Is the Quality of Brief Motivational Interventions for Drug Use in Primary Care Associated with Subsequent Drug Use?

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Abstract

Background—Although a number of brief intervention approaches for drug use are based on motivational interviewing (MI), relatively little is known about whether the quality of motivational interviewing skills is associated with intervention outcomes.

Method—The current study examined whether indices of motivational interviewing skill were associated with subsequent drug use outcomes following two different MI-based brief interventions delivered in primary care; a 15 minute Brief Negotiated Interview (BNI) and a 45 minute adaptation of motivational interviewing (MOTIV). Audio recordings from 351 participants in a randomized controlled trial for drug use in primary care were coded using the Motivational Interviewing Treatment Integrity Scale, (MITI Version 3.1.1). Separate negative binomial regression analyses, stratified by intervention condition, were used to examine the associations between six MITI skill variables and the number of days that the participant used his/her main drug 6 weeks after study entry.

Results—Only one of the MITI variables (% reflections to questions) was significantly associated with the frequency of drug use in the MOTIV condition and this was opposite to the hypothesized direction (global p = 0.01, adjusted IRR 1.50, 95%CI: 1.03-2.20 for middle vs. lowest tertile [higher skill, more drug use]). None were significantly associated with drug use in the BNI condition. Secondary analyses similarly failed to find consistent predictors of better drug outcomes.

Conclusion—Overall, this study provides little evidence to suggest that the level of MI intervention skills are linked with better drug use outcomes among people who use drugs and receive brief interventions in primary care. Findings should be considered in light of the fact that data from the study are from negative trial of SBI and was limited to primary care patients. Future work should consider alternative ways of examining these process variables (i.e., comparing thresholds of proficient versus non-proficient skills) or considering alternative methods of coding intervention skills.

Keywords

motivational interviewing; mechanisms; drugs; substance use; primary care; brief intervention

1. Introduction

Despite the costs and consequences associated with substance use, the majority of individuals who use substances do not seek treatment (Compton, Thomas, Stinson, & Grant, 2007). This has led to efforts to identify approaches that may be delivered in non-specialty "opportunistic" settings. Drawing from the success of SBI in addressing hazardous alcohol use in primary care settings (e.g., Solberg, Maciosek, & Edwards, 2008), a number of agencies have now recommended the use of screening and brief intervention (SBI) in primary care as a strategy for reducing the use of drugs (e.g., SAMHSA, 2013).

A variety of SBI approaches have been developed for drug use in health care settings (e.g.,Bernstein et al., 2005; Bogenschutz et al., 2014; D'Amico, Miles, Stern, & Meredith, 2008; Humeniuk et al., 2012; Roy-Byrne et al., 2014; Saitz et al., 2014). Many of them have been based on motivational interviewing (MI), a client-centered method for developing and exploring ambivalence about change and enhancing self-efficacy to enact change (Miller & Rollnick, 2002). These adaptations of motivational interviewing (Burke, Arkowitz, & Menchola, 2003; Dunn, Deroo, & Rivara, 2001) have typically been implemented as brief, single session, directive interventions delivered by a variety of health care educators/ providers in emergency departments (Bernstein, Edwards, Dorfman, Heeren, Bliss, & Bernstein, 2009) walk-in outpatient clinics (Bernstein et al. 2005) and primary care settings (D'Amico et al., 2008; Humeniuk et al., 2012; Roy-Byrne et al., 2014; Saitz et al., 2014). However, there have been relatively few randomized controlled trials for these interventions for drug use and evidence for the efficacy of these approaches in primary care has been limited (Humeniuk et al., 2012; Roy-Byrne et al., 2014; Saitz et al., 2014).

Even less is known about how intervention processes utilized in SBIs for drug use may be associated with outcomes. In particular, developing an understanding of how intervention skills in SBIs are associated with outcomes and for which patients is critical for improving the efficacy of these interventions and identifying potentially important factors for tailoring intervention strategies (Apodaca & Longabaugh, 2009; Kazdin & Nock, 2003). Small effect sizes at best suggest that improved understanding of the mechanisms of action is essential to enhance impact. Moreover, given the costs and effort required to deliver high quality MI-based interventions over time, better understanding of the essential and most prognostic intervention elements is important.

