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## Just showing up is not enough: Homework adherence and outcome in cognitive-behavioral therapy for cocaine dependence

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### Abstract

**Objective**—Homework in cognitive behavioral therapy (CBT) provides opportunities to practice skills. In prior studies, homework adherence was associated with improved outcome across a variety of disorders. Few studies have examined whether the relationship between homework adherence and outcome is maintained after treatment end or is independent of treatment attendance.

**Method**—This study combined data from four randomized clinical trials of CBT for cocaine dependence to examine relationships among homework adherence, participant variables, and cocaine use outcomes during treatment and at follow-up. The dataset included only participants who attended at least two CBT sessions to allow for assignment and return of homework (N = 158).

**Results**—Participants returned slightly less than half (41.1%) of assigned homework. Longitudinal random effects regression suggested a greater reduction in cocaine use during treatment and through 12 month follow-up for participants who completed half or more of assigned homework (3 way interaction  $F(2, 910.69) = 4.28, p = .01$ ). In multiple linear regression, the percentage of homework adherence was associated with greater number of cocaine-negative urine toxicology screens during treatment, even when accounting for baseline cocaine use frequency and treatment attendance; at three-months follow-up, multiple logistic regression indicated homework adherence was associated with cocaine-negative urine toxicology screen, controlling for baseline cocaine use and treatment attendance.

**Conclusions**—These results extend findings from prior studies regarding the importance of homework adherence by demonstrating associations among homework and cocaine use outcomes during treatment and up to 12 months after, independent of treatment attendance and baseline cocaine use severity.

## Keywords

cognitive-behavioral therapy; cocaine; homework; psychotherapy; treatment outcome

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A central component of cognitive-behavioral therapy (CBT) is emphasis on between-session practice assignments, or “homework.” Homework provides opportunities to practice new skills, test new ideas, and generalize learning outside of session (Kazantzis, Whittington, & Dattilio, 2010). Meta-analyses suggest homework adherence (partial or full completion of homework) has been associated with improved CBT outcome across a variety of disorders (Kazantzis et al., 2010; Mausbach, Moore, Roesch, Cardeness, & Patterson, 2010). Other dimensions of homework include its quality (Detweiler & Whisman, 1999). In meta-analyses comparing outcomes of treatments with and without homework, a small-to-medium mean effect size ( $d = 0.48$ ) favored treatments with homework (Kazantzis, et al., 2010). Homework adherence and improved symptoms have been found to be associated in several studies (e.g., Burns & Spangler, 2000; 33Bryant, Simons, & Thase, 1999, although see also Weck et al., 2013). In the addictions literature, homework adherence has been associated with improved symptoms in three studies (meta-analysis  $r = .27$ , Mausbach et al., 2010) and associated with reduced cocaine use as indicated by both self-report and cocaine-negative urine toxicology screens (redacted, 2005; redacted, 2008).

The relationship between homework adherence and symptom change may take several forms, including a direct impact of homework on symptoms or reflecting a third variable such as client motivation (Burns & Spangler, 2000; Gonzalez et al., 2006). Homework adherence has been associated with participant variables indicating clinical severity, (e.g., previous depressive episodes, Bryant, Simons, & Thase, 1999), although direct correlations between initial symptom severity and homework adherence have not been consistently found (e.g., Bryant et al., 1999; Weck et al., 2013). Other potential correlates of homework adherence include therapist, working alliance, task characteristics (Detweiler & Whisman, 1999), and therapist competence (Bryant et al., 1999; Kazantzis, Ronan, & Deane, 2001; Weck et al., 2013). While treatment attendance has been associated with homework adherence (Burns & Spangler, 2000), it has not been examined in all studies (e.g., Weck et al., 2013). Client ratings of homework’s helpfulness have been correlated with treatment attendance in cocaine dependence treatment (Siqueland et al., 2004), suggesting that attendance and client opinions on homework are related but distinct. As prior studies have not consistently included attendance, less is known about whether homework adherence is associated with symptom change when accounting for treatment attendance.

