



# A randomized controlled trial examining a cognitive behavioral therapy intervention enhanced with cognitive remediation to improve work and neurocognition outcomes among persons with schizophrenia spectrum disorders

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## ABSTRACT

This single blind, three-armed randomized controlled trial compared cognitive behavioral therapy (CBT) enhanced with cognitive remediation (CBT + CR) to CBT alone and an active control condition on work and neurocognition outcomes for persons with schizophrenia spectrum disorders. Seventy-five adult outpatients with schizophrenia or schizoaffective disorder were randomized to three study conditions ( $N = 25$  per group). The CBT intervention was the Indianapolis Vocational Intervention program (IVIP), consisting of weekly group and individual sessions focused on work-related content. Participants in the CBT + CR group received IVIP and Posit Science computer-based cognitive training. The active control group consisted of weekly vocational support groups and individual vocational support sessions. All participants were placed into a noncompetitive work assignment and were followed for 26 weeks. Data collection included hours worked, weekly work performance ratings, and neurocognition assessed at baseline and 6 months. Neurocognition was also assessed at 12 months. Data were analyzed using multilevel linear models to account for nested, repeated measures data. Results indicate that participants in the CBT + CR condition worked significantly more hours and had a more positive trajectory of improving global work performance and work quality across the study compared with the CBT alone and vocational support condition. Compared to the other conditions, CBT + CR also had a significant increase in overall neurocognition that continued to the 12 month follow-up, particularly in the domains of verbal learning and social cognition. In conclusion, CBT + CR may be an effective intervention to improve work functioning and neurocognition in persons with schizophrenia.

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## 1. Introduction

Although most people with schizophrenia desire to work, vocational difficulties are common (Luciano and Meara, 2014), leading to economic hardship (Danziger et al., 2009) and poor psychosocial outcomes (Kukla et al., 2012; Twamley et al., 2008). Previous studies examining this vocational dysfunction have highlighted two notable contributors: neurocognitive deficits and negative self-expectations. Neurocognitive deficits including difficulties in learning and memory, executive functioning, attention, and social cognition predict poor work outcomes

(Bryson and Bell, 2003; McGurk et al., 2003); these findings suggest that persons with schizophrenia may struggle at work when they have difficulty attending to, recalling, and flexibly thinking about work tasks. In parallel, defeatist beliefs and self-expectations of failure at work, low self-esteem, and underestimates of work-related skills have been linked to difficulties obtaining work and poor job performance (Campellone et al., 2016; Davis et al., 2004; Kukla et al., 2014).

Several studies have addressed the treatment of cognitive impairments in people with schizophrenia using cognitive remediation (CR) strategies. Prior studies demonstrate that CR improves core cognitive deficits in schizophrenia (McGurk et al., 2007), particularly when paired with psychiatric rehabilitation programs that allow persons to practice acquired skills in real world settings (Medalia and Saperstein, 2013). Going a step further, recent research has also found that CR

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augmentation of vocational rehabilitation is associated with a 20% higher employment rate and increases in hours worked and money earned among persons with schizophrenia (Chan et al., 2015).

Cognitive Behavior Therapy (CBT) approaches are well established as effective treatments addressing self-defeating beliefs and behaviors that occur in many disorders, including schizophrenia. Burgeoning evidence also indicates that CBT is a promising approach to ameliorate maladaptive work-related beliefs and behaviors, leading to significantly enhanced employment outcomes across domains (Kukla et al., 2016; Kukla et al., 2017; Lysaker et al., 2009; Mervis et al., 2016). However, most people with schizophrenia achieve only modest to moderate improvement in work functioning in response to CBT and a minority do not benefit at all from CBT. One possibility is that persisting cognitive deficits hinder the acquisition of cognitive and behavioral skills and application of these elements on the job.

This notion suggests that CR may be needed to amplify the effects of CBT leading to better work outcomes. For instance, it is possible that with improved memory acquired through CR, persons may be able to make more use of CBT in their lives, such as the use of cognitive restructuring on the job to promote positive self-expectations of work success. Another possibility is that with increased capacity for learning and problem solving, people with schizophrenia may be able to more effectively identify, practice, and apply useful behavioral coping strategies on the job. Third, increasing capacity in other neurocognitive areas may allow people to better relate to and have positive workplace interactions with co-workers and supervisors. Hence, to study the effects of CBT enhanced with CR, we compared a combined CBT and CR intervention (CBT + CR) to unenhanced CBT (CBT alone) and a vocational support condition on work and neurocognitive outcomes in adults with schizophrenia spectrum disorders engaged in vocational rehabilitation. First, we hypothesized that the CBT + CR group would experience greater gains in work outcomes compared with CBT alone and vocational support groups across the active study period. Second, we hypothesized that the CBT alone group would have better work outcomes compared to the control group across the active study period. Third, we hypothesized that the CBT + CR group would experience greater gains in neurocognition compared with CBT alone and vocational support groups at the 6 and 12 month follow up periods.

