur frequently with large sample sizes (Bentler and Bonett, 1980; Marsh et al., 1988) and is typically regarded as unsuitable as a means of model selection (Jöreskog, 1969). As a result, additional fit indices are reported, including the ratio of chi-square and degrees of freedom (Wheaton et al., 1977), the comparative fit index or CFI (Bentler and Bonett, 1980), the incremental fit index or IFI (Bollen, 1989), the goodness of fit index or GFI (Jöreskog and Sörbom, 1984) and the root means square error of approximation or RMSEA (Steiger and Lind, 1980; Browne and Cudeck, 1993). Chi square to degrees of freedom ratios in the range of 2–1 or 3–1 are indicative of an acceptable fit between the hypothesized model and the data (Carmines and McIver, 1981). The CFI, IFI and GFI indices of fit above .90 are generally indicative of an adequate fit of the data to the theoretical model (Arbuckle, 2006; Bentler, 1992; Bentler and Bonett, 1980). In contrast, values of RMSEA less than .08 indicate a reasonable fit to the model and values less than .05 indicate a close fit to the model in relation to the degrees of freedom (Arbuckle, 2006; Browne and Cudeck, 1993). AMOS 7.0 permits a single analysis that estimates parameters and test hypotheses for two groups at once (Arbuckle, 2006). The procedure involves comparing the fit of an unrestricted or free model and a restricted model or constrained model. This procedure was used to determine whether patients with primary drug use and primary alcohol use have the same path diagram and the same factor pattern for the URICA subscales. Differences in the measurement model between primary alcohol and primary drug users were examined using procedures defined by Byrne (2001).

2.3.2. Concurrent and predictive validity of composite measures of motivation to change

The concurrent and predictive validity of the URICA composite measures of motivation to change were evaluated using the simple correlations procedure in SPSS 15.0. Pearson correlations between pretreatment ASI Composite Scores, recent drug use, treatment retention, therapeutic alliance and patient motivation assessed by the therapist during the first session were calculated.

2.3.3. Moderating effect of motivation to change on treatment outcome

Multiple regression procedures described by Aiken and West (1991) were used to test the moderating effect or interaction between composite measures of motivation (RTC and CA) at baseline and treatment assignment (MI or MET vs. standard care) for primary drug dependent and alcohol dependent groups. Unstandardized regression coefficients, 95% confidence intervals, and *p*-values for the interaction term for both outcomes (primary substance use and treatment retention) were used to determine if motivation composites at baseline moderate treatment outcomes for patients with drug and alcohol dependence. Using step down procedures to explore higher order terms, global test of increasingly complex regression equations are used to assess potential linearity, curvilinearity and ANOVA-like effects by determining the gain in predictive value using the change in *F* between models.

2.3.4. Mediating effect of motivation to change on treatment outcome

The mean difference between RTC and CA at baseline and four weeks following intervention was used to evaluate the potential mediating effects of motivation to change on treatment outcomes at 12-week follow-up (Kraemer et al., 2002). As indicated by Kraemer et al. (2002), Baron and Kenny's approach to testing mediation does not take into account a possible interaction between treatment and motivation which may be an important mechanism by which treatment effects outcome. For example, treatment may not only effect motivation following intervention but also impact the effect that motivation has on treatment outcomes following intervention. Therefore, procedures defined by Kraemer et al. (2002) were followed to evaluate the potential mediating effect of changes in motivation at four weeks on treatment outcome and the main effect of motivation at four weeks on treatment outcome. The regression coefficients, 95% confidence intervals, *p*-values for the interaction term, and main effect are reported to characterize the relationship between treatment outcome and motivation. Because the two studies involved treatments of different length and may have different effects on motivation, the hypothesized mediator, the data from the two studies are analyzed separately. Based on several criteria, Kraemer et al. (2002) offers a classification of the target measures as a mediator, an independent outcome of treatment, a characteristic which is moderated by treatment, a non-specific predictor of treatment outcome or a measure that is irrelevant to treatment outcome. The classification of the target measures of RTC and CA with regard to treatment retention and days of primary substance use among primary drug and alcohol users in the MI and MET study are given.

3. Results

3.1. Construct validity and internal consistency of the URICA

Table 1 presents the results of the CFA using models which fit the four factor structure in a model with correlations among all of the latent variables. The latent variable for precontemplation

Table 1
Confirmatory factor analysis of the URICA.

	χ^2	*df*	χ^2:*df*	CFI	IFI	GFI	RMSEA
Drug	834	397	2.1	.94	.94	.90	.05
Alcohol	893	397	2.3	.92	.92	.86	.06
Free Model	1728	794	2.2	.93	.93	.88	.04
Constrained	1777	822	2.2	.93	.93	.88	.04

	Step	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*
Free model	A	1728	794	50	28	<.01
Constrained		1777	822			
Precontemplation	B	1750	801	22	7	<.01
Precontemplation[a]		1734	799	6	5	NS
Contemplation	C	1749	807	21	13	NS
Action	D	1757	814	29	20	NS
Maintenance	E	1761	827	6	6	NS
Variances	F	1769	825	41	31	NS
Covariances	G	1780	831	52	37	NS

[a] Removing items 5 and 11 from Precontemplation Subscale.

Table 2
Correlation between composite measures and pretreatment patient characteristics.