Based on the promising findings on the association between MI skills and proximal patient outcomes during the interview (e.g., patient statements in favor of change) (Moyers et al., 2007; Moyers, Martin, Houck, Christopher, & Tonigan, 2009), investigators have begun to explore the question of whether the quality of motivational interviewing skills in brief interventions for alcohol and other drugs is associated with distal outcomes such as subsequent substance use (e.g., McCambridge, Day, Thomas, & Strang, 2011). Motivational interviewing skills have been operationalized as the integration of a general therapeutic stance toward the patient (i.e. motivational interviewing spirit) and a set of specific interventionist behaviors. Motivational interviewing spirit includes the degree to which the interventionist collaborates with the patient, evokes the client's perspective and ideas about change, and supports patient autonomy. This style of interacting with the patient is facilitated by the use of specific strategies and therapist behaviors that include simple and complex reflections, open questions, and affirmation of client strengths among others. Investigators have used both the Motivational Interviewing Skills Code [MISC] (Moyers, Martin, Catley, Harris, & Ahluwalia, 2003) and the Motivational Interviewing Treatment Integrity [MITI] (Moyers, Martin, Manuel, Hendrickson, & Miller, 2005) coding measures to systematically explore the association between the quality of motivational interviewing skills demonstrated in brief interventions and proximal (i.e., within session patient behavior) and distal (i.e., substance use-related change) outcomes.

Recent studies of brief alcohol interventions suggest that MI skills may be linked with patient "change talk" (e.g., Gaume, Bertholet, Faouzi, Gmel, & Daeppen, 2010; Magill et al., 2014). There has been relatively little support, however, for the view that quality of MI-consistent skills in brief interventions are directly associated with better outcomes, such as reduced use or consequences (Bertholet, Palfai, Gaume, Daeppen, & Saitz, 2014; Gaume, Gmel, & Daeppen, 2008; Gaume, Gmel, Faouzi, & Daeppen, 2009). Gaume et al. (2009) suggested that an overall "MI attitude" (based on the combined effect of global interventionist ratings and MI-techniques), rather than specific MI-consistent behaviors, may be most important for producing better outcomes. Indeed, in one of the few studies of brief intervention processes for drug use, McCambridge et al. (2011) found that level of MI Spirit and complex reflections were the only MI variables that predicted cessation of marijuana use among adolescents recruited in non-traditional educational and training institutes.

Although MI-based brief interventions are hypothesized to work through specific therapeutic mechanisms, there is an absence of research exploring whether motivational interviewing skills are related to drug use outcomes, particularly among primary care patients. The goal of this study was to examine whether the quality of motivational interviewing skills were related to drug use outcomes following two distinct interventions, both based on motivational interviewing. Data for this study come from a randomized controlled trial that tested the efficacy of two brief intervention approaches for illicit drug use and prescription drug misuse among primary care patients identified by screening (Saitz et al., 2014). One intervention approach was a Brief Negotiated Interview (BNI, Bernstein et al., 2005), which was a 15-minute intervention based on motivational interviewing that was delivered by health educators in primary care as part of a government funded program supporting its real-world dissemination. The other approach was a more intensive intervention (MOTIV) that adapted motivational interviewing for the primary care context and was delivered by Masters

level counselors under weekly supervision. The primary aim of the study was to examine whether higher quality motivational interviewing skills within each of these distinct MI-based interventions were associated with fewer days of drug use at 6 weeks, controlling for relevant baseline measures. Because the intervention content and emphasis on MI skills was different by intervention condition, analyses were stratified by intervention condition. The primary hypothesis was that MI skills would be positively associated with drug use outcomes in both MOTIV and BNI conditions. In addition to analyses for the overall sample, a separate set of analyses were stratified by whether marijuana was the main drug of concern to the patient (i.e., marijuana versus other drugs). Stratification by marijuana use was based on the higher frequency of marijuana use as a drug of concern, a different set of treatment considerations for patients who used marijuana versus other drugs such as cocaine and heroin, and patient perceptions of marijuana use that differ substantially from those of other drugs. Secondary aims were to examine the association between MI skill ratings and other indices of drug involvement such as drug-related consequences and abstinence status and to explore associations between MI skills and 6-month drug outcomes.