## 2. Methods

Study procedures were approved by the institutional review boards of Indiana University-Purdue University Indianapolis and the Richard L. Roudebush VA Medical Center. After providing informed consent, 75 participants were randomized to one of three conditions using a random number generator in blocks of five to promote balance across the conditions: Vocational support (control group;  $N = 25$ ), work-focused CBT ( $N = 25$ ), or work-focused CBT enhanced with CR; CBT + CR ( $N = 25$ ). The active intervention was 26 weeks during which participants were placed in noncompetitive work positions and attended weekly individual therapy, group therapy, and CR training sessions according to condition assignment. Hours worked (assessed weekly across the 6-month work period), work performance (assessed bi-weekly across 6 months), neurocognition (assessed at baseline, 6 and 12 months) were measured. Assessments were completed by trained research staff blinded to study condition. Participants were paid \$20 for all assessments and \$3.50 per individual, group, and CR training sessions attended.

### 2.1. Participants

Seventy-five adult participants with a Statistical Manual of Mental Disorders, Fourth Edition (SCID-I First et al., 1994) confirmed diagnoses of schizophrenia ( $n = 53$ ; 71%) or schizoaffective disorder ( $n = 22$ ; 29%) were recruited from an urban VA outpatient psychiatry clinic serving 1500 veterans from August 2009 to September 2013. Demographics

are presented in Table 1. Additional inclusion criteria were unemployment, desire to work, and a post-acute phase of illness. Exclusion criteria were presence of a medical condition preventing study participation. Participants with substance use disorders were not excluded. During the study period, participants received medication management and standard outpatient psychiatric treatment.

### 2.2. Interventions

**Cognitive Remediation (CR) Intervention:** Participants randomly assigned to the CBT + CR group performed exercises using Posit Science Brain Fitness and Insight software. Developed using neuroplasticity models, Brain Fitness (auditory) and Insight (visual) hierarchically train cognitive domains by focusing on sensory discrimination and advancing to higher level cognitive abilities including working memory, sequencing, set shifting, and problem-solving. Sustained attention and processing speed are trained throughout. Difficulty is adjusted within training trails to minimize errors and sustain challenge. Scoring points and visual rewards are used to reinforce good performance (Fisher et al., 2009).

The Posit Science training occurred in the “Cog Lab”, an office with computer work stations. Participants progressed through their training plan, which consisted of 4 different exercises performed for 15 min each and involving many trials of the same task. The lab was supervised by trained research assistants who provided one-to-one software orientation and monitoring as needed. Research assistants did not provide “coaching” or suggest strategies to improve performance; rather, they ensured that participants were actively training.

**Cognitive Behavioral Therapy (CBT) Intervention:** The Indianapolis Vocational Intervention Program (IVIP) is a work-focused CBT intervention designed for persons with schizophrenia spectrum disorders engaged in noncompetitive work (Davis et al., 2005). The overall goal of the IVIP is to assist persons to learn to identify cognitive processes and correct work-related dysfunctional beliefs and behaviors. The IVIP includes 26 weekly group sessions and individual sessions. The hour long weekly group sessions center on a rotating manualized curriculum of 4 two-week modules (total of eight sessions): “Thinking About Work”; “Barriers to Work”; “Workplace Relationships”; and “Realistic Self-Appraisal.” Groups sessions include a structured agenda, instruction on the basic CBT principles applied to work, job-related feedback, and peer support. Weekly hour long IVIP individual sessions provide further opportunities for examination of work-related thoughts and behaviors using the CBT principles.

### 2.3. CBT therapist training and fidelity

IVIP therapists were experienced masters level clinicians. After initial training facilitated by the senior author, a clinical psychologist, weekly supervision involved the review of random IVIP individual and group session tapes, assessment of adherence to the CBT model, and feedback on individual fidelity items. Level of adherence to the principles of CBT for individual sessions was assessed using the Revised Cognitive Therapy Scale (CTS-R; Milne et al., 2001) conducted by a trained clinical psychologist. Adequate fidelity was defined as a CTS-R score of 36 on the individual version and a score of 21 on the group version, with no individual items falling below a rating of 2. This score reflects an average rating above “competent” as compared with an “average” skilled therapist. All IVIP therapists maintained at least adequate fidelity during the study period.

