Contents lists available at ScienceDirect

Drug and Alcohol Dependence

Examining motivational interviewing's effect on confidence and commitment using daily data

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A B S T R A C T

Mechanisms of behavior change (MOBC) within Motivational Interviewing (MI) are thought to operate via both relational and technical elements. These elements are hypothesized to increase client motivation and self-efficacy for change and subsequently decrease drinking. Only partial support for this causal chain exists, particularly when using within-session change talk as the primary intervening variable. This study explored whether commitment to moderate or abstain from drinking and confidence to moderate drinking in the next day measured via ecological momentary assessment (EMA) provided alternative support for the theory. Data were from a pilot randomized controlled trial testing active ingredients of MI. Problem drinkers (N = 89) seeking to moderate their drinking were randomly assigned to one of the three conditions: 1) MI; 2) Spirit only MI (SOMI), consisting of non-directive elements of MI, e.g., reflective listening; and 3) a non-therapy control. Participants completed daily EMA that measured confidence, both types of commitment, and drinks per day for a week prior to and during seven weeks of treatment. Hypotheses were not supported, and results were unexpected. Participants in SOMI were more likely to have higher daily confidence than those in MI; there were no condition differences for either type of commitment. All daily measures significantly predicted drinking; however, the MI group did not demonstrate a stronger relationship between the intervening variables and drinking, as hypothesized. Instead, participants in SOMI yielded the strongest relationship between daily commitment to abstain and drinking compared to the other two conditions. Multiple possible explanations for the unexpected findings are discussed.

1. Introduction

Motivational interviewing (MI) is a demonstrated effective stand-alone intervention for alcohol use disorders (AUD) (Lundahl et al., 2010; Morgenstern et al., 2007). It is defined by its authors as a "collaborative conversation style for strengthening a person's own motivation and commitment to change" (Miller and Rollnick, 2013) comprising a unique combination of Rogerian non-directive counseling and directional techniques. MI's consistency, magnitude, and durability of effects, especially given its brevity, suggest distinct mechanisms of behavior change (MOBC) are operating to reduce drinking.

The active ingredients of MI are thought to be 1) expression of empathy and avoidance of negative therapeutic interactions and 2) selective evocation and reinforcement of client pro-change statements (change talk, CT) and reduction of client pro-status quo statements (sustain talk, ST) (Miller and Rollnick, 2013; Miller and Rose, 2009). Miller and Rollnick (2002) postulate that MI's Rogerian non-directive

counseling elements that facilitate a strong therapeutic alliance and collaborative relationship mobilize a self-change process. Miller and Rollnick (2013) also argue that Rogerian strategies are necessary, *but not sufficient*, to instigate change and that directional strategies are an essential addition. Importantly, directional strategies serve to reinforce client CT, which is in-session client statements specifically about motivation (operationalized as statements regarding desires for, reasons for, need to, and commitment to change) and self-efficacy (operationalized as statements about ability to change and confidence to change) (Amrhein, 2004; Amrhein et al., 2003; DiClemente et al., 2004; Miller and Rollnick, 2002). By reinforcing CT, directional strategies are thought to enhance motivation and self-efficacy to change by resolving ambivalence about change—a construct central to maintaining drinking behaviors (Miller and Rollnick, 2002).

As described in a meta-analysis by Magill et al. (2014), a significant line of research has examined MI's theory of action and proposes a causal chain such that proficient use of MI techniques will increase

clients' CT and decrease their ST (the *a path* of a mediational chain). Subsequently, increased CT and reduced ST will predict reduced drinking (the *b path* of a mediational chain). This meta-analysis yielded mixed results. Proficient use of MI techniques was associated with higher rates of CT. Higher rates of within-session ST were associated with worse outcomes; however, greater CT alone was not associated with reduced drinking. Associations were found, however, for composite measures of CT and ST in predicting behavior change in some studies. In a follow up meta-analysis, Magill et al. (2018a) found that while CT alone was not predictive of substance use, a larger proportion of CT of all client statements predicted reduced risk behavior. An additional meta-analysis by Magill et al. (2018b) focusing on CT subtypes similarly demonstrated that only when CT, specifically frequency of reasons for change, was used as a proportion of total client statements (i.e., both CT and ST together) was it predictive of reduced substance use at follow-up only.

