

# Cognitive Enhancement Treatment for People With Mental Illness Who Do Not Respond to Supported Employment: A Randomized Controlled Trial

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**Objective:** Cognitive impairment presents a serious and common obstacle to competitive employment for people with severe mental illness, including those who receive supported employment. This study evaluated a cognitive enhancement program to improve cognition and competitive employment in people with mental illness who had not responded to supported employment.

**Method:** In a randomized controlled trial, 107 people with severe mental illness (46% with schizophrenia or schizoaffective disorder) who had not obtained or kept competitive work despite receiving high-fidelity supported employment were assigned to receive either enhanced supported employment (with specialized cognitive training of employment specialists) or enhanced supported employment plus the Thinking Skills for Work program, a standardized cognitive enhancement program that includes practice of computer cognitive exercises, strategy coaching, and teaching of coping and compensatory strategies. Research assistants

tracked competitive employment weekly for 2 years, and assessors blind to treatment assignment evaluated cognitive functioning at baseline, at the end of cognitive enhancement training, and 12 and 24 months after baseline.

**Results:** Participants in the Thinking Skills for Work group improved more than those in the enhanced supported employment only group on measures of cognitive functioning and had consistently better competitive employment outcomes during the follow-up period, including in jobs obtained (60% compared with 36%), weeks worked (23.9 compared with 9.2), and wages earned (\$3,421 compared with \$1,728).

**Conclusions:** The findings suggest that cognitive enhancement interventions can reduce cognitive impairments that are obstacles to work, thereby increasing the number of people who can benefit from supported employment and competitive work.

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Reduced capacity to work is one of the most burdensome consequences of severe mental illnesses such as schizophrenia, resulting in high unemployment rates and dependence on family members and disability payments (1). Despite the high unemployment rates, many people with severe mental illness want to work (2–4). Two decades of research and more than 20 randomized controlled trials have shown that the individual placement and support model of supported employment is more effective than other vocational programs at reducing unemployment (5).

The majority of people with severe mental illness who receive supported employment achieve some competitive work (5). Nevertheless, many participants have difficulty achieving their vocational goals, with at least one-third working

very little or not at all, and many experiencing brief job tenures with unsatisfactory job endings (6). Impaired cognitive functioning consistently predicts unemployment among people with severe mental illness, including those receiving supported employment and other vocational services (7).

Cognitive enhancement (or remediation) programs that target cognitive functioning in order to amplify the effects of vocational rehabilitation have been shown to improve cognitive and work functioning (8–15). These programs have not been extended to people who have failed to benefit from supported employment. In this study, we evaluated whether a validated cognitive enhancement program (11, 12, 14) could improve work outcomes in people who had not benefited from high-fidelity supported employment. We hypothesized

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that cognitive enhancement would improve both cognition and competitive work outcomes.

## METHOD

All study procedures were approved by local institutional review boards and monitored by a data safety and monitoring board.

### Sites

The study sites were two community mental health centers: the Mental Health Center of Greater Manchester, N.H., and Thresholds, Inc., in Chicago, both of which are large, private nonprofit agencies providing comprehensive psychiatric services, including pharmacological treatment, case management, and psychosocial programming for people with severe mental illness.

### Participants

All participants had failed to benefit from supported employment at one of the two study sites. To be included, participants 1) had to meet state definitions (in New Hampshire or Illinois) of severe mental illness, with a DSM-IV axis I diagnosis and persistent impairment in multiple areas of functioning; 2) had to have failed to respond to supported employment, defined as having been enrolled in a supported employment program for at least 3 months but not having worked within that period, or having quit or been fired from a competitive job that lasted less than 3 months; 3) had to want to work, as indicated by responding "yes" to the question "Do you want a competitive job?"; and 4) had to have no evidence of traumatic brain injury or other medical condition with a profound effect on brain functioning.