### 2.4. Vocational support condition

Vocational support services in the control group were modeled on usual services provided in VA Compensated Work Therapy programs and included 26 hour-long weekly group sessions offering general support of work endeavors and discussion of work-related matters. Support

**Table 1**  
Demographic table by study condition.

Variable	CBT CR N = 25		CBT Alone N = 25		Control N = 25		Total N = 75	
	M	SD	M	SD	M	SD	M	SD
Age	49.24	11.23	47.72	10.31	53.76	8.60	50.24	10.30
Years of Education	12.60	2.02	13.20	2.08	13.00	1.23	12.93	1.81
Yearly Income	928.46	1111.44	825.84	898.18	1007.16	833.32	920.38	942.54
Months of longest past full time work	57.40	69.62	39.04	26.70	74.79	56.20	56.84	55.12
Lifetime hospitalizations	4.84	4.26	4.76	4.80	6.72	10.30	5.44	6.97
PANSS total baseline	74.72	15.09	75.52	13.12	77.36	15.37	75.87	14.40
	N	%	N	%	N	%	N	%
<i>Gender:</i>								
Male	24	96%	22	88%	24	96%	70	93.3%
<i>Ethnicity:</i>								
African American	14	56%	14	56%	15	60%	43	57.3%
White	10	40%	11	44%	10	40%	31	41.3%
Hispanic American	1	4%	0	0%	0	0%	1	1.3%
<i>Diagnosis:</i>								
Schizophrenia	19	76%	16	64%	18	72%	53	70.67%
Schizoaffective disorder	6	24%	9	36%	7	28%	22	29.33%

group facilitators did not teach CBT principles nor include CR content. Participants in the support condition were also offered an individual meeting once per week that focused on providing support regarding specific work scenarios and discussion of real situations that arose on the job. The therapist who provided the support services was not the same therapist who provided the IVIP. Weekly supervision meetings lead by the senior author included fidelity checks of random support group session tapes assessed by a blind rater also utilizing the CTS-R; feedback was provided to therapists to ensure that support principles, rather than elements of CBT, were being appropriately delivered.

## 2.5. Work placements

At baseline, participants were provided noncompetitive job placements that involved working regularly scheduled hours at VA Medical center work sites at a compensation rate of \$3.50 per hour for 26 weeks. Participants worked between 10 and 20 h per week per their preferences; participants were guaranteed 20 h of work and had the opportunity to make-up hours as needed. Work positions were supervised by regular hospital staff. Work placements fit the participant's goals and included positions such as patient escort, housekeeping, and medical administration. Details of placements were independent of research procedures and at the discretion of the work site supervisors; participants could be terminated or work hours reduced for substandard performance.

## 2.6. Clinical instruments

Work duration was characterized by number of hours worked, collected from work supervisors weekly across the 26-week follow-up. Work performance was measured using the Work Behavior Inventory (WBI; Bryson et al., 1997), a 35-item situational assessment. A trained rater blinded to study condition completed the WBI through observation of participants' work behavior and an interview with the participants' supervisor. Each WBI item is behaviorally anchored and rated as a 1 ("persistent problem area") to 5 ("frequent area of strength"). The WBI has five subscales: Work Habits, Work Quality, Personal Presentation, Cooperativeness, and Social Skills. In past studies, the WBI has demonstrated good interrater reliability and concurrent validity (Lysaker et al., 2005).

Neurocognition was measured using the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008). The MCCB has been broadly utilized in studies of persons with schizophrenia demonstrating adequate psychometric properties (Green et al., 2008). The MCCB consists of an overall composite score and subtests that assess seven

cognitive domains, including speed of processing, attention/vigilance, verbal and nonverbal working memory, verbal learning, visual learning, reasoning and problem solving.

Psychiatric symptoms at baseline were assessed by the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987), a 30 item measure rated on a 7-point scale ranging from "Absent" to "Extreme". Research examining the psychometric properties of the PANSS in persons with schizophrenia has found the instrument to have strong inter-rater reliability (Lysaker et al., 2009).