One limitation of the research reviewed by Magill et al. (Magill et al., 2018a, b; 2014) is its reliance primarily on strength of association (i.e., correlation) to test a causal chain. Significant associations may be due to an unmeasured factor that remains masked in the absence of experimental manipulation of the mechanisms of action. To address this and other methodological limitations, in an earlier study (Morgenstern et al., 2012a), we experimentally manipulated key active ingredients (therapist behaviors) as an alternative design strategy to test MI mechanisms. We disaggregated MI into its relational only and directional plus relational elements to create two therapy conditions. One condition (labeled Spirit-Only MI or SOMI) consisted of the relational or nondirective elements of MI, including use of reflectolopive listening skills, atmosphere of warmth and egalitarianism, and avoidance of MI-inconsistent behaviors. In addition, directional elements designed to enhance CT (e.g., selective reinforcement of change talk through complex reflections, decisional balance, or formulation of change plan) or deliberately redirecting the therapy process to discuss drink reduction were proscribed. The second condition (MI) consisted of delivery of both relational and directional elements. Both therapies consisted of four one-hour sessions over seven weeks. A third condition (nontherapy control, NTC) accounted for external elements that might influence outcome (e.g., assessment reactivity).

It was hypothesized that MI, relative to SOMI, would increase CT (*a path*); CT would predict reduced drinking (*b path*); MI would significantly reduce drinking relative to SOMI and NTC (*c path*); and the effects of MI on reduced drinking would be mediated by increased CT. Problem drinkers seeking to moderate (N = 89) but not quit drinking were randomly assigned to one of the three conditions and assessed at end of treatment. Results were mixed. MI appeared to reduce drinking in the first two weeks of treatment, and these effects were mediated by greater CT; however, increased CT did not significantly predict reduced drinking beyond the initial two weeks. During the last month of treatment, SOMI and NTC yielded equivalent reduction in drinking compared to MI. Overall, experimental manipulation of therapist behaviors yielded strong support for the *a path,* as they predicted increased CT; however, there was no support for the *b path* of the MI causal chain, as increased CT did not predict reduction in drinking. While a proportion of CT to all motivational statements was not utilized in this study, it should be noted that this study measured CT as a bipolar construct, with negative values indicating ST and positive values indicating CT. Thus, it was not a measure of CT alone. While results appeared consistent with Magill et al.'s (2014) review, they differed in part from the other two Magill et al. (2018a, 2018b) studies.

1.1. Alternatives to CT: measures of motivation and self-efficacy using ecological momentary assessment

CT provides a proxy for a client's intrinsic motivation and self-efficacy, indicating only the strength of a client's within-session attitudes about these two change-related factors. If MI were to operate according to the theoretical causal chain, MI should not only increase within-session motivation and self-efficacy, it should also impact a client's motivation and self-efficacy outside of session in order to lead to any lasting impact on drink reduction. In the study described above, we used a proxy for clients' motivation and self-efficacy outside therapeutic sessions: single-item measures of commitment and confidence to reduce drinking implemented via daily ecological momentary assessment (EMA).

Several theories of behavior change, such as self-determination theory (Deci and Ryan, 1985), self-regulation theory (Brown, 1998), the Transtheoretical Model (Prochaska et al., 1992) and social learning theory (Bandura, 1982), view motivation and self-efficacy as dynamic and fluctuating over time in response to real world contexts. Therefore, EMA measures of motivation and self-efficacy are appropriate, providing more valid measures of these changing constructs across time and context and reducing systematic bias of retrospective reports that overvalue proximal experiences over distal experiences (Bradburn et al., 1987; Shiffman et al., 2008). Furthermore, previous research demonstrates that EMA daily motivation (operationalized as commitment) and self-efficacy (operationalized as confidence) demonstrate strong predictive validity of drinking outcomes (Morgenstern et al., 2016), which are stronger than global self-report measures even when intensive observations are aggregated (Kuerbis et al., 2013).

A limitation of our prior study was that the measure of motivation was restricted to CT during only the first two therapy sessions. Thus, it was not tested whether clients in SOMI and NTC also increased their motivation later in treatment, when their effects appeared. Assessment of commitment and confidence to change outside of treatment, during the entire treatment period, allows for testing later treatment period effects and might yield a stronger predictive measure of future behavior. Given MI's structured, directive component that includes a purposeful targeting of reinforcing CT, we would expect MI would lead to increases in commitment and confidence to reduce drinking in the early part of treatment that would be greater than SOMI; however, as clients move to a change plan at the very end of early treatment (when, if a change plan is achieved, in this protocol, reinforcing change talk specifically was less a focus, and planning actions, identifying support for and obstacles to change become central), it may be that motivation and self-efficacy plateau, explaining the early impact of CT on drinking in the previous analysis.