2. Methods

2.1 Overview of the Randomized Controlled Trial

Data for this study come from the Assessing Screening Plus brief Intervention's Resulting Efficacy to stop drug use (ASPIRE) study (Saitz et al., 2014), which was a 3-arm randomized trial that tested the efficacy of two brief interventions for drug use in primary care clinics at an urban hospital among patients identified by routine screening. Patients were enrolled based on inclusion criteria that included age 18 years and a drug-specific Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) score 2 (Humeniuk et al., 2008). The main RCT as described in Saitz et al (2014) used an inclusion criterion of an ASSIST score 4. Those who were pregnant, unable to interview and consent in English, or participate in follow-up were excluded as were those who had received brief intervention or on-site addiction treatment in the previous 3-months. Enrolled patients were randomized to either no brief intervention or one of two brief intervention conditions, either BNI or MOTIV, and completed follow-up assessments at 6 weeks and 6 months. The current study presents analyses using the same assessment and timepoints. Of the 390 intervention participants in the trial (https://clinicaltrials.gov/ct2/show/NCT00876941), 23 did not have recordings coded due to inaudible recordings, equipment failure, or interventionist failure to use a recording device. Of these remaining participants, 351 had data on covariates and outcomes necessary for analyses. Details of screening, randomization and follow-up procedures are presented in Saitz et al (2014).

2.2 Study Assessments

Patients completed study assessments at baseline, 6 weeks, and 6 months. Baseline assessment by in-person interview included demographics, Timeline Follow-back (TLFB) assessing number of days in the past 30 on which the main drug was used (Westerberg, Tonigan, & Miller, 1998), the ASSIST (Humeniuk et al., 2008), the 15-item short inventory of problems for drugs (SIP-D) (Alterman, Caccioloa, Ivey, Habing, & Lynch, 2009), and Readiness Ruler (Heather et al., 2008) adapted for drugs. At 6 weeks, patients completed the

TLFB for the main drug and SIPD (30-day timeframe) since study entry by telephone. In-person assessments were repeated 6 months later. The primary outcome was number of days using of the main drug at 6 weeks based on the 30-day TLFB, analyzed both in the full sample and stratified by marijuana or other drugs as the main drug. Six month outcomes were examined in secondary analyses and included number of days use of the main drug in the past 30 days, abstinence in the past 30 days, and drug-related problems (SIP-D) score in the past 3 months.

2.3 Interventions

Brief Negotiated Interview (BNI)—The BNI was a 10-15 minute structured intervention conducted by health educators all of whom had at least completed high school or the equivalent. The BNI uses the counseling style from MI that includes empathy, MI-spirit, and MI-consistent strategies to elicit change talk and help resolve ambivalence. The BNI also uses features of motivational interviewing including review of the "pros and cons" of use and development of a plan for change. Interventionists were provided with information about ASSIST scores prior to the intervention. Recordings from interviews of 12 interventionists who completed between 2 and 70 interventions each were coded.

Motivational Intervention (MOTIV)—The adaptation of motivational interviewing intervention (MOTIV) was a 30-45 minute intervention conducted by Master's degree level interventionists. The motivational intervention was less structured than BNI and included eliciting possible links between drug use and health concerns, heightening discrepancies between negative drug use outcomes and valued goals, enhancing self-efficacy about behavior change, and providing options for change. Interventionists were provided with ASSIST scores and information about readiness-to-change, self-efficacy for change, and drug related social and medical consequences prior to the intervention. Interventionists in this condition also reviewed medical records. At the end of the intervention, patients were offered a 20-30 minute follow-up session that could be completed in-person or by phone if they wished. Recordings from interviews of 4 interventionists who completed between 9 and 90 interventions each were coded.