## 2.7. Missing data

As shown in Figs. 1, 67 participants who completed at least one follow-up assessment were included in the analyses. The remaining 8 participants were randomized to a condition, completed the baseline assessment, but were lost to follow-up due to causes including rehospitalization, ceasing VA care and/or transferring to outside care, and moving. Missing data did not differ between study conditions.

## 2.8. Statistical analyses

SPSS 20 was used for analyses. Preliminary analyses examined differences between the study groups on background variables using ANOVA and chi square; the relationships between covariates and outcomes were investigated using Pearson's correlations. Next, to test the hypotheses, the three study groups were compared on continuous outcome variables, including hours worked, overall WBI and subscale scores, and MCCB composite and subtest scores using linear mixed models (LMM) for repeated measures. Fixed effects were utilized to examine between group differences (main effects) and interactions between study group and time. To test the hypotheses, interactions between study group and time (group  $\times$  time) were used as the main contrast, characterizing emerging differences in outcomes between study groups across the study period, rather than at a discrete point in time. Random effects were utilized for intercepts. Lastly, the relationship between treatment adherence, or sessions attended in each condition, and outcomes was examined using Pearson's correlations. *p* values were set at *p* < .05.

## 3. Results

### 3.1. Preliminary and covariate analyses

As shown in Table 2, the study groups did not significantly differ on demographics or primary outcome variables at baseline with the