1.2. The current study

To further probe the findings in our above described study that focused solely on in session CT, we examined the impact of condition (MI, SOMI, or NTC) on daily prospective measures of commitment not to drink heavily, commitment to abstain from drinking, confidence not to drink heavily, as well as a measure of subsequent drinking, all collected using EMA across eight weeks (one week prior to treatment and then during the 7 weeks of treatment, for a total of 56 days). It was hypothesized that 1) MI would yield a *larger increase* in daily commitment and confidence to reduce drinking relative to the other conditions and that these differential effects would be strong in the early treatment period (first four weeks) but, as these effects would presumably plateau after a change plan, weaker for the later treatment period (second four weeks). It was also hypothesized that 2) during the treatment period, the size of the relationship between the intervening variables (i.e., commitment to reduce, commitment to abstain, and confidence) and drinking would be larger for the MI group than for the other conditions (as revealed by an interaction effect). Given that MI proactively targets confidence and commitment to change in relation to drinking behavior, it would be expected that there would be a more conscious and therefore stronger relationship between these intervening variables and drinking behavior.

Table 1
Baseline characteristics of study sample (N = 89).

	Condition			Total M (SD) or %
	MI M (SD) or %	SOMI M (SD) or %	SC M (SD) or %	
Age	40.8 (11.9)	39.8 (11.8)	37.4 (11.4)	39.2 (11.7)
Male	41.4	50.0	60.0	50.6
Race/Ethnicity				
Hispanic/Latino, any race	79.3	86.7	80.0	82.0
Caucasian, non-Hispanic	6.8	10.0	10.0	9.0
Other	13.7	3.3	10.0	9.0
Employment				
Employed Full or Part Time	89.6	90.0	76.7	85.2
Unemployed, looking for work	6.9	3.3	13.3	7.9
Not in labor force	3.4	6.7	10.0	6.7

Note. MI is Motivational Interviewing, SOMI is spirit only MI, and NTC is the self-change condition. These demographics were originally reported in Morgenstern et al. (2012a, b).

2. Method

This was a secondary data analysis using data from the original study, described in detail elsewhere (Morgenstern et al., 2012a). Procedures were approved by the Institutional Review Board at the New York State Psychiatric Institute.

2.1. Participants

Problem drinkers (N = 89) with an AUD diagnosis seeking to reduce but not stop drinking were recruited via web-based local media advertising. Table 1 presents participant demographics by condition.

2.1.1. Study eligibility

Participants were considered eligible if they were: (1) over age 18; (2) drank on average more than 15 or 24 standard drinks per week for women and men, respectively, during the prior 8 weeks and (3) had current AUD. The Composite International Diagnostic Instrument, Substance Abuse Module (CIDI-SAM, Cottler et al., 1989) was used to evaluate the number of AUD criteria a participant endorsed. Exclusion criteria were: (1) had another substance use disorder (other than alcohol, marijuana, nicotine) or reported greater than weekly drug use; (2) had a serious psychiatric disorder or suicide or violence risk; (3) demonstrated current or a history of physical alcohol withdrawal symptoms; (4) were mandated to substance abuse treatment; (5) reported social instability (e.g., homeless); (6) expressed a desire to achieve abstinence at baseline; or (7) expressed a desire/intent to obtain additional substance abuse treatment during study treatment period.

2.2. Procedures

After the initial screening assessment (week 0), participants were trained on and initiated a daily diary assessment via the Interactive Voice Recording (IVR) questionnaire system (TELESAGE, 2005). At week 1, participants completed a full assessment battery and were then (1) provided feedback using the National Institute of Alcohol Abuse and Alcoholism guidelines (National Institute of Alcohol Abuse and Alcoholism, 2004) for non-hazardous drinking and (2) randomly assigned to one of three conditions: Motivational Interviewing (MI), Spirit-Only Motivational Interviewing (SOMI), or non-therapy control (NTC). Participants were followed for a total of eight weeks using IVR and completed in-person assessments at weeks 0, 1, 4 and 8 with follow up rates of 100%, 96%, and 92.1%, respectively.

2.3. Daily interactive voice recording survey

Participants completed IVR at the end of each day for eight weeks, starting one week prior to randomization (accounting for potential assessment reactivity) and throughout the seven-week treatment phase of the study. The IVR system could be accessed between 4:00 pm and 10:00 p.m. If participants failed to call the system by 8:00 p.m., an automated reminder call was made. The survey required approximately five minutes to complete, and compliance was equivalent across condition with 66.1% of the possible 56 days completed.

2.4. Study interventions

There were three conditions: MI, MI without directional or technical elements (SOMI), and non-therapy control (NTC). Treatment was delivered in four sessions of one hour each at weeks 1, 2, 4, and 8. NTC participants received no treatment until after the week 8 assessment.

2.4.1. Motivational interviewing (MI)

We adapted the MI condition from MET used in Project MATCH (Miller et al., 1992; Project MATCH Research Group, 1993). It included both the relational (described below under SOMI) and directional elements of MI. Directional activities, such as importance and confidence rulers, amplified and double-sided reflections, decisional balance, and the change plan were delivered flexibly to elicit only change talk and reinforce/strengthen commitment to change. Personalized feedback, which included normative feedback and health risk information, was provided in week 2. Therapists did not reinforce sustain talk, yet therapists may have helped clients to explore their ambivalence for change, which would yield at least some sustain talk within session, particularly in early treatment.