A total of 107 participants met inclusion criteria, provided informed consent, completed the baseline assessments, and were randomly assigned to enhanced supported employment only ( $N=50$ ) or enhanced supported employment plus the Thinking Skills for Work program ( $N=57$ ) (the interventions are described below). Participant characteristics are summarized in Table 1. For the study's CONSORT flow diagram, see Figure S1 in the data supplement that accompanies the online edition of this article.

### Assessment

Trained clinical interviewers blind to treatment assignment assessed neurocognition, symptoms, and quality of life at baseline, at a postintervention assessment approximately 6 months after randomization, and at follow-up assessments 12 months and 24 months after randomization, usually at the study site. Interviewers had no contact with participants other than for assessments and had no contact with the supported employment team. Participants were instructed before each follow-up assessment not to disclose their group assignment. Researchers established combined-site interrater reliability for symptom and cognitive assessments before the study was initiated, and reliability checks were conducted on 15% of recorded assessments throughout the study. Participants were remunerated for completing

assessments but not for involvement in the treatment programs. Competitive work during the 6 months before study enrollment was collected at baseline through participant interviews, supplemented by data from the supported employment program. Work was tracked weekly by research assistants through contacts with employment specialists, participants, and occasionally the treatment team or the family, triangulating data sources when necessary to resolve discrepancies.

### Measures

Interviewers assessed psychiatric and substance use diagnoses at baseline with the Structured Clinical Interview for DSM-IV Axis I Disorders (16) and reading level with the reading subtest of the WRAT-III (17). At all assessments, interviewers assessed cognitive functioning with the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) Consensus Cognitive Battery (18) and the Trail Making Test, part B (Trails B), symptoms with the Expanded Brief Psychiatric Rating Scale (19) and the subscales delineated by Velligan et al. (20), and psychosocial functioning with the Quality of Life Scale (21).

For all paid jobs lasting at least 1 day, information was collected on hours and weeks worked, wages earned, job tenure, and whether the work was competitive, which was defined as paying at least minimum wage, in an integrated community setting, working directly for the employer rather than for a vocational agency, and not set aside for people with a disability (22). Examples of noncompetitive jobs included being a foster grandparent and babysitting.

### Interventions

All participants continued to receive their usual mental health services throughout the study, including a supported employment program enhanced by training employment specialists in the management of cognitive impairments. Participants were randomly assigned to receive enhanced supported employment only or enhanced supported employment plus the Thinking Skills for Work program.

*Enhanced supported employment.* Supported employment followed the individual placement and support model, the elements of which include program eligibility determined by client's desire for work, focus on competitive employment, rapid job search, attention to client preferences regarding jobs and disability disclosure, follow-along support after attaining work, integration of vocational and clinical services, and benefits counseling (23). Employment specialists carried caseloads of approximately 20 clients, with weekly supervision meetings (without the cognitive specialist) and team meetings (with the cognitive specialist).

Supported employment services were enhanced by teaching employment specialists about cognitive impairments that interfere with work functioning and strategies to help clients cope with them, such as repeating back verbal instructions to facilitate attention and ensure accurate recall (24). Employment supervisors conducted monthly case

consultations with the teams regarding use of coping strategies to address challenging cases. Each employment specialist served participants in both treatment conditions. Potential for contamination between conditions was minimized by providing the manual for the Thinking Skills for Work program only to the cognitive specialist who implemented the program.

*Thinking Skills for Work program.* The cognitive specialist served as a member of the employment team and participated in team meetings. This involved updating the team about participants' progress in the Thinking Skills for Work program, learning about their difficulties with job search or performance, recommending compensatory strategies for reducing the impact of cognitive challenges, and problem solving related to implementing these and other strategies. The cognitive specialist had no contact with participants in enhanced supported employment.

The program began with an assessment of the client's cognitive strengths and weaknesses and their potential contributions to the client's job history. The cognitive and employment specialists collaborated on the assessment, which included self-report, collateral reports, review of prior jobs, and naturalistic observations in the community. Treatment planning focused on cognitive areas that posed challenges to successful employment.