	Primary Alcohol Problem		Primary Drug Problem	
	Readiness to Change	Committed Action	Readiness to Change	Committed Action
ASI Medical	.12*	−.06	.13**	−.14**
ASI Employment	.04	−.003	.003	−.10*
ASI Alcohol	.52**	−.29**	.13**	−.05
ASI Drugs	.28**	−.08	.37**	−.20**
ASI Legal	−.03	−.04	−.04	−.05
ASI Family	.32**	−.07	−.21**	−.17**
ASI Psychiatric	.36**	−.18**	.29**	−.15**
Days Used Primary Drug, (Past 28)	.25**	−.22**	−.12**	.0001
Therapeutic Alliance (Therapist)	.23**	−.05	.16**	−.04
Therapeutic Alliance (Client)	.43**	−.10	.46**	.01
Therapist Rating of Patient's Motivation to Change	.29**	−.07	.33**	−.05

* Correlation is significant at the .05 level (2-tailed).
** Correlation is significant at the .01 level (2-tailed).

was negatively correlated with the latent variables for contemplation, action and maintenance ($r = -.85$, $-.83$ and $-.67$, respectively). The latent variable for action was positively correlated with the latent variables for contemplation and maintenance ($r = .99$ and .85, respectively). Similarly, the latent variables for contemplation and maintenance were positively correlated ($r = .84$). Item R^2 ranged between .1 and .68 with a mean of .46, a standard deviation of .15 and a mode of .58. For illustrative purposes, separate models for patients with primary alcohol and primary drug problems were tested and the results are included. The fit indices for the two populations are relatively robust. Since chi-square and degrees of freedom are additive, the unrestricted model represents the two populations combined. The unrestricted or free model yielded a chi-square of 1728 ($df = 794$, $p < .01$), a chi-square to degrees of freedom ratio of 2.2, a GFI of .88, an IFI and CFI of .93 and an *RMSEA* of .04, suggesting a reasonably good fit to the model. Constraining the regression weights across patients with primary drug abuse and primary alcohol abuse (restricted model) yielded a chi-square and degrees of freedom difference which was significant ($\chi^2_{diff} = 49$, $df = 28$, $p < .01$). As a result, procedures defined by Byrne (2001) were undertaken to determine the source of the difference in factor structure between the two populations (Table 1a). The measurement model was evaluated by entering the subscales in order according to the theoretical model (precontemplation, contemplation, action and maintenance) and comparing the resulting model to the base model by examining the change in chi-square and degrees of freedom. Significant differences between the two populations were identified in the precontemplation scale. When items were consecutively removed, the differences were found to lie in items 5 and 11. The deviations do not appear to warrant concluding that the factor structure is significantly different between the two populations but merely that the influence of these two items within this subscale varies. After allowing for these differences, there were no differences found in the variance or covariance structures between the two groups and the fit indices for the individual populations themselves are robust. Therefore, we calculated subscale scores for both groups of patients on the basis of their original item composition.

The internal consistency of the scales for primary drug abusers and primary alcohol abusers were similar. Cronbach's alpha for the four subscale among primary drug abusers were .81 for precontemplation, .88 for contemplation, .86 for action and .85 for maintenance. Cronbach's alpha for the four subscales among primary alcohol abusers were .79 for precontemplation, .90 for contemplation, .87 for action and .87 for maintenance. Among drug abusers, contemplation was positively correlated with action ($r = .71$) and maintenance ($r = .74$), action and maintenance were positively correlated ($r = .56$), and precontemplation was negatively correlated with contemplation ($r = -.61$), action ($r = -.49$) and maintenance ($r = -.47$). Similar patterns were observed among alcohol abusers, contemplation was positively correlated with action ($r = .76$) and maintenance ($r = .71$), action and maintenance were positively correlated ($r = .63$), and precontemplation was negatively correlated with contemplation ($r = -.71$), action ($r = -.60$) and maintenance ($r = -.50$). RTC at baseline ranged from 6 to 114 (mean = 85.7, SD = 16.2) and CA at baseline ranged from 4 to 46 (mean = 31.1, SD = 3.2). Significant differences in baseline RTC ($t = -2.4$, $df = 810$, $p = .02$) were found between patients with primary alcohol (mean = 68, SD = 17.1) and primary drug use problems (mean = 70.9, SD = 15.5). No differences were found between these two groups in baseline CA.

3.2. Concurrent validity of composite measures of motivation to change

The correlation between composite measures of motivation to change and the ASI Composite Scores from patients with primary drug use and primary alcohol use are shown in Table 2. Among both patient populations, RTC was associated with increased drug ($r_{alcohol} = .28$; $r_{drug} = .37$) and alcohol problems ($r_{alcohol} = .52$; $r_{drug} = .13$). Interestingly, among patients with primary drug use problems, increased RTC was associated with decreased family problems ($r = -.21$) and drug use ($r = .-12$). Increased CA was associated with decreased drug problems among primary drug users ($r = -.20$) and decreased alcohol problems among primary alcohol users ($r = -.29$). In addition, CA was associated with decreased psychiatric ($r_{alcohol} = -.18$; $r_{drug} = -.15$). In the case of patients with primary drug use problems CA was also associated with decreased family ($r = -.17$) and medical problems ($r = -.14$).

Table 2 also presents the correlation between the composite measures of motivation to change, recent drug use, and therapeu-

Table 3
Correlation between composite measures at baseline and treatment outcome.