2.4.2. Spirit only MI (SOMI)

SOMI consisted solely of the non-directive, relational elements of MI, such as therapist stance (warmth, genuineness, egalitarianism), emphasis on client responsibility for change, extensive use of reflective listening skills (e.g., open-ended questions, simple reflections), and avoidance of MI-inconsistent behaviors (advice-giving, confronting, taking expert role). Evocation of change talk was proscribed, including the directional elements designed to elicit change talk, listed above. Reflective listening focused on affective content, consistent with client-centered treatments (Bohart, 1995). Elsewhere, the term MI Spirit includes both non-directive elements and therapist elicitation and reinforcement of change talk (Moyers et al., 2007). Here the term Spirit Only MI is intended only as a descriptive label for this study condition.

2.4.3. Non-therapy control (NTC)

The NTC condition incorporated elements not associated with relational or directional active ingredients but also hypothesized to contribute to change, such as emphasis on personal responsibility and assessment. Participants were encouraged to change on their own; told that research revealed that some individuals reduced their drinking without professional help; and told completion of the IVR and other assessments might be helpful in that effort. Participants were offered treatment after the end of treatment assessment.

2.4.4. Therapists, condition fidelity and condition discriminability

Six master's- and doctoral-level therapists provided both therapies. Sessions were video recorded for supervision, fidelity, and condition discrimination purposes. Three measures determined fidelity to condition and successful disaggregation of MI into its component parts: 1) The Motivational Interviewing Treatment Integrity Code, Version 3.0 (MITI, Moyers et al., 2007); 2) a count of directive activities, such as providing structured feedback; and 3) DARN-C coding (Amrhein et al., 2003) to measure change talk within session. Each measure's demonstrated conditions were discriminable and faithful to protocols, with

Table 2
Condition differences on protocol fidelity and discriminability measures.

Measure	Therapy Condition		
	MI M (SD)	SOMI M (SD)	p-value
MITI Coding (54 sessions), 3.1.1.			
MI Adherent Behaviors	7.6 (3.9)	6.6 (4.4)	NS
Autonomy Support	4.4 (.6)	4.4 (.6)	NS
Empathy	4.6 (.5)	4.9 (.3)	< .01
Collaboration	4.3 (.8)	4.5 (.6)	NS
Evocation	4.2 (.7)	3.1 (1.2)	< .001
Direction	4.6 (.7)	2.6 (1.4)	< .001
Directional Activities	3.9 (2.9)	.43 (.8)	< .001
DARN-C Coding			
Frequency of Commitment	20.2	12.3	< .001
Strength of Commitment	1.47	0.85	< .001
Frequency of DARN	66.0	41.4	< .001
Strength of DARN	0.64	0.29	< .001

Note: The threshold for competency for MI according to MITI Coding is 4. All measures above the bolded line were the factors on which MI and SOMI were expected to be equivalent. All measures below the line, significant differences were expected.

high therapist competency (for detail, please see Table 2 and Morgenstern et al., 2012a). MITI coding indicated MI was significantly higher than SOMI on direction and evocation but equivalent on autonomy and collaboration—as anticipated. While both SOMI and MI were rated above competent on empathy, SOMI rated significantly higher. MI had significantly more directional activities than SOMI. Finally, MI yielded greater frequency and strength of change talk than SOMI.

2.5. Measures

2.5.1. Drinking outcomes

Drinking was assessed during the daily survey by asking a series of six questions— three asked the number of standard drinks of beer, wine, and hard liquor the participant had last night since their last survey; three asked about how many standard drinks of beer, wine, and hard liquor they had consumed today. This yielded two aggregate measures of drinking: total number of drinks consumed last night and total number of drinks consumed today. By adding these two variables, drinks in the previous 24 h was created. For these analyses, drinking outcomes were lagged to align with report of commitment and self-efficacy with drinking, resulting in two drinking outcomes: "*evening drinking*" (i.e., tonight's drinking) and "*next* 24 h *drinking*", referring to drinking during the 24 -h period following reports of commitment and confidence. *Evening drinking* was used due to its proximity to confidence and commitment reports, and *next 24 -h drinking* was considered a distal drinking outcome.

2.5.2. Daily confidence

Confidence to reduce heavy drinking was assessed by one item: "How confident are you that you can resist the temptation to drink heavily (that is, drink 5 or more drinks) over the next 24 h?" (*daily confidence*). The response set for this item ranged from 0 "not at all" to 4 "extremely."