2.4 Intervention skill coding

As part of the intervention fidelity assessment procedures, all available intervention recordings were coded using the Motivational Interviewing Treatment Integrity (MITI) (Moyers et al., 2005) instrument, version 3.1.1. This instrument is widely used to assess practitioner fidelity to motivational interviewing. The measure consists of items that assess dimensions of motivational interviewing style (e.g., collaboration) using global ratings (Likert scale ratings of 1-5) and behavior counts of specific practitioner behavior that are considered to be consistent with Motivational Interviewing (e.g., open questions, complex reflections) and those that are inconsistent with MI (e.g., advice without permission). Specific items are then aggregated into MITI summary scores which reflect indices associated with better motivational interviewing skill including global skill ratingsand four specific behavior count indices. The two global ratings are "empathy" and "MI spirit", the latter of which refers to 3 important features of the interventionist style; (1) collaboration with the patient in the development of treatment goals and solutions, (2) evocation of the

patient's reasons for change, and (3) efforts to support and reinforce the patient's sense of autonomy and choice. The behavioral counts are indices of MI skill that are based on the relative frequency of specific interventionist behaviors (1) the ratio of reflections-to-questions,, (2) the percentage of complex reflections, (3) the percentage of open vs. closed questions, and (4) percentage of MI-adherent behavior (i.e., asking permission, affirming, emphasizing control, and supporting the client) which refers to MI adherent/MI adherent + MI-non-adherent behavior (Moyers et al., 2005). These six scores constituted the independent variables of interest for our analyses. Because of the short duration of these interventions (e.g., BNI was approximately 15 minutes) and the desire to represent the content of these two interventions evenly, we coded the full intervention sessions instead of the typically coded 20 minute segment. Three Master's level graduate students were trained in coding procedures. Twenty-percent of the interventions were coded by at least 2 coders to establish inter-rater reliability. Coders were blind to recordings that were multiply coded prior to rating and met weekly to discuss coding procedures and review a designated training recording.

2.5 Statistical analyses

All analyses were stratified by intervention condition because the length of the intervention and the degree of correspondence to motivational interviewing were expected to differ by condition. Independent variables were divided into tertiles within each intervention condition to avoid assumptions of linearity. For any variable with a distribution that did not allow categorization by tertile (e.g., empathy in the MOTIV condition), a median split was used instead. Baseline gender, age, marital status, homelessness, race (white versus other), and main drug (marijuana or not) were included as covariates, as was the relevant baseline measure of the outcome variable. The primary outcome, number of days used at 6-weeks, was analyzed using negative binomial regression models. Separate models were fit for each of the six MI skill variables. The analyses were conducted in the overall sample and subsequently stratified by marijuana versus other main drug in secondary analyses. Number of days use at 6-month outcome was examined in secondary analyses using the same approach as above. In addition, a series of secondary analyses were conducted that examined the association *between the MITI variables* and both drug-related consequences and abstinence status at 6-week and 6-month outcomes. The drug related consequence measure was analyzed using negative binomial regression and abstinence was analyzed using logistic regression models. Due to the exploratory nature of these analyses, no adjustments were made for multiple comparisons. Two-sided tests were performed and p-values < 0.05 were considered statistically significant. All statistical analyses were performed using SAS version 9.2 (SAS Institute Inc., NC, USA).

3. Results

3.1 Sample characteristics

Baseline characteristics of the study sample are presented in Table 1. [1] Patients were primarily male, non-White, unmarried and reported marijuana as their main drug. Mean (SD) number of days of use in the past 30 days for BNI was 13.48 (SD = 11.72) and for

MOTIV was 12.73 (SD = 11.07). Participants in the BNI had mean SIP-D scores of 10.92 (SD = 13.55) and those in the MOTIV group had a mean of 12.06 (SD = 13.39).[2]

3.2 Inter-rater reliability

Inter-rater reliability was established through ratings of a subsample of intervention recordings by two coders. The inter-rater reliability data for these codes are presented in Table 2. The MITI codes generally showed good to excellent reliability with one composite code in the "fair" range (Ciccetti, 1994). Thus, the MITI proved to be reliable instrument for coding MI skills for these two adaptations of motivational interviewing.