	Primary Alcohol Problem		Primary Drug Problem	
	Readiness to Change	Committed Action	Readiness to Change	Committed Action
% Days Substance Use	.02	−.09	−.15**	.05
% Days in Treatment	−.18**	−.01	−.09	.03

** Correlation is significant at the .01 level (2-tailed).

Table 4
Test of moderation.

	Readiness to Change		Committed Action	
	% Days in Tx	% Days Used	% Days in Tx	% Days Used
Primary Alcohol Problem				
Interaction*	.06 (−.41, .53) .80	−.01 (−.25, .22) .91	1.4 (−1.2, 4.0) .30	−.9 (−2.2, .43) .19
Linear**	.82 (3, 288) .49	.87 (3,244) .46	.94 (2,289) .39	.91 (2,245) .4
Curvilinear**	1.2 (2,288) .31	1.3 (2,244) .28	.95 (1,289) .60	.02 (1,245) .9
Main Effect**	3.2 (4,288) .02§	.69 (4,244) .6	.63 (3,289) .60	1.34 (3,245) .25
Primary Drug Problem				
Interaction*	−.27 (−.81, .27) .32	.08 (−.27, .42) .66	1.3 (−1.3, 3.9) .32	−.67 (−2.3, 1.0) .43
Linear	.60 (3,383) .61	1.9 (3,304) 1.4	.66 (3,384) .58	1.1 (3,305) .35
Curvilinear	.40 (2,383) .67	2.7 (2,304) .07	4.9 (2,384)	1.34 (2,305) .26
Main Effect	1.3 (4,383) .27	3.0 (4,304) .02§	.58 (4,384) .68	1.0 (4,305) .40

* Unstandardized Beta Coefficient for interaction term (95% Confidence Interval) and *p* value.
** *F* Change (degrees of freedom) and *p* value.
§ $p < .05$.

tic alliance among patients with primary drug use and primary alcohol use. For both groups, RTC was significantly and positively related with these pretreatment characteristics ($r_{alcohol}$ = .23–.43; r_{drug} = .). Most notably, RTC was highly correlated with the patient ratings of therapeutic alliance (r = .43). Increased RTC was also modestly associated with increased drug use ($r_{alcohol}$ = .43; r_{drug} = .46), observer ratings of therapeutic alliance ($r_{alcohol}$ = .23; r_{drug} = .16), and patient motivation ($r_{alcohol}$ = .29; r_{drug} = .33). In contrast, CA was not associated with these characteristics in either group of patients. However, increased CA was associated with decreased alcohol use among primary alcohol users (r = −.22). Likewise, increased RTC was associated with decreased drug use among primary drug users (r = −.12).

3.3. Predictive validity of composite measures of motivation to change

Table 3 indicates that RTC was significantly associated with fewer days of drug use among patients with primary drug use (r = −.15) and lower treatment retention among patients with primary alcohol use (r = −.18). CA was not significantly associated with treatment outcomes in either patients with primary drug use or primary alcohol use.

3.4. Moderating effect of motivation to change on treatment outcome

There was a significant main effect of RTC on treatment retention among primary alcohol users and substance use among primary drug users (Table 4). Readiness to change was associated with increased treatment retention among primary alcohol users and decreased substance use among primary drug users. However, there was not a significant interaction or evidence of a non-linear relationship between either baseline RTC or CA and treatment group.

3.5. Mediating effect of motivation to change on treatment outcome

The results of the analysis evaluating the potential mediating effect of changes in RTC and CA from baseline to four weeks

Table 5
Test of mediation.

	Readiness to Change		Committed Action	
	% Days in Tx	% Days Used	% Days in Tx	% Days Used
Motivation Enhancement Therapy				
Primary Alcohol Problem				
Interaction§	−.06 (−.62, .50)	−.40 (−1.5, .67)	3.4 (−.34, 7.1)	−.01 (−2.0, 2.0)
Main Effect§	.25 (−.17, .66)	.30 (−.50, 1.1)	−1.9 (−4.5, .58)	−1.3 (−2.6, −.05)*
Classification§§	Irrelevant	Irrelevant	Irrelevant	Nonspecific Predictor of Treatment Outcome
Primary Drug Problem				
Interaction§	.12 (−.38, .62)	.20 (−.63, 1.03)	−1.0 (−3.5, 1.5)	2.2 (.81, 3.6)**
Main Effect§	−.05 (−.40, .30)	.24 (−.35, .84)	−.23 (−1.9, 1.4)	−1.8 (−2.7, −.90)**
Classification§§	Irrelevant	Irrelevant	Irrelevant	Treatment Moderates Committed Action
Motivation Interviewing				
Primary Alcohol Problem				
Interaction§	−.01 (−.43, .41)	.31 (−.52, 1.1)	−.62 (−3.9, 2.7)	.65 (−.97, 2.3)
Main Effect§	−.12 (−.42, .18)	.22 (−.35, .78)	.81 (−1.5, 3.1)	−.35 (−1.5, .80)
Classification§§	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Primary Drug Problem				
Interaction§	−.50 (−1.1, .13)	.91 (−.17, 2.0)	−.92 (−3.7, 1.9)	−.35 (−2.0, 1.3)
Main Effect§	.44 (.06, .82)*	−.05 (−.68, .59)	.70 (−1.0, 2.4)	−.14 (−1.2, .90)
Classification§§	Nonspecific Predictor of Treatment Outcome	Irrelevant	Irrelevant	Irrelevant