2.5.3. Daily commitment

Commitment was measured with two items: "How committed are you to not drink heavily (that is, 5 or more drinks) in the next 24 h?" (*daily commitment to moderate*) and "How committed are you to not drink at all in the next 24 h?" (*daily commitment to abstain*). The response set for these items ranged from 0 "not at all" to 4 "extremely."

2.5.4. Period (Early vs. Late)

There was a total of 56 possible days of the IVR. Days 1 through 7

occurred pre-randomization (pre-randomization period). A binary factor variable was used to indicate early (days 8–28) or late (days 29–56) treatment periods.

2.5.5. Condition

Condition was represented by a three-level variable for MI, SOMI and NTC.

2.5.6. Day of treatment

Day of treatment was a continuous variable, ranging from 1 to 49, accounting for time during the treatment period. This variable was used as a covariate.

2.5.7. Pre-randomization period mean of each outcome

For each outcome variable, a respective baseline value was calculated for the week prior to randomization. These mean values were entered as covariates into the models.

2.6. Analytic plan

Previous analyses found no condition effects on drinking (Morgenstern et al. (2012a, b)) as measured by the Timeline Followback (TLFB, Sobell et al., 1988). Given a different data collection method for drinking in this analysis (EMA), we began our analyses by reexamining this relationship.

2.6.1. Hypothesis 1: condition and period effects on intervening variables

Next, we tested condition by period interaction effects on confidence and commitment. To do so, we attempted to analyze *daily confidence* and *daily commitment to moderate* as five-level ordinal responses using mixed effects cumulative logit models; however, those models were unstable due to low cell counts. Therefore, we collapsed adjacent cells to yield three-level ordinals responses by combining the 0 and 1 levels and the 3 and 4 levels. Thus, new collapsed levels were labeled low, medium, and high for both variables. *Daily commitment to abstain* showed very low variability and was collapsed into a binary variable, indicating no commitment versus any commitment. Models with intervening variables as outcomes included random intercept terms to allow for individual variability in levels of commitment and/or confidence. An unstructured variance-covariance matrix was specified. All models converged.

2.6.2. Hypothesis 2: condition by period by intervening variables on drinking

Next, we tested the impact of condition, period, and intervening variables on drinking using three-way interaction terms. Models testing drinking outcomes were analyzed using mixed effects Poisson models, which included random intercept terms to allow for individual variability in drinking levels. An unstructured variance-covariance matrix was again specified. Models were fit for both evening drinking and next 24 -h drinking. Results were similar, with the strength of association with evening drinking being slightly larger than next 24 -h drinking. Thus, results for evening drinking are reported. Additionally, we controlled for previous day's drinking, which yielded equivalent results not reported here.

2.6.3. Covariates and model building

All models included two covariates: day of treatment and the pre-randomization period mean for each of the outcomes. Models containing interaction terms also included all main effects and lower-level interactions; if the highest-order term was non-significant, it was dropped, and the model was refit to examine relevant lower-order interactions and main effects. All analyses were performed using SAS 9.4 (SAS Institute Inc. [INTERNET], 2002-2012SAS Institute Inc. INTERNET, -, 2012SAS Institute Inc. [INTERNET], 2002-2012).

Table 3

Condition by period means and standard deviations of the within-person averages of evening standard drinks, confidence, commitment to moderate, and commitment to abstain.

Period	Condition	Evening Drinks	Confidence	Commitment to Moderate	Commitment to Abstain
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Baseline	NTC	3.68 (2.46)	1.16 (0.60)	1.20 (0.52)	0.46 (0.35)
Baseline	SOMI	3.98 (1.98)	0.93 (0.55)	1.05 (0.57)	0.40 (0.25)
Baseline	MI	3.86 (2.57)	1.15 (0.66)	1.18 (0.59)	0.36 (0.26)
Early Treatment	NTC	3.08 (1.93)	1.12 (0.59)	1.19 (0.59)	0.49 (0.59)
Early Treatment	SOMI	3.28 (1.45)	1.23 (0.52)	1.27 (0.52)	0.38 (0.52)
Early Treatment	MI	3.18 (1.81)	1.16 (0.59)	1.21 (0.59)	0.40 (0.59)
Late Treatment	NTC	3.26 (1.76)	1.16 (0.64)	1.19 (0.64)	0.43 (0.64)
Late Treatment	SOMI	3.02 (1.48)	1.28 (0.56)	1.34 (0.56)	0.46 (0.56)
Late Treatment	MI	2.96 (1.84)	1.12 (0.64)	1.12 (0.64)	0.34 (0.64)

Note: MI is Motivational Interviewing, SOMI is spirit only MI, and NTC is the non-therapy control condition. For confidence, commitment to moderate and commitment to abstain, the response set for these items ranged from 0 "not at all" to 4 "extremely.".