3.3 Intervention characteristics

Table 3 shows mean ratings of each of the MI skill indices by intervention condition. As expected the intervention groups showed differences in the level of MI skills with those in the MOTIV group showing higher ratings on each of the indices examined. Global ratings of empathy and MI spirit in particular were very high among this intervention group. Behavioral counts (e.g. reflections to questions ratio) showed considerably more range in both interventions.

3.4 Regression analyses

For the number of days use of the main drug, there was little evidence that ratings of MI skills were significantly associated with better drug outcomes at 6 weeks (see italicized p-values in Table 3 for summary of primary analyses) or 6-months (see Table 4 for summary of analyses) for either intervention condition. For 6-week outcomes, the only significant findings were observed in the MOTIV group where there was a significant association between the reflections-to-questions ratio and number of days use at 6-weeks (global $p = 0.01$). Although comparison of the middle and low tertiles suggest that a higher ratio of reflections-to-questions was associated with worse outcomes (more frequent days used; not the hypothesized direction of association) among those in the MOTIV group (aIRR = 1.50, 95%CI: 1.03, 2.02, $p = 0.04$), the highest tertile group was not significantly different from the low tertile group (aIRR = 0.83, 95%CI: 0.56, 1.24, $p = 0.36$). For 6-month outcomes, higher levels of empathy (i.e., categorized as high vs. low) were associated with significantly better outcomes (i.e., lower number of days used) among those who used other drugs (aIRR = 0.32, 95%CI: 0.14, 0.77, $p = 0.01$) in the MOTIV condition. In the BNI condition, only %reflections-to-questions was significantly associated with outcomes (global p = .01) with among those who used other drugs with the highest tertile group significantly different than the low tertile group in the expected direction (aIRR = 0.20, 95%CI: 0.56, 1.24, p = 0.36. Thus, there was little consistent evidence that global scores or specific MI skills were associated with fewer days use.[3]

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[1]Participants in the current study sample (n= 351) were compared to those who were excluded due to missing data (n = 39) on variables listed in Table 1. Those included in the study appeared to be older (42 vs. 37 years) and more likely to be female (32% vs. 15%) than those excluded. No other differences were observed between groups.

[2]Mean SIP-D scores in the current sample were lower than reported mean SIP (drug & alcohol) scores of 20 or greater observed in substance specialty treatment settings (Kiluk et al., 2013)

[3]Results indicated a wide range of substance use frequency among participants at follow-up outcomes. For example, the median number of days using drugs at 6 weeks was 5 with an interquartile range of 1-24.

Additional analyses provided limited evidence that MI-skill variables may be related to consequences among those in the BNI condition (shown in the supplementary online tables). Among those in the MOTIV group, there was a significant association between the percentage of open questions and drug related consequences at 6-months (global $p = 0.03$). Comparison of the middle and low tertiles showed that a higher percent of open questions was associated with fewer consequences (aIRR = 0.58, 95%CI: 0.34, 0.99, $p = .045$) whereas the highest tertile group was not significantly different from the low tertile group (aIRR = 1.21, 95%CI: 0.71, 2.05, $p = 0.49$). Among those with marijuana as their main drug in the MOTIV group, percent MI-adherent was significantly associated with fewer drug consequences at 6-months, global $p = 0.01$ (highest versus lowest tertile comparison aIRR = 0.40, 95%CI: 0.20, 0.78, $p = 0.01$) and percent open questions was significantly associated with abstinence at 6-months among those whose main drug was not marijuana in the MOTIV condition (aOR = 0.14 for highest versus lowest tertile, 95%CI: 0.02, .83, $p = 0.03$). Overall, the secondary analyses provided little evidence to support the view that MI-related variables were associated with better outcomes (see online supplementary tables for complete analyses).