§ Unstandardized Beta Coefficient for interaction or main effect (95% Confidence Interval) and *p* value.
§§ Classification of Posttreatment Target Measure according to Kraemer et al. (2002).
* $p < .05$
** $p < .01$.

following intervention on treatment outcome are presented in Table 5. Neither the change in RTC or CA was significantly correlated with treatment assignment ($r = -.02$, $p = .59$ and .05, $p = .24$, respectively). Thus, by definition, neither RTC nor CA were mediators of treatment outcomes (Kraemer et al., 2002). Subsequent analyses recommended by Kraemer et al. (2002) revealed some other types of relationship between treatment, the composite measures and outcomes. In the study involving MET, there was a significant main effect between CA and days of primary substance use ($B = -1.3$, 95% CI = −2.6, −.05; $r_{partial} = -.22$) among patients with alcohol use. Thus, CA would be classified as a non-specific predictor of treatment outcome for percent days use among primary alcohol users in the MET study (Kraemer et al., 2002). There was also a significant interaction ($B = 2.2$, 95% CI = .81, 3.6; $r_{partial} = .25$) and main effect ($B = -1.8$, 95% CI = −2.,−.9; $r_{partial} = -.30$) between treatment and CA among patients with primary drug use and percent days of primary substance use in the study involving MET. Finally, in the study involving MI, there was a significant main effect ($B = .44$, 95% CI = .06, .82; $r_{partial} = .20$) between RTC among patients with primary alcohol use and treatment retention. Thus, RTC would be classified as a non-specific predictor of treatment outcome for treatment retention among primary alcohol users in the MI study (Kraemer et al., 2002). In the majority of cases, the composite measures were irrelevant to treatment outcome.

4. Discussion

This is the first study to compare the factor structure of the URICA in patients with primary drug versus primary alcohol problems using confirmatory factor analysis. The assessment of motivation to change among drug abusers has been considered problematic or more challenging than assessing motivation to change among drinkers (DiClemente et al., 2004; Prochaska et al., 1992b). In comparison to prior studies, we included a large and diverse sample of individuals with primary drug and primary alcohol problems seeking outpatient treatment in different community treatment programs across the United States. While relatively modest differences were found in the measurement model of the URICA across the two patient populations, the four factor structure was equally robust for both groups of patients. Based on the findings from these two multi-site clinical trials, there is substantial support for the internal consistency and factor structure of the URICA subscales among patients with primary drug and alcohol problems.

There was also some evidence supporting the concurrent validity of RTC, a composite measure of motivation to change derived from the URICA. However, the observed associations were contrary to our expectations. The current hypothesis was generated on the basis of observed differences in associations between RTC and CA with baseline characteristics (Field et al., 2007). In that study, RTC was significantly associated with less anger and a greater number of stressful life events during the last year. In contrast, CA was associated with fewer alcohol problems and decreased anxiety (Field et al., 2007). Field et al. (2007) hypothesized that RTC may reflect the patient's desire to change or initiate help seeking behavior but CA may be a better indicator of a patient's long term commitment to behavior change. Thus, we hypothesized that RTC would predict recent psychosocial problems and substance use while CA would predict substance use outcomes (Field et al., 2007). In contrast to the prior study, the present study found a positive association as opposed to a negative association between RTC and problems associated with drug or alcohol dependence. With the exception of family problems among patients with drug dependence, increased RTC was associated with increased problems in a number of areas assessed by the ASI. RTC was also associated with increased therapeutic alliance from both the patient's and therapists' perspective. This would suggest that increased motivation to change is associated with more drug and alcohol problems and a stronger alliance between the client and therapist. A stronger therapeutic alliance may be influenced by the mutual expectations of the therapist and client that more severe problems should be associated with increased motivation to change, if only temporarily. Alternatively, the difference in study findings may be a function of convenience sampling procedures used in the prior study and the greater representativeness of the current study. Given that these are the strongest observed associations, this possibility may warrant further study.

The predictive validity of CA and RTC on treatment outcome was not confirmed. In our prior study we speculated that, because of its association with significant problems and distress, CA would be a stronger indicator of treatment outcome (Field et al., 2007). Contrary to this hypothesis, CA was not associated with primary drug use or treatment retention at follow-up for either group of patients. Our findings also suggest that RTC explains only a small percentage of the variance in patient outcomes. In the case of treatment retention among patients with drug dependence, the association was in the opposite direction to that previously observed by Field et al. (2007), i.e., increased RTC at baseline associated with fewer days in treatment. A possible explanation is that patient's perception of motivation to change subsequent behavior could be overly optimistic and these inaccuracies may lead to poor predictive validity.

We found no evidence of a moderating or mediating effect of either composite measure on treatment outcomes among patients with primary drug or alcohol use problems. Baseline measures of motivation to change did not appear to moderate treatment outcomes even after controlling for treatment assignment or a possible interaction between treatment assignment and motivation to change. Prior research indicated that motivational based interventions were particularly useful with clients who were less motivated or ready for change (Project MATCH Research Group, 1997). However, the current evidence suggested that the effectiveness of treatment was not dependent on the patient's initial motivation to change. Thus, motivation to change as measured by the composite measures of motivation derived from the URICA did not facilitate interpretation of the findings from the parent studies (Ball et al., 2007; Carroll et al., 2006). While these measures of motivation have been found to have predictive validity in prior studies, the association between motivation and subsequent behavior has been relatively weak and inconsistent. For example, in Project MATCH, RTC accounted for 3% of the variance in drinking outcomes during treatment and at three-year follow-up (Project MATCH Research Group, 1998a,b). Similarly, CA accounted for only 5% of the variance in percent days abstinent (Pantalon et al., 2002). Thus, the current findings reflect generally weak associations between motivation to change and actual patient behavior following treatment.