The present trial extends earlier findings that showed an association between homework adherence and cocaine outcomes (redacted, 2005) by using data pooled across four independent outpatient CBT trials, resulting in a larger and more diverse sample, and including data through 12 months after treatment’s end. To avoid overlap, (redacted, 2005), analyses were conducted with and without data from this study.

## Method

Data for these analyses were drawn from four randomized clinical trials (A - redacted, 1998; B - redacted, C - redacted, 2004; D - redacted, 2008) evaluating CBT for cocaine dependence. Trials were conducted by the same research group, using similar assessment batteries and procedures. Participants were included in this analysis if they were assigned to receive CBT and attended at least two CBT sessions, thus having the opportunity to be assigned and to return homework at least once. Three studies (A, B, C) used a 12-week manualized CBT protocol, with follow-up assessments at one-, three-, six-, and 12 months post-treatment. Therapist training included a didactic seminar and completion of at least one closely supervised training case; all sessions were recorded for fidelity monitoring. The remaining study (D) evaluated an 8-week computerized CBT protocol, with follow-up assessments at one-, three-, and six-months post-treatment. As study A, B, C's fidelity measures were similar but not identical and study D represented a different modality of treatment, therapist fidelity data were not included in these analyses. All studies were reviewed and approved by the institutional review board; participants provided written informed consent.

## Measures

**Cocaine use**—We evaluated cocaine use with self-report (percent days abstinent) and a biological measure (percentage of urine specimens that were negative for cocaine metabolites). Self-reported cocaine use in the 28 days prior to randomization, during the treatment period, and at each follow-up period was assessed using the Substance Use Calendar (redacted, 2004), a calendar-format interview based on the Time Line Follow-Back (Sobell & Sobell, 1992). Urine samples were collected weekly or more during treatment and at each follow-up interview, tested for cocaine metabolites, and compared to standard cutoff values (benzoylecgonine level < 300ng/mL considered cocaine-negative). The percentage of cocaine-negative urine samples during treatment was calculated by dividing the number of cocaine-negative urine samples by the number of urine samples obtained. See redacted (2014) for further detail on original trials and operationalization of outcome variables.

**Homework assignment and adherence**—Homework was assigned at most sessions starting with session 1 (studies A, B, C) or at the completion of each computerized CBT module (study D). A dichotomous report of homework assignment at each session was generated from therapist report (studies A, C) or computer (study D); in study B, the report of homework assignment was generated at the subsequent session (was homework completed, not completed, or not assigned?). Study therapists recorded whether participants had partially or fully completed the previous week's homework assignment at each weekly session in studies A, B, and C. In study D, the computer program asked each participant if they had completed homework at the start of each session. Homework adherence was calculated by dividing the number of homework assignments reported as partially or fully completed by number of homework assignments given. For participants who terminated treatment early, the calculation was based on the data from available sessions (number of homework assignments reported as partially or fully completed/number of sessions in which

homework was checked) to avoid artificial deflation given missing homework adherence data for the last session.

## Analyses

Descriptive analyses (mean, percent) were used to examine homework adherence; t-tests, ANOVA, and Pearson's correlation were used to evaluate relationships among homework adherence, participant variables, and treatment attendance. We hypothesized that greater homework adherence would be associated with lower levels of self-reported cocaine use and more cocaine-negative urine toxicology screens. Random effects regression models were used to evaluate relationships of homework adherence to self-reported cocaine use outcomes across time (from baseline to treatment end or to 12-month follow-up). For the random regression models, homework adherence was categorized as an ordinal variable with 3 levels: (1) no homework adherence, (2) some homework adherence, but no more than 50%, or (3) more than 50% of homework assignments completed. For models using data from baseline to treatment end, time was log-transformed to account for the high rate of change in the first weeks of treatment. Piecewise models (Singer & Willet, 2003) were used to evaluate cocaine use from baseline to 12-month follow-up, with both treatment month and treatment phase (weeks 1–12 versus follow-up) as independent variables. These analyses were replicated in a subsample excluding the previously examined study C ( $n = 110$ ). To separate homework adherence from treatment attendance, analyses were replicated in treatment completers only ( $n = 81$ ); a third model included treatment completion as an independent variable. For cocaine-negative urine toxicology screens, longitudinal models were precluded by having only one urine result at follow-up points. The relationship between homework adherence and the percentage of cocaine-negative urine toxicology screens from baseline to treatment end was examined using multiple linear regression; multiple logistic regression was used for urine toxicology screen result at each follow-up point. Models included baseline frequency of cocaine use (self-reported cocaine use in 28 days prior to study), percentage of sessions attended, and study protocol. As the sample size did not permit multiple regression without study C, we examined partial correlations among homework and percentage of cocaine-negative urine toxicology screens for each study, controlling for baseline cocaine use and attendance.