3. Results

3.1. Condition and period effects on evening drinking

There was no condition-by-period effect on drinking, as the interaction term was non-significant. While there was no significant difference between conditions on drinking, there was a significant decrease in drinking ($B = -0.09$, $SE = 0.04$, $F(1, 2643) = 4.24$, $p < .05$) from the early to the late treatment period.

3.2. Hypothesis 1: condition and period effects on daily confidence, commitment to moderate, and commitment to abstain

Table 3 presents means and standard deviations for the intervening variables by condition across treatment period.

3.2.1. Interaction effects

Mixed effect model results indicated that condition-by-period interactions were non-significant for all three of the intervening variables (see Table 4).

3.2.2. Main effects

Table 4 shows the type III tests for the fixed effects of each of the models. *Pre-randomization confidence* significantly predicted higher levels of *daily confidence* ($B = 1.22$, $SE = 0.14$, $p < .001$). There was a significant main effect of condition on *daily confidence* such that SOMI was significantly *more* likely to have higher levels of confidence than MI ($B = .80$, $SE = 0.14$, $p = 0.01$). There were no differences for SOMI versus NTC or NTC versus MI. There was no significant effect of period on *daily confidence*.

For *daily commitment to moderate*, only the pre-randomization mean was significantly associated with higher levels of *daily commitment to moderate* ($B = 1.29$, $SE = 0.15$, $p < 0.001$). Neither condition nor period effects were significant.

For *daily commitment to abstain*, only the pre-randomization mean was significant ($B = 1.02$, $SE = 0.21$, $p < 0.001$). There were no significant condition or period effects.

3.3. Hypothesis 2: condition effects on the strength of association between intervening variables and evening drinking

Of all the interaction effects, only the condition by *daily commitment to abstain* interaction was significant, discussed further below. The main effects of the three intervening variables were significantly associated with evening drinking such that higher levels of commitment to moderate and abstain and confidence were significantly associated with lower levels of drinking, discussed further below.

3.3.1. Daily confidence

Daily confidence was a significant predictor of evening drinking ($F(2, 2629) = 306.15$, $p < .0001$). There were significant differences in drinking between the low and medium levels of *daily confidence* and between the medium and high levels (see Table 5). The estimated mean number of evening drinks for the low level was 1.34 times greater than the mean in the medium level, which was in turn 1.60 times greater than the mean in the high level.

3.3.2. Daily commitment to moderate

There was a similar pattern for *daily commitment to moderate* ($F(2, 2629) = 339.34$, $p < 0.0001$). Significant differences emerged between the low and medium levels of *daily commitment to moderate* and between the medium and high levels (see Table 5). The estimated mean number of evening drinks for the low level was 1.25 times greater than the mean of the medium level, which was in turn 1.82 times greater than the mean for the high level.

3.3.3. Daily commitment to abstain

Daily commitment to abstain was also associated with evening

Table 4

Type 3 tests of fixed effects for each of the models predicting intervening variables as outcomes.

Effect	Intervening Variable											
	Confidence				Commitment to Moderate				Commitment to Abstain			
	Num DF	Den DF	F Value	P Value	Num DF	Den DF	F Value	P Value	Num DF	Den DF	F Value	P Value
PreRandMean	1	2642	80.89	< 0.001	1	2641	74.91	< 0.001	1	2642	24.44	< 0.001
Condition	2	2642	3.43	0.03	2	2641	2.83	0.06	2	2642	0.50	0.61
Period	1	2642	0.01	0.91	1	2641	0.01	0.93	1	2642	0.81	0.37
Condition*Period	2	2640	1.02	0.36	2	2639	1.06	0.35	2	2640	1.58	0.21

Note: PreRandMean is the respective pre-randomization mean for each outcome variable. Non-significant interaction effects were removed, and the parameter estimates reported here above the bolded line are main effects of condition and period without the interaction term in the model.

Table 5
Final results of tests of condition effects on the strength of association between intervening variables and evening drinking.

Predictor	Contrast	β (SE)	p-value	Ratio of means, 95% CI
Relationships where there was a non-significant condition effect				
Confidence	Low vs. Medium	0.29 (0.03)	< .0001	1.34, (1.26, 1.42)
	Medium vs. High	0.47 (0.03)	< .0001	1.60, (1.50, 1.72)
Commitment to Moderate	Low vs. Medium	0.22 (0.03)	< .0001	1.25, (1.18, 1.32)
	Medium vs. High	0.60 (0.03)	< .0001	1.82, (1.70, 1.94)
Relationship where there was a significant condition effect				
Commitment to Abstain	None vs. Any: All	0.74 (0.03)	< .0001	2.09, (1.97, 2.21)
	None vs. Any: NTC	0.58 (0.05)	< .0001	1.78, (1.61, 1.98)
	None vs. Any: SOMI	0.91 (0.05)	< .0001	2.48, (2.25, 2.74)
	None vs. Any: MI	0.70 (0.05)	< .0001	2.02, (1.81, 2.24)