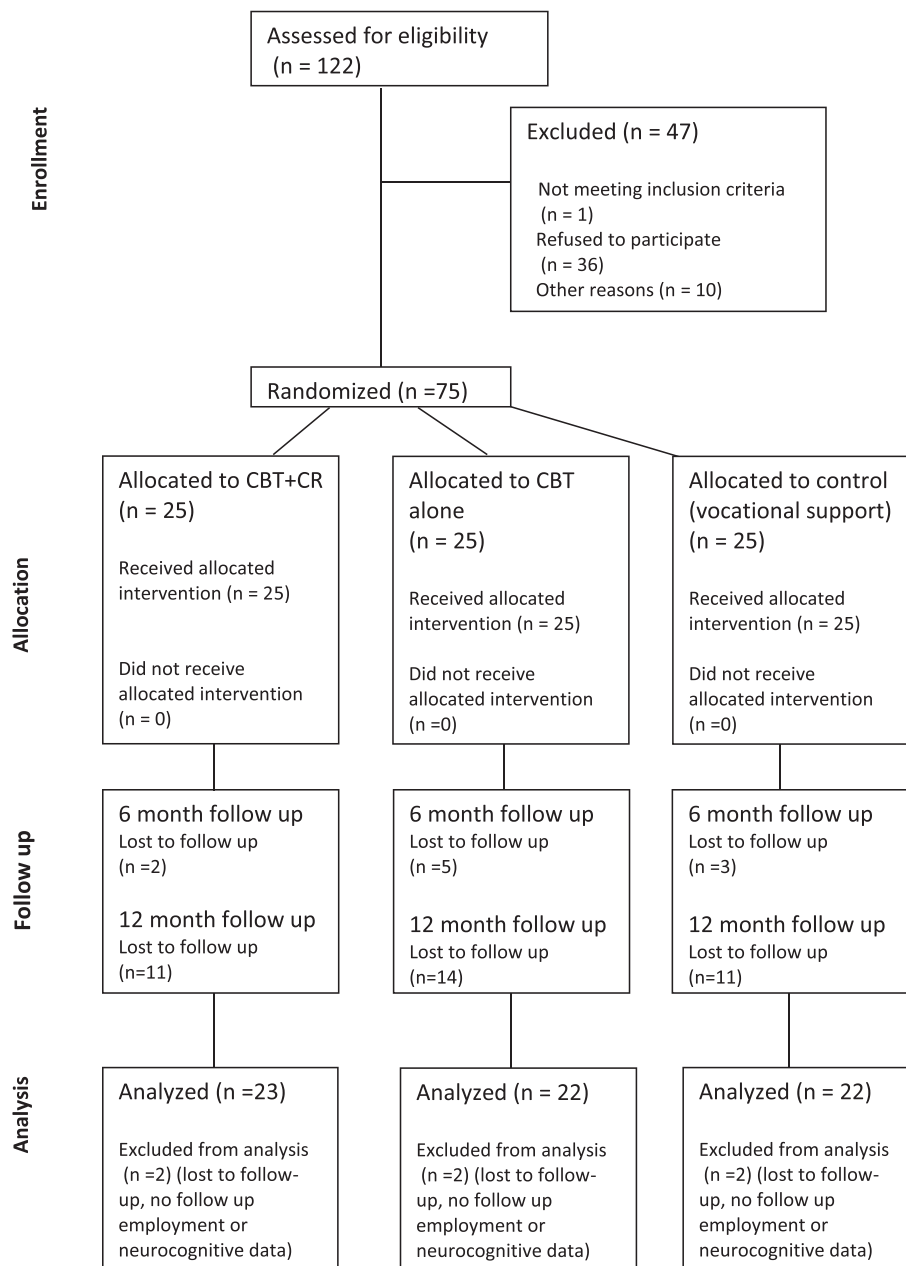


Fig. 1. Flow of participants throughout the study.

exception of MCCB social cognition scores. Work history and symptoms were examined as covariates; both were significantly related to MATRICS composite scores and symptoms were significantly correlated with WBI scores. Thus, all analyses were performed with and without these covariates. Because the results were unchanged, those findings are not reported.

### 3.2. Hypothesis 1: CBT + CR will have improved work outcomes compared with other groups

Descriptive statistics pertaining to work outcomes across time are displayed in Table 2. As shown in Fig. 2, a significant group  $\times$  time interaction effect was found on hours worked across the 6-month active phase,  $F(1,90) = 5.51, p = .02$ . Specifically, the CBT + CR group worked significantly more hours per week across the 6-month active phase compared with the other two study groups.

As shown in Fig. 3, the group  $\times$  time interaction for work performance approached significance,  $F(1, 82) = 2.10, p = .15$ . A one-way ANOVA found that the CBT + CR group had a significantly higher mean WBI score across the active phase compared with the support group;  $F(2,63) = 4.41, p = .016$ . Further, sub analyses reveal that compared with the other groups, the CBT + CR group had a significant improvement in WBI Work Quality across time (group  $\times$  time interaction),  $F(1, 85.1) = 4.62, p = .03$ .

### 3.3. Hypothesis 2: CBT alone will have improved work outcomes compared with vocational support group

The CBT alone group did not differ from the vocational support group on hours worked, work performance, overall work quality, or other WBI subscales across time.