To the extent that motivation to change assessed at intake reflects behavior that occurred prior to completing the assessment, any association with outcome may reflect changes in the client that occurred prior to treatment (Project MATCH Research Group, 1998a). There is some evidence from the current study that suggest that this may be the case. Increased RTC at intake among drug users was associated with fewer days use during the past 28 days and fewer family problems while CA at intake was associated with fewer days use and less severe alcohol problems among patients with primary alcohol dependence. CA was also associated with less severe problems associated with addictive disorders at intake among patients with primary drug problems. In contrast, RTC at intake was significantly associated with more problems. Alternatively, motivation to change at intake may be less important than what actually happens during treatment (Simpson and Joe, 1993). However, the current findings also suggested that motivation fol-

lowing intervention did not appear to mediate treatment outcomes. This was a particularly noteworthy finding given that one of the explicit functions of motivational interviewing and its variants is to increase motivation to change (Miller and Rollnick, 2002). The cumulative evidence supporting the effectiveness of Motivational Interviewing and its derivatives is overwhelming in comparison to non-active treatments (Miller et al., 2003). Moreover, Motivational Enhancement Therapy is equally efficacious as Twelve Step Facilitation and Cognitive Behavior Therapy (Project MATCH Research Group, 1997). It may be that motivation to change, as measured by the composite measures of readiness to change derived from the URICA, was not relevant to treatment outcome. Thus, while the URICA appeared to conform to the *a priori* theoretical model for patients with both primary drug and alcohol problems, it had limited utility for explaining differences in treatment outcome or understanding underlying mechanisms of change.

In the same way that the lack of association between changes in cognition and treatment should not lead to doubts regarding the overall effectiveness of CBT (Morgenstern and Longabaough, 2000), the current results should not lead to doubts regarding the utility of motivational interviewing. Rather, the theoretical assumptions underlying the effectiveness of motivational interviewing and other evidenced-based treatments for substance abuse should be further examined. Because of the limitations of measures of motivation including the URICA and the transtheoretical model in general, some have argued for abandoning the transtheoretical model and related concepts (Sutton, 2001; West, 2005). The current study does provide some support for their observations and criticisms. Most notably, as observed by Sutton (2001) the elevated correlations among the subscales and the latent variables representing the stages of change are highly correlated and suggest that they may not be discrete or qualitatively distinct. Moreover, precontemplation is negatively correlated with contemplation, action and maintenance. This is more consistent with the calculation of RTC, which subtracts precontemplation from the subtotal of contemplation, action, maintenance to measure readiness, than the calculation of CA, which subtracts contemplation from action. Since contemplation and action are positively correlated there may be limited utility in the use of CA as a measure of readiness. However, it is worth noting that the calculation of RTC was derived statistically and the development of CA was theoretically driven. However, the current study does not assess the Transtheoretical Model as a whole, or the Stages of Change, in particular. The current study is focused on the potential usefulness of the composite measures of motivation to change derived from the URICA. It is possible that motivation to change effects treatment outcome through another mechanism such as the processes of change or therapeutic alliance. However, no evidence regarding such causal chains was identified in Project MATCH (DiClemente et al., 2001). Perhaps other process oriented measures can provide better insight into the client and therapists contribution to behavior change which may, in turn, lead to a better understanding of the mechanisms of change underlying evidenced-based treatments. For example, examinations of the impact of therapist communication on client speech might prove more fruitful in understanding patient outcomes. Miller and colleagues (Miller et al., 2008) have developed coding procedures to assess client commitment. Moyers and Martin (2006) have explored therapeutic interactions and found significant associations between therapist behaviors and client commitment to change. Moyers et al. (2007) have also demonstrated that client speech may be powerful predictors of treatment outcomes. In addition, proximal measures of the interactions during treatment using motivational interviewing may result in a better understanding of the active ingredient of this and other approaches.

With its emphasis on generalizability and dissemination of evidenced based approaches to community treatment providers, NIDA's CTN offers an invaluable infrastructure for evaluating hypotheses regarding therapeutic mechanisms of action and, ultimately, generating innovative findings that will lead to progress in the investigations of behavioral interventions for substance abuse problems. To better understand the mechanisms of change underlying motivational interviewing, there is a need to develop new strategies for measuring potential moderators and mediators of behavior change in evidenced based treatments.

Role of funding source

Funding for this study was provided by NIDA Clinical Trials Network; NIDA had no further role in study design; in the collection, analysis and interpretation of data; or in the writing of the report. The NIDA Clinical Trials Network publications committee approved submission of this paper for publication. Dr. Adinoff's time is also supported by Veteran Affairs (VA). The VA had no further role in study design; in the collection, analysis and interpretation of data; or in the writing of the report.

Contributors

Authors Ball and Carroll designed the study and wrote the protocol and were chiefly responsible for the implementation of this study. Authors Adinoff and Field managed the literature searches and summaries of previous related work. Authors Field and Harris undertook the statistical analysis, and author Field wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare they have no conflicts of interest.