Note: The second variable listed is the reference group for these comparisons. MI is Motivational Interviewing, SOMI is spirit only MI, and NTC is the non-therapy control condition. All non-significant relationships are not shown. Estimates for confidence and commitment to moderate are reported for models from which the interaction terms were removed.

drinking ($F(1, 2630) = 595.31$, $p < 0.0001$), with *no commitment to abstain* associated with higher evening drinking compared to *any commitment to abstain* (see Table 5). There was a significant difference in this effect across conditions ($F(2, 2628) = 10.57$, $p < .0001$). *No commitment to abstain* was significantly associated with higher evening drinking, with the strongest effect within SOMI (see Table 5). For the SOMI group, the estimated mean for evening drinking in the *no commitment* level was 2.48 times greater than the mean in the *any commitment* level with corresponding factors of 2.02 in the MI group and 1.79 in the NTC group.

4. Discussion

The causal chain theory of MOBC within MI posits that increases in motivation and self-efficacy are the processes by which MI is effective at reducing substance use. The present study aimed to explore whether motivation and self-efficacy outside the therapeutic context (operationalized as commitment to moderate drinking and to abstain from drinking and confidence to moderate drinking) measured via EMA would provide an alternative pathway to change talk to support the theory. In addition, we examined whether differences in condition effects between early treatment and late treatment, found in previous analyses, emerged. Hypotheses were not supported. While drinking decreased significantly from early treatment to late treatment for all groups, there was no effect of time on condition's impact on the intervening variables (commitment to abstain from drinking, commitment to moderate drinking and confidence to moderate drinking). SOMI emerged as a significant predictor of greater daily confidence across the entire treatment period compared to MI, with no other differences between conditions.

Consistent with Morgenstern et al. (2016), EMA measures of commitment to moderate, commitment to abstain, and confidence to moderate all significantly predicted drinking outcomes. Contrary to hypotheses, participants in MI did not demonstrate a stronger relationship between these constructs and drinking, regardless of treatment period, compared to the other two conditions. The only significant condition effect on the relationship between the intervening variables and drinking was again unexpectedly related to SOMI. Participants in SOMI produced the strongest relationship between commitment to abstain and reduced drinking of the three conditions across the entire treatment period with no difference between MI and NTC.

4.1. Possible explanations for current findings

4.1.1. The role of ambivalence

Explanations for why and how these findings emerged are not immediately apparent, but one plausible explanation is to examine the role of ambivalence. The differential effects of SOMI in this study may be explained by the presence of an explicit focus on ambivalence within

MI that did not occur in SOMI. In the original study (Morgenstern et al., 2012a), examination of CT during both sessions 1 and 2 revealed stronger statements of ST (operationalized as negative values of commitment strength in initial session deciles) made in MI than in SOMI, even when overall CT was greater (more positive) for MI. This indicated an overt exploration of ambivalence in MI that was absent in SOMI. While discussing ambivalence may have reduced drinking for MI in early treatment, it appears the explicit exploration of ambivalence was not differentially therapeutic for the longer term. Other studies have demonstrated similar findings related to ambivalence. Results from an analysis of Project MATCH data demonstrated that therapist-reported focus on ambivalence within MI was associated with poor drinking outcomes among clients in the outpatient arm (Magill et al., 2013). Additionally, Miller and Rose (2015) reviewed studies that demonstrated that overt exploration of ambivalence, such as in the form of a decisional balance, may entrench someone in the status quo inadvertently rather than motivating for change. Due to the fact that the meta-analyses by Magill and colleagues (2014, 2018a) found that CT alone did not predict outcomes, but the proportion of change talk to total motivational utterances did suggest that at least some exploration of ambivalence may be helpful. Magill et al. (2014) assert that the relationships between therapist skills, CT and ST are likely dynamic. It remains unknown what level of exploration of ambivalence might yield the best therapeutic outcomes and under what circumstances. Importantly, ambivalence about moderated drinking might be quite different from that of abstinence. An abstinence goal rarely changes over time, while a specific goal for moderation may change frequently throughout treatment, impacted in part by success and failure to achieve the goal during any given week, and ambivalence may change along with it.