The Thinking Skills for Work program uses three approaches to enhance cognitive performance at work: cognitive exercise practice, strategy coaching, and teaching coping/compensatory strategies. The cognitive specialist engaged participants once or twice weekly in computer-based cognitive practice across the broad range of cognitive domains, using a 24-session standardized curriculum of exercises derived from the COGPACK training program, version 7.0 (25), which has been shown to improve cognitive functioning in schizophrenia (26). Exercises included tasks significantly diverging from neuropsychological tests. Participants received a packet of the cognitive exercise curriculum, which was used to guide exercise completion at an individual pace, to record newly learned strategies and performance scores, and to monitor performance progress. The cognitive specialist supplemented task practice with strategy coaching to improve efficiency of task approach and performance, such as teaching how to chunk information to optimize retention. Broader targets for coaching included work-relevant behaviors observed in the sessions, such as timeliness, focus on the curriculum, and appropriate dress and demeanor.

The decision to use a standardized curriculum of cognitive practice exercises and strategy coaching was informed by several considerations. Cognitive enhancement programs vary in training methods and individualization of exercises (27, 28). Some programs take a "bottom-up" approach to training, with an initial focus on basic cognitive functions (e.g., attention) before progressing to higher-order abilities (e.g., executive functions). Others provide training across the broad range of cognitive functions from the outset. Also, some programs select cognitive exercises based on the individual's specific strengths and weaknesses, with task difficulty

adjusted to the person, whereas other programs use the same training exercises and levels of task difficulty for all participants. No evidence indicates that training method or individualization are related to differential benefits from cognitive enhancement (29), which suggests that a standardized curriculum is the most parsimonious option. Adding strategy coaching to practice exercises is associated with greater improvements in functional outcomes than practice alone in studies of cognitive enhancement and psychiatric rehabilitation (29). We included strategy coaching to facilitate client progress on exercises, to increase engagement, and to establish the relevance of cognitive exercises to work goals.

Based on the assessment, participants were also taught coping strategies to reduce the effects of cognitive impairments on vocational functioning (24). Specific strategies were identified from input from the client and the employment specialist; they were initially taught by the cognitive specialist and were followed up by the employment specialist. This teaching often occurred in a parallel or integrated fashion with the cognitive exercises, but sometimes took place after their completion, as needed to optimize work performance. After completing the cognitive exercises and teaching coping strategies, the cognitive specialist continued to work as a consultant with the employment specialist and the client.

### Fidelity

Fidelity to the individual placement and support model was assessed annually at each site with the 15-item Supported Employment Fidelity Scale (30) or the 25-item revised version (31). Total scores on these instruments (means of 70 and 104 for the two scales, respectively) indicated high fidelity at both sites. The two lead authors measured fidelity to cognitive enhancement using the Thinking Skills for Work Fidelity Scale, which contains 11 items, each rated on 5-point Likert scales, and three subscales: staffing (e.g., cognitive specialist), services (e.g., cognitive assessment, computer cognitive exercises), and integration (e.g., integrating cognitive exercises, coping strategies, supported employment). Total scores (mean=48) indicated high fidelity at both sites.

### Screening, Recruitment, and Randomization

Treatment teams identified potential study participants and referred them to the site research coordinator. Eligible and interested participants signed consent forms, completed baseline assessments, and were randomly assigned to the enhanced supported employment program with or without the Thinking Skills for Work program via a computer program operated by an off-site data manager; no study personnel were aware of assignments in advance. Randomization was stratified by site, history of competitive work, and recent work in supported employment (no work  $\geq 3$  months or loss of job held  $\leq 3$  months). Participants in the enhanced supported employment only group were yoked to participants in Thinking Skills for Work group for the postintervention assessment in order to equate the two groups on duration of time between baseline and postintervention assessments.