Acknowledgements

The authors would like to thank Tami Frankforter and Carla Pezzia who facilitated data analysis and preparation of this manuscript, respectively.

References

Abellanas, L., McLellan, A.T., 1993. "Stage of change" by drug problem in concurrent opioid, cocaine, and cigarette users. J. Psychoactive Drugs 25 (4), 307–313.
Aiken, L.S., West, S.G., 1991. Multiple Regression: Testing and Interpreting Interactions. Sage Publications, Thousand Oaks.
Alterman, A.I., Bovasso, G.B., Cacciola, J.S., McDermott, P.A., 2001. A comparison of the predictive validity of four sets of baseline ASI summary indices. Psychol. Addict. Behav. 15, 159–162.
Alterman, A.I., Brown, L.S., Zaballero, A., McKay, J.R., 1994. Interviewer severity ratings and composite scores of the ASI: A further look. Drug Alcohol Depend. 34, 201–209.
Arbuckle, J., 2006. AMOS User's Guide Version 3.6. SmallWalters, Chicago.
Ball, S.A., van Horn, D., Crits-Christoph, P., Woody, G.E., Martino, S., Nich, C., Frankforter, T.L., Obert, J.L., Carroll, K.M., 2007. Site matters: multisite randomized trial of motivational enhancement therapy in community drug abuse clinics. J. Consul. Clin. Psychol. 75 (4), 556–567.
Bartko, J.J., Carpenter, W.T., McGlashan, T.H., 1988. Statistical issues in long-term followup studies. Schizophrenia Bull. 14, 575–587.
Belding, M.A., Iguchi, M.Y., Lamb, R., 1996. Stages of change in methadone maintenance: assessing the convergent validity of two measures. Psychol. Addict. Behav. 10, 157–166.
Belding, M.A., Iguchi, M.Y., Lamb, R., 1997. Stages and processes of change as predictors of drug use among methadone maintenance patients. Exp. Clin. Psychopharmacol. 5 (1), 65–73.
Belding, M.A., Iguchi, M.Y., Lamb, R.J., Lakin, M., Terry, R., 1995. Stages and processes of change among polydrug users in methadone maintenance treatment. Drug Alcohol Depend. 39 (1), 45–53.
Bentler, P.M., 1992. EQS Structural Equation Program Manual. BMDP Statistical Software, Los Angeles.
Bentler, P.M., Bonett, D.G., 1980. Significance tests and goodness of fit in the analysis of covariance structures. Psychol. Bull. 88, 588–606.
Blanchard, K.A., Morgenstern, J., Morgan, T.J., Labouvie, E., Bux, D.A., 2003. Motivational subtypes and continuous measures of readiness for change: concurrent and predictive validity. Psychol. Addict. Behav. 17 (1), 56–65.