4.1.2. Possibility of multiple pathways of behavior change

While findings related to condition differences were unexpected, they may hold little clinical meaning in terms of overall differences in drinking outcomes. All three conditions reduced drinking at significant levels, across time, demonstrating multiple possible pathways to behavior change and reduced drinking. Given that significant results related to SOMI involved two distinct intervening variables, it remains unclear what differentiates paths in terms of mechanisms of action and what should be emphasized by therapists, when, and for whom for optimal change. Given the results of the parent study, as well as findings from other studies of MI (e.g., Morgenstern et al., 2007) that demonstrate a faster behavior change trajectory, it was surprising to find no time effect across conditions. It would appear, for this particular measure or conceptualization of time, that none of the conditions operated faster than the others. Relatedly, it is important to note that MI and SOMI were more similar than different. MI and SOMI differed on only two relationships out of seven tested, suggesting perhaps their similarities outweighed their differences.

4.1.3. Relationship of in-session statements to self-report measures

Given the highly predictive nature of the EMA measures of commitment and confidence on drinking, and the lack of impact of CT on drinking in the parent study, it may be that in-session statements and self-report measures of the same or similar constructs do not correspond with one another as assumed or hypothesized. Hallgren and Moyers (2011) discovered a lack of relationship between cross-sectional, self-report measures of readiness to change and in-session readiness client statements, concluding that motivational statements made in-session did not correspond well to measures of motivation as conceptualized by the Stages of Change and the Transtheoretical Model. In a separate analysis of data from the current study, we examined whether in-session CT, regardless of condition, predicted EMA reports of confidence and commitment to reduce drinking in the week that followed each therapy session (Kuerbis et al., 2018). Hypotheses were not supported. In-session client statements and real-world reports of these constructs were not related. Lack of findings could have been due to a small sample size; however, it is also possible that CT and EMA reports of commitment and confidence measure distinct yet important aspects of motivation and self-efficacy. Findings in aggregate suggest further refinement of these constructs and their measurement across contexts are warranted.

4.1.4. Wishful Thinking?

Relatedly, studies that demonstrate the lack of relationship between self-report measures and in-session statements, along with the present study's documentation of high levels of change talk with overall low levels of EMA reports of confidence and either type of commitment, may suggest that in-session statements are capturing what could be referred to as "wishful thinking". In-session statements may only reflect clients' wish to moderate drinking, yet real world contexts may alter a person's motivation and self-efficacy to such an extent as to make in-session CT irrelevant. As of yet, there is no empirical data to support this directly.

4.2. Study limitations

Findings should be considered in the context of the study's limitations. First, the sample is non-traditional treatment seeking problem drinkers with a goal of moderation. Findings cannot be generalized to other substance using populations, in which MOBC may operate differently. Second, the sample size of the study was relatively small, increasing the risk for Type II error. A larger sample may yield different results. In addition, both the TLFB and the EMA may be reactive, causing an undue influence over all three conditions. While we addressed potential reactivity by including the NTC condition, it is still possible the assessments may be so potent for this particular population that other potential therapeutic condition effects wash out.

Furthermore, early and late treatment periods were defined by using clinical information with a specific research question in mind— doing so may in fact mask other dynamics of change over time. It is also possible that lack of time effects may be due to continued evocation commitment and confidence throughout the entire treatment period.

Importantly, as with any EMA study, lack of compliance may have prevented detection of hypothesized relationships. Due to the wide range of EMA methodologies (such as differences in duration (e.g., 7 vs. 56 days), number of times a day, and number of questions), there is no established standard for EMA compliance rates. The compliance rate of the current study (66%) is comparable to other studies in which similar methodologies were implemented (Mereish et al., 2018; Morgenstern et al., 2012b). For example, the compliance rate for a study with almost identical methodology was also 66% for the first eight weeks of the study period. Other studies with lower participant burden have yielded higher rates of compliance (e.g., Sanjuan et al., 2019).

Finally, it is important to acknowledge that the null relationship between condition and drinking in the parent study may be preventing identification of mechanisms of change in this study. That said, mediational or indirect relationships can still emerge in the absence of main effects (MacKinnon, 2008; O'Rourke and MacKinnon, 2018), which was the focus here.

4.3. Conclusion

This experimental test of mechanisms of motivational interviewing did not yield expected findings. It may be that the heterogeneity of responses to the two conditions prevented large differences between MI and SOMI from being detected. Findings may hint that multiple pathways of change exist. Further research is needed to clarify for whom and under what circumstances particular pathways may be the fastest and most effective.

Contributors

Morgenstern was PI of the original study and contributed to the design and hypotheses to this study and reviewed drafts and edited this manuscript. Kuerbis was project director of the original study, implemented the IVR and was primary for write up of the current manuscript. Lynch was primary on data analysis. Shao was the data manager for the IVR, and she was secondary support on data analysis, contributing the tables to the paper. All authors contributed to and approved of the final manuscript.

Role of funding source

Declaration of Competing Interest

No conflict declared.

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