**Table 2**  
Descriptive statistics across time for primary outcomes.

Variable	Support, N = 25		CBT Alone, N = 25		CBT + CR, N = 25	
	M	SD	M	SD	M	SD
Hours worked, weeks 1–8	13.13	7.77	13.62	6.16	12.64	4.76
Hours worked, weeks 9–16	9.85	8.61	9.81	8.46	11.62	5.90
Hours worked, weeks 17–24	10.23	9.65	7.98	7.99	11.66	5.80
WBI total scores, weeks 1–8	3.05	0.35	3.26	0.36	3.24	0.45
WBI total scores, weeks 9–16	3.05	0.33	3.32	0.36	3.36	0.42
WBI total scores, weeks 17–23	3.07	0.39	3.31	0.26	3.39	0.45
WBI work habits, weeks 1–8	3.44	0.71	3.93	0.47	3.71	0.75
WBI work habits, weeks 9–16	3.42	0.84	3.87	0.47	3.89	0.57
WBI work habits, weeks 17–23	3.42	0.81	3.95	0.27	3.86	0.72
WBI work quality, weeks 1–8	2.91	0.31	3.07	0.36	2.98	0.45
WBI work quality, weeks 9–16	2.92	0.39	3.12	0.41	3.15	0.37
WBI work quality, weeks 17–23	2.90	0.32	3.10	0.36	3.19	0.48
WBI personal presentation, weeks 1–8	3.07	0.39	3.26	0.35	3.25	0.47
WBI personal presentation, weeks 9–16	3.15	0.40	3.43	0.49	3.44	0.48
WBI personal presentation, weeks 17–23	3.08	0.50	3.27	0.41	3.41	0.39
WBI Cooperativeness, weeks 1–8	3.06	0.35	3.16	0.29	3.19	0.38
WBI Cooperativeness, weeks 9–16	3.03	0.35	3.18	0.26	3.31	0.46
WBI Cooperativeness, weeks 17–23	3.01	0.37	3.26	0.22	3.34	0.52
WBI Social Skills, weeks 1–8	2.83	0.49	2.94	0.48	3.03	0.46
WBI Social Skills, weeks 9–16	2.88	0.39	3.12	0.55	3.14	0.45
WBI Social Skills, weeks 17–23	2.95	0.36	2.98	0.44	3.16	0.48
MCCB composite baseline	20.26	9.22	27.00	10.92	24.80	9.26
MCCB composite 6 months	21.85	9.04	25.07	11.19	28.33	10.51
MCCB composite 12 months	24.45	10.44	25.13	10.06	32.00	8.80
MCCB verbal learning baseline	33.80	8.82	35.28	8.65	35.72	7.02
MCCB verbal learning 6 months	36.85	7.87	37.50	8.42	40.07	8.75
MCCB verbal learning 12 months	38.91	11.53	34.75	7.61	44.79	8.66
MCCB social cognition baseline <sup>a</sup>	29.36	9.14	39.44	10.76	36.04	12.56
MCCB social cognition 6 months	31.31	10.31	37.93	12.56	39.87	13.89
MCCB social cognition 12 months	29.64	8.66	40.38	14.66	39.71	12.43
MCCB attention baseline	32.09	6.87	36.20	10.85	35.56	8.97
MCCB attention 6 months	31.15	7.45	30.86	11.95	34.40	10.30
MCCB attention 12 months	33.82	10.06	34.75	10.01	37.08	8.64
MCCB reasoning baseline	35.52	3.08	39.60	9.21	36.96	5.83
MCCB reasoning 6 months	37.69	5.56	37.36	6.44	38.60	5.94
MCCB reasoning 12 months	37.64	6.85	38.13	5.77	38.14	4.78
MCCB working memory baseline	29.80	12.24	35.52	9.70	35.84	8.13
MCCB working memory 6 months	31.54	8.59	33.64	12.2	35.47	8.83
MCCB working memory 12 months	33.18	11.08	32.25	11.45	38.36	9.95
MCCB speed baseline	28.40	12.22	34.60	10.18	29.12	10.49
MCCB speed 6 months	28.77	11.03	34.00	10.48	32.47	10.61
MCCB speed 12 months	28.64	9.20	31.75	6.65	34.36	9.97
MCCB visual baseline	32.28	8.71	31.00	13.21	32.76	9.88
MCCB visual 6 months	31.69	10.98	31.64	15.15	36.33	13.31
MCCB visual 12 months	38.46	10.06	32.00	9.34	38.43	10.99
Individual sessions attended	11.08	9.97	10.20	7.90	11.20	6.96
Group sessions attended	12.48	11.26	12.28	8.29	16.52	8.99
Weekly CR training hours	–	–	–	–	2.72	1.30
Total CR training across study	–	–	–	–	68.81	33.72

<sup>a</sup> The support group had significantly lower MCCB social cognition at baseline compared to the CBT alone group (mean difference = 10.1; SE = 3.1);  $F(2, 72) = 5.53, p = .006$ .

### 3.4. Hypothesis 3: CBT + CR will have improved neurocognition outcomes compared with other groups

Descriptive statistics pertaining to neurocognitive outcomes across time are displayed in Table 2. As shown in Fig. 4, during the active phase from baseline to 6 months, there was a significant group  $\times$  time interaction effect for MCCB composite scores; the CBT + CR and support groups significantly improved, whereas the CBT alone group decreased in cognition,  $F(1, 39.6) = 6.15, p = .018$ . In addition, the CBT + CR group demonstrated significant gains over time from baseline to 12 months (group  $\times$  time interaction) compared to the support and CBT alone groups on MCCB composite scores,  $F(1, 43) = 11.50, p = .002$ .

In addition, from baseline to 6 months, there was a group  $\times$  time interaction effect in favor of CBT + CR that trended toward significance for MCCB social cognition,  $F(1, 52.8) = 3.25, p = .08$ . Similarly, on social cognition from baseline to 12 months, the CBT + CR group had a significant trajectory of improvement compared to the other groups (group  $\times$  time interaction),  $F(1, 48) = 8.14, p = .006$ . Furthermore, though there were no significant group differences, all three study groups improved on verbal learning from baseline to 6 months,  $F(1, 52.8) = 6.21, p = .016$ . Group differences emerged across 12 months, as the CBT + CR group had significant gains in verbal learning compared with the support and CBT alone groups (group  $\times$  time interaction),  $F(1, 57) = 9.30, p = .003$ .

There were no significant group or time effects found for any other MCCB domains across the 6 or 12 month follow-up periods.