4. Discussion

A number of brief interventions for substance use are based on the principles of motivational interviewing. Supervision and training for these interventions are based on the view that better quality MI-skills will be associated with better outcomes. Using a well-established instrument for coding motivational interviewing skills, the current study assessed whether the level of skill displayed in two adaptations of motivational interviewing for primary care (i.e., BNI, MOTIV) was associated with lower frequency of drug use. Results provided limited evidence that the level of performance on MI-relevant skills was associated with outcomes. There were a few significant associations between interventionist skill ratings and outcomes, however these did not predict drug use outcomes in a consistent manner. Although some previous studies that have found that certain indices of MI skill may be linked with better outcomes (McCambridge et al., 2011), the association between higher levels of intervention skills and better outcomes has not been consistently observed (e.g. Bertholet et al., 2014).

It is important to consider the context and limitations of this study before making generalizations about these findings. First, results from the ASPIRE trial (Saitz et al., 2014) did not indicate that the BNI or MOTIV decreased drug use. Indeed the majority of patients in the sample (over 90%) showed evidence of drug use at 6-month follow-up, though many did decrease their use, and such decreases could have been associated with MI processes. Nonetheless, there was no difference between intervention and control groups. Such null findings are consistent with the few other efficacy studies of brief intervention for illicit drug use among patients identified by screening (Bogenschutz et al., 2014; Humeniuk et al., 2012; Roy-Byrne et al., 2014). Thequestion of whether better MI skills are associated with better outcomes is still important in a negative overall trial, however, findings must be interpreted in this context (e.g., a brief intervention may not be sufficient to change drug use no matter how competently it is delivered). Second, although there was sufficient range of drug use outcomes for each condition, the limited range of some of the skill variables may

have contributed to the absence of a significant association between these skills (e.g., %MI consistent for the MOTIV condition) and outcomes. Third, the study consisted of the delivery of brief interventions in a primary care context only. It is important to consider the possibility that the impact of motivational interviewing skills may have a very different effect in adaptations of MI conducted in other health settings or among people seeking help for their drug use. Future work should consider alternative ways of examining these process variables such as comparing thresholds of proficient versus non-proficient skills rather than exploring continuous variables. In addition, there may be value in considering alternative methods to code interventionist skills using theoretical frameworks that have been integrated with MI such as self-determination theory. Finally, it is important to consider that the study tested only simple associational models of MI skill quality and outcomes. These skills are likely to interact with one another or with other variables (e.g., depression) to influence drug use outcomes (Longabaugh & Magill, 2011).

Despite these limitations, this study is among the first to examine motivational interviewing skills associated with brief intervention (SBI) among people identified by screening for illicit drug use and prescription drug misuse in adults in primary care. As outlined by Saitz et al (2014), data for this study come from a randomized controlled trial (the ASPIRE study) that had a number of strengths including the large sample size, breadth of inclusionary criteria, and a high follow-up rate (over 98%). Moreover, the current study is one of the few that have examined MI processes across multiple brief interventions using the entire available set of audio-recordings from a randomized clinical trial. Previous researchers using the MITI and other motivational interviewing processing instruments have typically assessed segments of interviews (e.g., Moyers et al., 2005) and typically conducted analyses on random samples of study interviews from larger study data sets (Moyers et al., 2007).

The goal of this study was to examine the association between relative quality of MI skills and outcomes. Although results from this large-scale study provide important information about how these variables may be associated with outcomes across multiple brief interventions, alternative analyses on absolute levels of performance based on threshold quality standards rather than relative quality for each of these MI-components may yield different results. Similarly, individual components of MI skill may not be strong univariate predictors of outcome and composite indices of MI skills as well as other therapist characteristics may need to be considered in subsequent work. Future research should focus attention on the potential interaction of these intervention variables in multivariate models that also consider patient characteristics.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Highlights

Examined associations between quality of brief motivational interventions for drug use and subsequent drug-related outcomes among a sample of primary care patients

Findings suggest that higher quality of motivational interviewing skills in the brief interventions tend not to be associated with better drug use outcomes for these patients.