Bollen, K.A., 1989. A new incremental fit index for general structural equation models. Sociol. Methods Res. 17, 303–316.
Bordin, E.S., 1979. The generalizability of the psychoanalytic concept of the working alliance. Psychother.: Theory Res. Pract. 16, 195–199.
Brower, K.J., Blow, F.C., Hill, E.M., Mudd, S.A., 1994. Treatment outcome of alcoholics with and without cocaine disorders. Alcohol.: Clin. Exp. Res. 18, 734–739.
Browne, M.W., Cudeck, R., 1993. Alternative ways of assessing model fit. In: Bollen, K.A., Long, J.S. (Eds.), Testing Structural Equation Models. Sage, Newbury Park, pp. 136–162.
Byrne, B.M., 2001. Structural equation modeling with Amos: Basic concepts, applications, and programming. Erlbaum, Mahwah, New Jersey.
Cacciola, J.S., Alterman, A.I., O'Brien, C.P., McLellan, A.T., 1997. The Addiction Severity Index in clinical efficacy trials of medications for cocaine dependence. NIDA Research Monograph Series No. 175. NIDA, Rockville, MD. pp. 182–191.
Carbonari, J.P., DiClemente, C.C., 2000. Using transtheoretical model profiles to differentiate levels of alcohol abstinence success. J. Consult. Clin. Psychol. 68 (5), 810–817.
Carey, K.B., Maisto, S.A., Carey, M.P., Purnine, D.M., 2001. Measuring readiness to change substance misuse among psychiatric outpatients: I. Realibility and validity of self-report measures. J. Stud. Alcohol. 62, 79–88.
Carey, K.B., Purnine, D.M., Maisto, S.A., Carey, M.P., 1999. Assessing readiness to change substance abuse: a critical review of instruments. Clin. Psychol.: Sci. Pract. 6 (3), 245–266.
Carmines, E.G., McIver, J.P., 1981. Analyzing models with unobserved variables. In: Bohrnstedt, G.W., Borgatta, E.F. (Eds.), Social Measurement: Current Issues. Sage Publications, Beverly Hills.
Carney, M.M., Kivlahan, D.R., 1995. Motivational subtypes among veterans seeking substance abuse treatment: profiles based on stages of change. Psychol. Addict. Behav. 9, 1135–1142.
Carroll, K.M., Ball, S.A., Nich, C., Martino, S., Frankforter, T.L., Farentinos, C., Kunkel, L.E., Mikulich-Gilbertson, S.K., Morgenstern, J., Obert, J.L., Polcin, D., Snead, N., Woody, G.E., for the NIDA CTN, 2006. Motivational interviewing to improve treatment engagement and outcome in individuals seeking treatment for substance abuse: a multisite effectiveness study. Drug Alcohol Depend. 81, 301–312.
Cohen, J., 1988. Statistical Power Analysis for the Behavioral Sciences, second ed. Lawrence Earlbaum Associates, Hillsdale, NJ.
Connors, G.J., Carroll, K.M., DiClemente, C.C., Longabaugh, R., Donovan, D.M., 1997. The therapeutic alliance and its relationship to alcoholism treatment participation and outcome. J. Consult. Clin. Psychol. 65, 588–598.
Connors, G.J., DiClemente, C.C., Dermen, K.H., Kadden, R., Carroll, K.M., Frone, M.R., 2000. Predicting the therapeutic alliance in alcoholism treatment. J. Stud. Alcohol. 61 (1), 139–149.
DiClemente, C.C., 1999. Motivation for change: Implications for substance abuse treatment. Psychol. Sci. 10, 209–213.
DiClemente, C.C., Bellino, L.E., Neavins, T.M., 1999. Motivation for change and alcoholism treatment. Alcohol Res. Health 23 (2), 86–92.
DiClemente, C.C., Carbonari, J., Zweben, A., Morrel, T., Lee, R.E., 2001. Motivation hypothesis causal chain analysis. In: Longabaugh, R., Wirtz, P.W. (Eds.), Project MATCH: a Priori Matching Hypotheses, Results, and Mediating Mechanisms. National Institute on Alcohol Abuse and Alcoholism Project MATCH Monograph Series, vol. 8. National Institute on Alcohol Abuse and Alcoholism, Rockville, MD. pp. 206–222.
DiClemente, C.C., Hughes, S.O., 1990. Stages of change profiles in outpatient alcoholism treatment. J. Subst. Abuse 2 (2), 217–235.
DiClemente, C.C., Prochaska, J.O., Fairhurst, S., Velicer, W.F., Velasquez, M., Rossi, J., 1991. The process of smoking cessation: an analysis of preconemplation, contemplation and preparation. J. Consult. Clin. Psychol. 59, 295–304.
DiClemente, C.C., Schlundt, D., Gemmell, L., 2004. Readiness and stages of change in addiction treatment. Am. J. Addict. 13, 103–119.
Edens, J.F., Willoughby, F.W., 1999. Motivational profiles of polysubstance-dependent patients: do they differ from alcohol-dependent patients? Addict. Behav. 24 (2), 195–206.
Edens, J.F., Willoughby, F.W., 2000. Motivational patterns of alcohol dependent patients: a replication. Psychol. Addict. Behav. 14 (4), 397–400.
el-Bassel, N., Schilling, R.F., Ivanoff, A., Chen, D.R., Bidassie, B., Hanson, M., 1998. Stages of change profiles among incarcerated drug-using women. Addict. Behav. 23 (3), 389–394.
Fals-Stewart, W., O'farrell, T.J., Freitas, T.T., Mcfarlin, S.K., Rutigliano, P., 2000. The timeline followback reports of psychoactive substance use by drug-abusing patients: psychometric properties. J. Consult. Clin. Psychol. 68, 134–144.
Field, C.A., Duncan, J., Washington, K., Adinoff, B., 2007. Association of baseline characteristics and motivation to change among patients seeking treatment for substance dependence. Drug Alcohol Depend. 91, 77–84.
Horvath, A.O., Luborsky, L., 1993. The role of the therapeutic alliance in psychotherapy. J. Consult. Clin. Psychol. 61, 561–573.
Jöreskog, K.G., 1969. A general approach to confirmatory maximum likelihood factor analysis. Psychometrika 34, 183–202.
Jöreskog, K.G., Sörbom, D., 1984. LISREL—VI User's Guide, third ed. Scientific Software, Mooresville, IN.
Kraemer, H.C., Wilson, G.T., Fairburn, C.G., Agras, W.S., 2002. Mediators and moderators of treatment effects in randomized clinical trials. Arch. Gen. Psychiatry 59, 877–883.
Luborsky, L., Barber, J.P., Siqueland, L., Johnson, S., 1996. The revised Helping Alliance questionnaire (Haq-II). J. Psychother. Pract. Res. 5, 260–271.
Marsh, H.W., Balla, J.R., McDonald, R.P., 1988. Goodness-of-fit indexes in confirmatory factor analysis: the effect of sample size. Psychol. Bull. 103, 392–410.