## Results

### Sample Characteristics

Across the four studies, 243 participants were assigned to CBT. Of these, 158 (65.0%) who attended at least 2 CBT sessions were included in this report. Participant demographic information across the 4 studies is presented in Table 1. The sample was largely male ( $n = 115$ , 72.8%), and African-American ( $n = 68$ , 43.0%) or Caucasian ( $n = 73$ , 46.2%). While there were no significant gender or educational differences across studies, participants in trial D were more likely to be employed, married, referred by the criminal justice system, or on public assistance (Table 1). Participants reported they used cocaine a mean of 13.8 of the 28 days prior to randomization ( $SD = 8.51$ ). Across studies, participants attended more than 50% of CBT sessions offered; *post-hoc* testing indicated higher levels of attendance in study C than study B (mean difference = 19.0,  $SD = 5.8$ ,  $p = .01$ , 95% CI = 4.4 – 35.5). There

were no significant main effects of study on self-reported cocaine abstinence (Table 1), suggesting outcomes were similar across CBT protocols and combining data was appropriate.

### Homework Adherence

The mean number of homework assignments given and reported as partially or fully completed were 5.7 ( $SD = 3.3$ ) and 2.6 ( $SD = 2.6$ ) respectively, such that participants returned 41.1% ( $SD = 32.5$ , range 0–100%) of assigned homework. Percentage of homework assignments completed did not differ by gender, race, education, referral by the criminal justice system, previous outpatient mental health treatment, lifetime diagnoses of depression, alcohol use disorder, or anxiety disorder, or current antisocial personality diagnosis (results available on request). Percentage of homework assignments completed was not significantly correlated with percentage of sessions attended ( $r = .14$ ,  $p = .08$ ), nor with baseline cocaine use frequency ( $r = .03$ ,  $p = .71$ ).

### Homework Adherence and Self-Reported Cocaine Use Over Time

Random effects regression indicated a significant reduction in frequency of cocaine use across time. In the model using data from baseline to treatment end (Table 2, model 1), an interaction between percent of homework adherence and time indicated greater cocaine use reduction in those who completed more than 50% of homework assignments compared to those with 50% or less homework adherence, or those who completed no homework (Homework by Time  $F(2, 390.24) = 6.77$ ,  $p = .00$ ). A second model included data from baseline through 12-month follow-up (Table 2, model 2). A three-way interaction between homework group, time, and phase indicated that while the change in cocaine use was greatest during active treatment for those with homework adherence more than 50% of the time compared to those with 50% or less homework adherence, the rate of change in cocaine use during follow-up was less than that during treatment ( $F(2, 910.69) = 4.28$ ,  $p = .01$ ), but the effect of homework group remained significant through follow-up. When these models were repeated in the subsamples excluding study C ( $n = 110$ ), or in treatment completers only ( $n = 81$ ), power was limited. However, the patterns of results did not change direction. To examine whether the relationship of homework to cocaine use was due to treatment attendance, an additional model included a dichotomous indicator of treatment attendance (completed treatment versus dropped out). The three-way interaction between homework, time, and phase remained statistically significant, indicating support for the finding that completion of greater than 50% of homework assigned was associated with less cocaine use during treatment and through follow-up, and suggesting that the relationship of homework to reduced cocaine use was independent of treatment attendance.