Results have implications for understanding factors that may influence the efficacy of brief interventions for drug use in primary care

Table 1

Baseline Characteristics by Intervention Group and Stratified by Main Drug (n=351)

Variable	Level	BNI: All (N=171)	BNI Main Drug Marijuana (N=107)	BNI: Main Drug Other (N=64)	MOTIV: All (N=180)	MOTIV: Main Drug Marijuana (N=114)	MOTIV: Main Drug Other (N=66)
Sex	**Male**	118 (69%)	71 (66%)	47 (73%)	119 (66%)	76 (67%)	43 (65%)
	Female	53 (31%)	36 (34%)	17 (27%)	61 (34%)	38 (33%)	23 (35%)
Race/Ethnicity	**White**	32 (19%)	14 (13%)	18 (23%)	36 (20%)	18 (16%)	18 (27%)
	Other	139 (71%)	93 (87%)	46 (77%)	144(80%)	96 (84%)	48 (73%)
Married		15 (8.77)	8 (7.48)	7 (10.94)	21 (11.67)	16 (14.04)	5 (7.58)
Homeless		23 (13.45)	10 (9.35)	13 (20.31)	31 (17.22)	16 (14.04)	15 (22.73)
Marijuana as Main Drug		107 (63%)	107 (100%)		114 (63%)	114 (100%)	
Age at Screening		40.8 (12.75)	39.63 (.14)	42.77 (11.91)	42.52 (12.17)	40.7 (13.09)	45.67 (9.73)
Readiness to Change – Decided to Use Less/Already Trying to Cut Back[+]		2.37 (0.83)	2.26 (0.86)	2.55 (0.75)	2.31 (0.82)	2.21 (.83)	2.48 (0.79)
Number of Days Used Main Drug - Past 30 Days: Baseline		13.48 (11.72)	16.67 (11.71)	8.14 (9.68)	12.73 (11.07)	15.78 (11.27)	7.45 (8.48)
Current SIP (Drug) score: Total Sum (Baseline)		10.92 (13.55)	6.1 (9.06)	18.97 (15.87)	12.06 (13.39)	6.34 (9.59)	21.94 (13.32)

Categorical variables: N(%)

Continuous variables: Mean (SD)

Main Drug Other: Opioids, Cocaine, Sedatives

Homeless = one or more nights spent in a shelter or on the street in the past 3 months

SIP = short inventory of problems, score possible range 0-45

[+] Analyses were conducted on a three level variable based on patient responses to the 4-item readiness scale; low = "never think about using less", moderate = "sometimes think about using less", and high = either "decided to use less" or "already trying to use less." For the analysis of the interaction between empathy and readiness on 6-month TLFB outcomes among Other Drug MOTIV condition participants, medians were used for both the readiness and empathy variables because of distributional characteristics of these variables.

Table 2

Inter-rater reliability of MI skill variables and mean ratings by intervention condition

MITI Code	ICC	BNI (N=171)	MOTIV (N=180)	Z, p-value
Global MI Spirit	0.78	3.6 ± 0.69 3.67 (3.33 - 4) 1.56 - 5	4.56 ± 0.46 4.67 (4.33 - 5) 2.67 - 5	−12.60, <0.0001
Global Empathy	0.72	3.71 ± 0.96 4 (3 - 4) 1 - 5	4.69 ± 0.54 5 (4.33 - 5) 2 - 5	−10.77, <.0001
Ratio of Reflections to Questions	0.90	0.75 ± 0.43 0.71 (0.45 - 0.93) 0.11 - 3.5	1.47 ± 0.63 1.36 (1.11 - 1.7) 0.45 - 4.08	−11.97, <.0001
Percent Open Questions	0.79	34% ± 15% 33% (22% - 45%) 4% - 75%	53% ± 13% 53% (44% - 62%) 24% - 88%	−10.59, <.0001
Percent Complex Reflections	0.47	43% ± 20% 42% (28% - 57%) 0% - 90%	49% ± 12% 51% (42% - 57%) 11% - 80%	−3.48, 0.0005
Simple Reflections	0.72			
Complex Reflections	0.71			
Percent MI Adherent	0.57	70% ± 27% 73% (54% - 96%) 0 - 1	96% ± 14% 100% (100% - 100%) 0% - 100%	−11.52, <.0001

ICC: Intraclass correlation coefficient

MITI = Motivational Interviewing Treatment Integrity

Continuous Tests: Wilcoxon Two-Sample

Continuous Variables: Mean ± SD; Median (IQR); Range

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Table 3

Summary table for the association between MITI process variables and substance use outcomes at 6 weeks: p-values for associations between MI variables and outcomes.