### 3.5. Session attendance and outcomes

Descriptive statistics pertaining to session attendance are presented in Table 2. The study groups did not significantly differ with regard to individual or groups sessions attended. Among the full sample, mean weekly individual and group sessions attended were significantly correlated with hours worked ( $r = 0.68, p = .00$ ;  $r = 0.75, p = .00$  respectively), but not WBI total or MCCB composite scores. Further, CR dose was significantly correlated with mean hours worked across 6 months ( $r = 0.44, p = .03$ ), but not WBI or MCCB scores.

## 4. Discussion

This study examined the effectiveness of a combined CBT + CR intervention on work and neurocognition outcomes compared with a CBT intervention and a vocational support intervention in persons with schizophrenia receiving vocational rehabilitation services. Consistent with predictions, compared to CBT alone and the active support condition, CBT + CR participants worked more hours over time and had a trajectory of improving vocational performance and work quality during the 6-month intervention, characterized by medium to large effects. In addition, compared to the other groups, those in the CBT + CR condition experienced greater gains in overall neurocognition across the 6 and 12 month follow-up periods; the CBT + CR group also had improvements in social cognition and verbal learning across 12 months. These hypothesized neurocognition improvements over time in favor of the CBT-CR group were also of medium to large effect.

These results are consistent with previous findings demonstrating the effectiveness of CR to improve both important areas of work functioning (e.g., Wexler and Bell, 2005; McGurk et al., 2007) and key neurocognitive outcomes (Wykes et al., 2011). Further, the finding that social cognition also improved is in line with notions that functioning in work settings requires persons to make sense of social cues and thoughts, feelings, and intentions of others (Bell et al., 2009). For instance, it may be that as persons were better able to understand the mental states of co-workers, social exchanges at work served as a beneficial source of support.

Contrary to hypotheses, the CBT alone group did not show a benefit compared to the control group in hours worked over time. These findings may suggest the CBT alone is not sufficient to enhance work outcomes in persons with schizophrenia. However, this interpretation is at odds with a growing body of literature evidencing the benefits of work tailored CBT on vocational outcomes (Kukla et al., 2016; Mervis et al., 2016). Instead, it may be that the CBT alone group learned skills to examine and restructure their thoughts (e.g., beliefs about their worth as an employee) and engage in healthier behaviors (e.g., problem solving on the job), yet they were unable to masterfully implement these skills due to persisting neurocognitive deficits. However, it is notable that the CBT alone group showed modest improvements in overall work behavior and social cognition over 12 months; these gains were not evident in the vocational support condition. These findings are

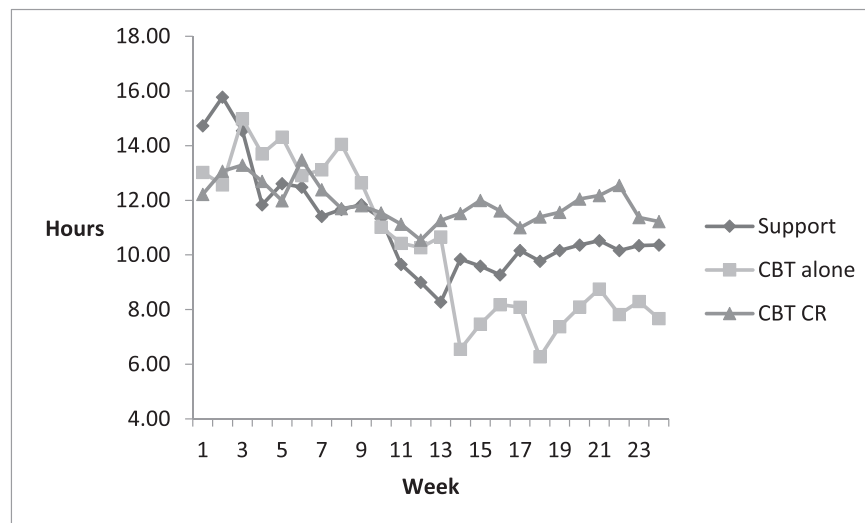


Fig. 2. Mean hours worked weekly across time by study condition.

consistent with the possibility that that CR may operate synergistically with and enhance CBT, contributing to the beneficial effects found in the CBT + CR group. Further research should examine the effects of CR alone versus CBT + CR; this would aid in more specifically elucidating comparative effectiveness and the synergistic impact of these interventions. In addition, understanding the mechanisms by which these treatments exert their benefits by examining the perspectives of participants or through examination of mediators of outcome will be a key future step to potentially bolster the potency of these interventions.