### Homework Adherence and Cocaine- Negative Urine Toxicology Screens

The multiple linear regression model indicated that greater homework adherence was associated with more cocaine-negative urine toxicology screens during treatment, even with treatment attendance in the model (Table 3;  $\beta = 0.17$ ,  $t = 2.59$ ,  $p = .01$ ,  $sr^2 = 0.17$ ). Partial Pearson's correlations on homework and percentage of cocaine-negative urine toxicology screens during treatment, controlling for baseline cocaine frequency and attendance, had small samples, and only study C's reached statistical significance. At one-, three-, and six-

months follow-up, logistic regression models for cocaine-negative urine toxicology screen result were significant (Table 4). Homework adherence was associated with cocaine-negative urine toxicology screen at three- month follow-up ( $\beta = 1.02$ , 95% CI = 1.00–1.04,  $p = .01$ ). The model was not significant at 12-month follow-up. Small sample size did not permit meaningful comparison of cocaine-negative urine toxicology screen results for each study at each time point.

## Discussion

This examination of pooled data from four randomized controlled trials evaluating clinician- and computer-delivered CBT indicated that homework adherence was associated with significantly less cocaine use from baseline to treatment end on two indicators (self-report and cocaine-negative urine toxicology screen). Longitudinal models suggested that participants with greater than 50% homework adherence had a greater reduction in cocaine use than those with less homework adherence during treatment and up to 12 months after, even when accounting for treatment attendance. Greater homework adherence was associated with cocaine-negative urine toxicology screens during treatment and at three months' follow-up.

Correlations and bivariate analyses indicated homework adherence was not associated with baseline cocaine use or other participant variables. This was consistent with other studies showing no direct correlation between homework adherence and initial symptom severity (Bryant et al., 1999; Burns & Spangler, 2000) or other participant variables (Weck et al., 2013).

Why might homework adherence be associated with improved outcomes? While homework may be related to participant motivation (Detweiler & Whisman, 1999; Gonzalez et al., 2006), its association with outcomes during and after treatment was independent of treatment attendance. Homework adherence may be associated with acquisition of new skills (Kazantzis et al., 2010), or increases in coping skill quality and quantity (redacted, 2005); skill quality has been shown to mediate the relationship between CBT and substance use treatment outcomes (redacted, 2010). The persistence of homework's association with reduced cocaine use at up to 12 months after treatment also suggests homework may have been associated with learning generalization, although these analyses could not evaluate relationships between homework adherence and skills acquisition or generalization across these four studies.

Despite the emphasis on homework in most CBT protocols and manuals, data on the association of homework and outcomes are still relatively sparse. To date, this is the first report evaluating the role of homework in substance use disorder treatment using combined samples from multiple studies and using longitudinal models to evaluate cocaine use through 12-month follow-up. Other strengths include drawing data from well controlled RCTs based on the same CBT manual; evaluation of cocaine use via both self-report and biological samples; and use of weekly reports of homework adherence rather than retrospective reports (Bryant et al., 1999). Limitations of the current study include the limited range of indicators potentially associated with homework across trials, such as acquisition of coping skills,

motivation, or therapist competence, as these were not collected uniformly across all studies. Other limitations include the absence of data on homework quality or a continuous measure of homework adherence; missing data, particularly at follow-up points; and varying data collection methods on homework completion across studies (Mausbach et al., 2010). These analyses were conducted without correction for multiple analysis. Nevertheless, this report adds to the accumulating evidence that homework is associated with improved outcome in CBT, its positive effects remain even after treatment ends, and it may be a factor associated with the durability of CBT in many samples.

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### Public Health Significance

This examination of data from four randomized trials suggests that homework adherence in cognitive-behavioral therapy for cocaine dependence is associated with better cocaine outcomes during treatment and through 12 months follow-up, independent of the effects of treatment attendance or baseline cocaine severity. This study joins others in demonstrating an association between homework adherence and symptom change during CBT and suggests homework assignment and adherence warrant continued study as key ingredients in CBT.