Martino, S., Ball, S.A., Nich, C., Frankforter, T.L., Carroll, K.M., 2008. Community program therapist adherence and competence in motivational enhancement therapy. Drug Alcohol Depend. 96, 37–48.
McConnaughy, E.A., DiClemente, C.C., Prochaska, J.O., Velicer, W.F., 1989. Stages of change in psychotherapy: a follow-up report. Psychotherapy 26 (4), 494–503.
McConnaughy, E.A., Prochaska, J.O., Velicer, W.F., 1983. Stages of change in psychotherapy: Measurement and sample profiles. Psychother.: Theory Res. Pract. 20 (3), 368–375.
McLellan, A.T., Kushner, H., Metzger, D., Peters, R., Smith, I., Grissom, G., Pettinati, H., Argeriou, M., 1992. The fifth edition of the addiction severity index. J. Subst. Abuse Treat. 9 (3), 199–213.
Miller, W.R., 1985. Motivation for treatment: a review with special emphasis on alcoholism. Psychol. Bull. 98, 84–107.
Miller, W.R., Delboca, F.K., 1994. Measurement of drinking behavior using the Form 90 family of instruments. J. Stud. Alcohol. (Suppl.), 112–117.
Miller, WR, Moyers, T. B., Ernst, D., Amrhein, P., 2008. The motivational interviewing skills code Version 2.1 Available at http://casaa.unm.edu/download/misc.pdf. <Accessed on: December 10, 2008>.
Miller, W.R., Rollnick, S., 2002. Motivational Interviewing: Preparing People to Change, second ed. Guilford Press, New York.
Miller, W.R., Wilbourne, P.L., Hettema, J.E., 2003. What works? A summary of alcohol treatment outcome research. In: Hester, R.K., Miller, W.R. (Eds.), Handbook of Alcoholism Treatment Approaches, third ed. Allyn and Bacon, Boston.
Miller, W.R., Zweben, A., DiClemente, C.C., Rychtarik, R.G., 1992. Motivational Enhancement Therapy Manual: A Clinical Research Guide for Therapists Treating Individuals with Alcohol Abuse and Dependence. National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.
Morgenstern, J., Longabaough, R., 2000. Cognitive-behavioral treatment for alcohol dependence: a review of evidence for its hypothesized mechanisms of action. Addiction 95 (10), 1475–1490.
Moyers, T.B., Martin, T., 2006. Therapist influence on client language during motivational interviewing sessions. J. Subst. Abuse Treat. 30, 245–251.
Moyers, T.B., Martin, T., Christopher, P.J., Houck, J.M., Tonigan, J.S., Amrhein, P.C., 2007. Client language as a mediator motivational interviewing efficacy: Where is the evidence? Alcohol Clin. Exp. Res. 31 (3s), 40s–47s.
Pantalon, M.V., Nich, C., Frankforter, T., Carroll, K.M., 2002. The URICA as a measure of motivation to change among treatment-seeking individuals with concurrent alcohol and cocaine problems. Psychol. Addict. Behav. 16 (4), 299–307.
Pantalon, M.V., Swanson, A.J., 2003. Use of the University of Rhode Island Change Assessment to measure motivational readiness to change in psychiatric and dually diagnosed individuals. Psychol. Addict. Behav. 17, 91–97.
Prochaska, J.O., DiClemente, C.C., 1992. Stages of change in the modification of problem behaviors. Prog. Behav. Modif. 28, 183–218.
Prochaska, J.O., DiClemente, C.C., 1983. Stages and processes of self-change of smoking: toward an integrative model of change. J. Consult. Clin. Psychol. 51 (3), 390–395.
Prochaska, J.O., DiClemente, C.C., Norcross, J.C., 1992a. In search of how people change. Applications to addictive behaviors. Am. Psychol. 47 (9), 1102–1114.
Prochaska, J.O., DiClemente, C.C., Velicer, W.F., Rossi, J.S., 1992b. Criticisms and concerns of the transtheoretical model in light of recent research. Br. J. Addict. 87, 825–828.
Project MATCH Research Group, 1997. Matching alcoholism treatments to client heterogeneity: Project MATCH posttreatment drinking outcomes. J. Stud. Alcohol. 58 (1), 7–29.
Project MATCH Research Group, 1998a. Matching alcoholism treatments to client heterogeneity: Treatment main effects and matching effects on drinking during treatment. J. Stud. Alcohol. 59, 631–639.
Project MATCH Research Group, 1998b. Matching alcoholism treatments to client heterogeneity: Project MATCH three-year drinking outcomes. Alcohol. Clin. Exp. Res. 22, 1300–1311.
Rosnow, R.L., Rosenthal, R., 1996. Computing contrasts, effect sizes, and counternulls on other people's published data: general procedures for research consumers. Pyschol. Methods 1, 331–340.
Siegal, H.A., Li, L., Rapp, R.C., Saha, P., 2001. Measuring readiness for change among crack cocaine users: a descriptive analysis. Subst. Use Misuse 36, 687–700.
Simpson, D.D., Joe, G.W., 1993. Motivation as a predictor of early dropout from drug abuse treatment. Psychotherapy 30, 357–368.
Sobell, L.C., Sobell, M.B., 1992. Timeline followback: a technique for assessing self-reported alcohol consumption. In: Litten, R.Z., Allen, J. (Eds.), Measuring Alcohol Consumption: Psychosocial and Biological Methods. Humana Press, New Jersey.
Steiger, J.H., Lind, J.C., 1980. Statistically-based tests for the number of common factors. Paper presented at the Annual Spring Meeting of the Psychometric Society, Iowa City, May 30, 1980.
Sutton, S., 2001. Back to the drawing board? A review of applications of the transtheoretical model to substance use. Addiction 96, 175–186.
Weisner, C., 1992. A comparison of alcohol and drug treatment clients: Are they from the same population? Am. J. Drug Alcohol Abuse 18, 429–444.
West, R., 2005. Time for a change: putting the transtheoretical (stages of change) model to rest. Addiction 100, 1036–1039.
Wheaton, B., Muthén, B., Alwin, D.F., Summers, G.F., 1977. Assessing reliability and stability in panel models. In: Heise, D.R. (Ed.), Sociological Methodology. Jossey-Bass, San Francisco, pp. 84–136.
Willoughby, F.W., Edens, J.F., 1996. Construct validity and predictive utility of the stages of change scale for alcoholics. J. Subst. Abuse 8 (3), 275–291.