This study has limitations that warrant mentioning. Though the study was focused on whether CR could enhance the effects of CBT and improve work outcomes, as mentioned, the study did not include a CR alone group. This limits the strength of the conclusions that can be drawn. Second, the time CBT + CR participants spent in the CR lab with the lab monitor precludes ruling out attention as a factor influencing results. However, this possible confound is mitigated by the fact that lab monitors minimized contact and did not coach participants, but rather, only provided needed assistance with computer logistics. Third, the overall sample size per condition was modest and statistical power was limited in the analyses of the

WBI which included only working participants, potentially increasing type II error rate. Fourth, the sample was comprised of mostly middle aged adults of white and African American ethnicity, in non-acute phase of illness. It is unclear to what extent these findings generalize to other samples. To increase generalizability, future research should examine the effectiveness of a combined CBT and CR intervention in larger and more heterogeneous samples; this will also increase power and allow for the exploration of mediation links between cognitive and behavioral factors, neurocognition, and employment.

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#### Conflicts of interest

Drs. Kukla, Bell, and Lysaker have no conflicts of interest.

#### Contributors

Drs. Lysaker and Bell designed the study and wrote the protocol. Dr. Lysaker oversaw the execution of the study. Dr. Kukla performed the literature searches, conducted statistical analyses, and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

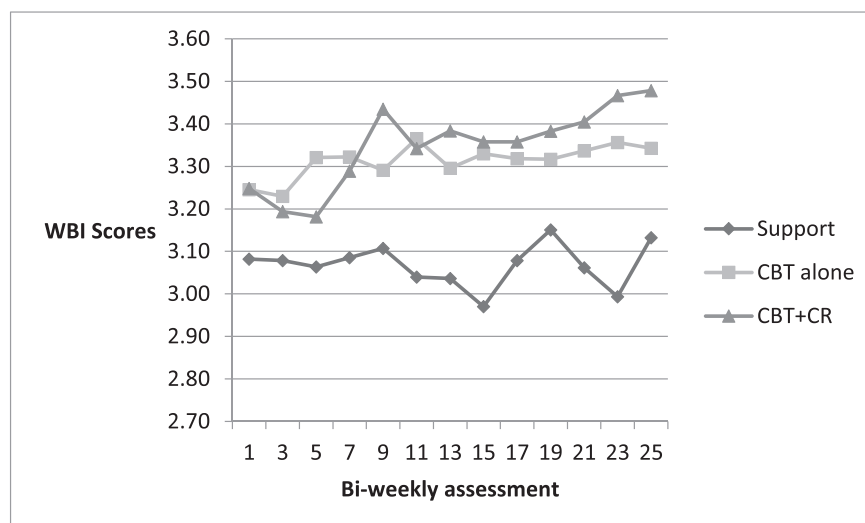


Fig. 3. Mean Work Behavior Inventory scores across time by study condition.

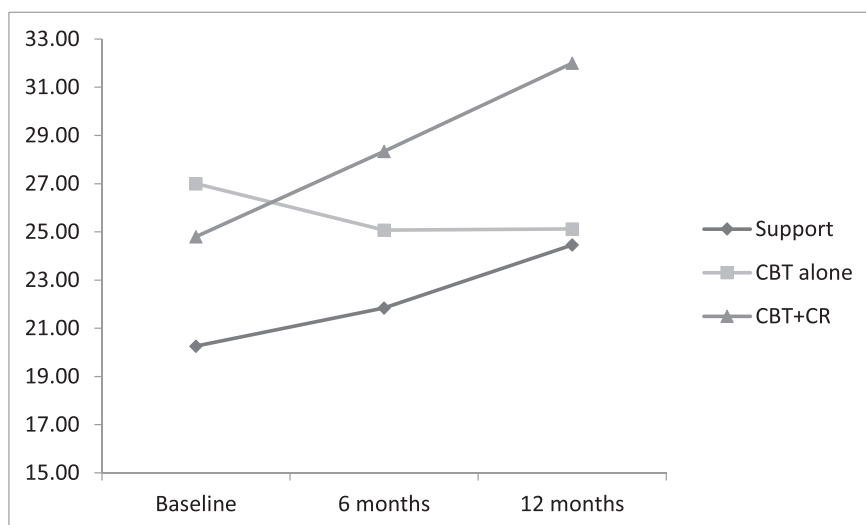


Fig. 4. Mean MATRICS composite scores across time by study condition.

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