**Table 1**

Descriptive Statistics on Sample

Study	A		B		C		D		Total		$\chi^2$	df	p
	(N=37) n (%)	(N=60) n (%)	(N=60) n (%)	(N=48) n (%)	(N=13) n (%)	(N=158) n (%)	(N=158) n (%)						
Number (%) female	11 (29.7)	17 (28.3)	11 (22.9)	4 (30.8)	43 (27.2)	0.69	3	.88					
Race*													
White	12 (32.4)	28 (46.7)	31 (64.6)	2 (15.4)	73 (46.2)	<b>21.20</b>	<b>9</b>	<b>.01</b>					
Black	20 (54.1)	27 (45.0)	13 (27.1)	8 (61.5)	68 (43.0)								
Hispanic	4 (10.8)	2 (3.3)	4 (8.3)	3 (23.1)	13 (8.2)								
Other	1 (2.7)	3 (5.0)	0	0	4 (2.5)								
Married	3 (8.1)	19 (31.7)	11 (22.9)	7 (53.8)	40 (25.3)	<b>12.82</b>	<b>3</b>	<b>.01</b>					
Employed full or part time	18 (48.6)	21 (35.0)	17 (35.4)	10 (76.9)	66 (41.8)	<b>9.25</b>	<b>3</b>	<b>.03</b>					
Completed High School	28 (75.7)	52 (86.7)	39 (81.3)	9 (69.2)	128 (81.0)	3.11	3	.38					
Prompted or referred by criminal justice system	6 (22.2)	4 (7.1)	12 (27.9)	5 (38.5)	27 (19.4)	<b>10.52</b>	<b>3</b>	<b>.02</b>					
On public assistance	11 (29.7)	20 (33.3)	7 (14.6)	6 (46.2)	44 (27.8)	<b>7.34</b>	<b>3</b>	<b>.06</b>					
Alcohol use disorder (lifetime)	36 (100)	28 (71.8)	37 (77.1)	9 (69.2)	110 (80.9)	<b>12.18</b>	<b>3</b>	<b>.01</b>					
Depression (lifetime)	8 (22.2)	14 (23.3)	7 (15.2)	5 (38.5)	34 (21.9)	<b>3.36</b>	<b>3</b>	<b>.34</b>					
Anxiety disorder (lifetime)	2 (5.6)	3 (5.0)	10 (20.8)	2 (15.4)	17 (10.8)	<b>8.40</b>	<b>3</b>	<b>.04</b>					
Antisocial personality disorder	16 (61.5)	4 (6.7)	20 (43.5)	4 (30.8)	44 (30.3)	<b>31.64</b>	<b>3</b>	<b>.00</b>					
	<b>M(SD)</b>	<b>M(SD)</b>	<b>M(SD)</b>	<b>M(SD)</b>	<b>M(SD)</b>	<b>F</b>	<b>df</b>	<b>p</b>					
Percentage CBT sessions attended	67.8 (31.6)	56.9 (31.6)	76.9 (28.4)	73.1 (23.9)	66.9 (31.0)	<b>4.15</b>	<b>3,154</b>	<b>.01</b>					
Percentage of homework	43.9 (31.4)	31.9 (32.0)	46.0 (29.5)	57.6 (40.2)	41.1 (32.5)	<b>3.30</b>	<b>3,154</b>	<b>.02</b>					
Percentage days cocaine abstinence during treatment	83.6 (20.5)	77.0 (24.4)	73.8 (31.4)	88.8 (16.0)	78.6 (25.6)	<b>1.82</b>	<b>3,151</b>	<b>.15</b>					

Note. Results that are statistically different across studies with  $p < .05$  are presented in bold text.

\* Low count per cell.