	BNI			MOTIV		
	Any [1]	**MJ** [2]	**Other** [3]	**Any**	**MJ**	**Other**
MI Spirit						
Use	*0.36**	0.27	0.59	*0.05*	0.18	0.16
Abstinence	0.96	0.26	0.95	*0.84*	0.50	0.69
Consequences	0.78	0.58	0.94	*0.62*	0.32	0.82
Empathy						
Use	*0.78*	0.81	0.75	*0.71*	0.72	0.96
Abstinence	*0.39*	0.61	0.72	*0.85*	0.71	0.65
Consequences	*0.94*	0.52	0.81	*0.29*	0.48	0.26
% Reflections to Questions						
Use	*0.14*	0.07	0.83	*0.01*[+]	**0.02**	0.10
Abstinence	0.28	0.55	0.51	*0.63*	0.37	0.51
Consequences	0.07	0.05	0.15	*0.48*	0.95	0.26
% Open Questions						
Use	*0.45*	0.80	0.78	*0.13*	0.48	0.21
Abstinence	0.11	0.11	0.42	*0.95*	0.64	0.72
Consequences	0.70	0.80	0.99	*0.53*	0.77	0.45
% Complex Reflections						
Use	*0.80*	0.51	0.81	*0.48*	0.77	0.36
Abstinence	0.57	0.52	0.06	*0.17*	0.16	0.46
Consequences	0.97	0.96	0.35	*0.88*	0.52	0.84
% MI Adherent						
Use	*0.69*	0.53	0.25	*0.89*	0.23	0.22
Abstinence	0.79	0.79	0.47	*0.63*	0.14	0.38
Consequences	0.05	0.12	0.19	*0.59*	0.10	0.04

[1] Total sample

[2] Marijuana as main drug

[3] Drug other than marijuana main drug

*
Italicized p-value indicates results from primary hypotheses

+
Bolded p-values indicate significant effect, p < .05

Table 4

Summary table for the association between MITI process variables and substance use outcomes at 6 months: p-values for associations between MI variables and outcomes.

	BNI			MOTIV		
	Any	**MJ**	**Other**	**Any**	**MJ**	**Other**
MI Spirit						
Use	0.21	0.34	0.86	0.40	0.51	0.11
Abstinence	0.56	0.31	0.40	0.19	0.91	0.09
Consequences	0.38	0.36	0.93	0.42	0.14	0.77
Empathy						
Use	0.58	0.45	0.96	0.40	0.52	**0.01**
Abstinence	0.05	0.16	0.18	0.60	0.70	0.45
Consequences	0.80	0.64	0.94	0.62	0.39	0.95
% Reflections to Questions						
Use	0.06	0.77	**0.01**	0.09	0.27	0.08
Abstinence	0.05	0.56	0.06	0.86	0.17	0.51
Consequences	0.61	0.70	0.14	0.68	0.79	0.88
% Open Questions						
Use	0.63	0.71	0.19	0.39	0.64	0.33
Abstinence	0.93	0.65	0.63	0.14	0.15	0.05
Consequences	0.05	0.12	0.45	0.03	0.30	0.27
% Complex Reflections						
Use	0.22	0.73	0.39	0.98	0.71	0.40
Abstinence	0.28	0.22	0.29	0.69	0.89	0.43
Consequences	0.67	0.45	0.67	0.30	0.27	0.64
% MI Adherent						
Use	0.82	0.81	0.89	0.57	0.95	0.43
Abstinence	0.62	0.64	0.43	0.94	0.86	0.46
Consequences	0.09	0.08	0.38	0.08	0.01	0.62

[1] Total sample

[2] Marijuana as main drug

[3] Drug other than marijuana main drug

[+]Bolded p-values indicate significant effect, $p < .05$