**Table 2**

## Longitudinal Models on Self-Reported Cocaine Use Over Time

Model		Num. df	Den. df	F	p
1: Active Treatment	Intercept	1	264.44	444.10	.00
	Homework	2	264.20	0.81	.45
	Time (log)	1	392.16	243.04	.00
	Homework X Time	2	390.24	6.77	.00
2: Active Treatment and Follow-Up	Intercept	1	364.85	444.96	.00
	Homework	2	364.07	0.75	.47
	Time	1	916.33	162.89	.00
	Phase	1	899.56	106.37	.00
	Homework X Time	2	913.85	4.81	.01
	Homework X Phase	2	898.43	1.49	.23
	Time X Phase	1	913.17	147.21	.00
	Homework X Time X Phase	2	910.69	4.28	.01

Note. Num. = numerator. Den. = denominator. Homework = ordinal variable with 3 levels; (1) no homework adherence, (2) some homework adherence, but no more than half of the assigned homework returned, or (3) more than half of the assigned homework was returned. Time = month of treatment. Phase = active treatment vs. follow-up. Model 1:  $N = 158$ , observations = 528. Model 2:  $N = 158$ , observations = 1050.

Multiple Linear Regression Analysis and Partial Correlations on Percentage of Cocaine-Negative Urine Toxicology Screens

Table 3

	B	SE B	$\beta$	$sr^2$	p
Baseline frequency	-2.15	0.31	<b>-0.47</b>	-0.46	<b>.00</b>
Attendance	0.29	0.08	<b>0.23</b>	0.23	<b>.00</b>
Study protocol	0.82	2.43	0.02	0.02	.74
Homework	0.21	0.08	<b>0.17</b>	0.17	<b>.01</b>
(constant)	51.86	9.87			
Total $R^2$	0.34				
Total Adjusted $R^2$	0.33				
Total R	0.59				
Total F(6, $n-7$ )	<b>19.80</b>				
p	.00				
n	157				

Partial Correlations between Homework Adherence<sup>a</sup> and Cocaine-Negative Urine Toxicology Screens<sup>b</sup>, Controlling for Attendance, and Baseline Cocaine Use Frequency<sup>d</sup>

Study	$r_{abcd}$	p	df	n
A	-.02	.89	32	36
B	.21	.11	56	60
C	<b>.32</b>	<b>.03</b>	44	48
D	.39	.24	9	12
A,B,D	.16	.10	105	109
All	<b>.21</b>	<b>.01</b>	153	157

Note. Bold text denotes significance at  $p < .05$ . Baseline frequency = days of self-reported cocaine use in 28 days prior to trial. Attendance = percentage of sessions attended. Homework = percentage of homework adherence.

**Table 4**  
Logistic Regression on Cocaine-Negative Urine Toxicology Screen at Follow-Up

	Month 1				Month 3				Month 6						
	B	SE B	p	OR	95% CI	B	SE B	p	OR	95% CI	B	SE B	p	OR	95% CI
Baseline frequency	<b>-0.09</b>	0.03	<b>.00</b>	0.91	[0.86, 0.96]	<b>-0.10</b>	0.03	<b>.00</b>	0.91	[0.86, 0.96]	<b>-0.11</b>	0.03	<b>.00</b>	0.90	[0.85, 0.95]
Attendance	0.00	0.01	.96	1.00	[0.99, 1.02]	0.00	0.01	.65	1.00	[0.99, 1.02]	<b>0.02</b>	0.01	<b>.01</b>	1.02	[1.00, 1.04]
Study protocol	-0.09	0.21	.66	0.91	[0.61, 1.37]	0.22	0.25	.37	1.25	[0.77, 2.02]	0.02	0.25	.94	1.02	[0.63, 1.65]
Homework	0.01	0.01	.11	1.01	[0.99, 1.03]	<b>0.02</b>	0.01	<b>.01</b>	1.02	[1.01, 1.04]	0.01	0.01	.05	1.01	[1.00, 1.03]
(constant)	1.25	0.88	.16	3.50		0.03	0.82	.97	1.03		-0.13	0.90	.88	0.88	
<i>Model Statistics</i>															
-2 log likelihood					127.78					109.30					
$\chi^2(4)$					<b>13.99</b>					<b>21.77</b>					
p					<b>.01</b>					<b>.00</b>					
Nagelkerke R <sup>2</sup>					0.17					0.24					
% correct					64.4					71.6					
n					101					109					

Note. Bold text denotes significance at  $p < .05$ . Baseline frequency = days of self-reported cocaine use in 28 days prior to trial. Attendance = percentage of sessions attended. Homework = percentage of homework adherence.