## Statistical Analysis

Based on our previous study comparing usual supported employment with and without the Thinking Skills for Work program (12, 13), we estimated power to detect a group effect size (Cohen's  $d$ ) of 0.91 on competitive work over 2 years using independent-groups  $t$  tests (32). With a type I alpha of 0.05, an initial planned sample size of 80, and attrition estimated at 10%, the power to detect a significant difference at the end of treatment is 0.93. Because the attrition rate was somewhat higher than anticipated, we increased the target sample size to 110 participants.

An overall composite measure of cognitive functioning was established using methods employed in our previous research (13, 14, 33). The primary performance scores for each cognitive test were standardized (by computing  $z$ -scores) across all assessment points. Then, within each assessment, the signs of  $z$ -scores of timed tests were reversed so that more positive scores indicated better performance, and the  $z$ -scores were summed. Cronbach's alpha was 0.79 for this composite measure, indicating moderately high internal reliability.

Demographic, cognitive, and clinical differences between the two groups at baseline were evaluated using chi-square analyses or  $t$  tests. Intent-to-treat analyses were conducted for all outcomes, regardless of level of participation in the assigned treatment program. Parallel exposure analyses were conducted for the cognitive and work outcomes to compare participants in the Thinking Skills for Work condition

**TABLE 1. Characteristics of Participants in the Thinking Skills for Work and Enhanced Supported Employment Only Groups (N=107)**

Variable	Thinking Skills for Work (N=57)		Enhanced Supported Employment Only (N=50)		Total	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	45.12	11.33	42.94	10.71	44.07	11.04
	N	%	N	%	N	%
Site						
Manchester, N.H.	38	66.7	37	74.0	75	70.0
Chicago	19	33.3	13	26.0	32	30.0
Male	34	59.6	36	72.0	70	65.4
Hispanic	5	8.8	7	14.0	12	11.2
Race						
White	49	86.0	43	86.0	92	86.0
Black or African American	6	10.5	5	10.0	11	10.3
Asian	1	1.8	1	2.0	2	1.9
More than one race	1	1.8	1	2.0	2	1.9
Marital status						
Never married	35	61.4	34	68.0	69	64.5
Married	5	8.8	5	10.0	10	9.3
Separated	1	1.8	3	6.0	4	3.7
Divorced	14	24.6	7	14.0	21	19.6
Widowed	2	3.5	1	2.0	3	2.8
Education						
Less than high school	16	28.1	15	30.0	31	29.0
High school, GED, or more	41	71.9	35	70.0	76	71.0
Diagnosis						
Schizophrenia	14	24.6	11	22.0	25	23.4
Schizoaffective disorder	11	19.3	13	26.0	24	22.4
Bipolar disorder	12	21.1	13	26.0	25	23.4
Major depression	12	21.1	6	12.0	18	16.8
Other	8	14.0	7	14.0	15	14.0
Current substance use disorder						
None	43	75.4	32	65.3	75	70.8
Alcohol use disorder	3	5.3	2	4.1	5	4.7
Drug use disorder	3	5.3	10	20.4	13	12.3
Alcohol and drug use disorder	8	14.0	5	10.2	13	12.3
Lifetime substance use disorder						
None	24	42.1	17	34.7	41	38.7
Alcohol use disorder	11	19.3	6	12.2	17	16.0
Drug use disorder	7	12.3	8	16.3	15	14.2
Alcohol and drug use disorder	15	26.3	18	36.7	33	31.1
Competitive work history (12 months or more)	10	17.5	9	18.0	19	17.8
Competitive work in past 5 years	33	61.1	35	72.9	68	66.7
Competitive work in past 6 months	7	12.5	12	24.0	19	17.9
Did not work in supported employment in past 3 months	47	82.5	41	82.0	88	82.2
Job loss in supported employment in past 3 months	10	17.5	9	18.0	19	17.8
	Mean	SD	Mean	SD	Mean	SD
Months of supported employment before baseline	26.11	32.05	18.10	20.93	22.36	26.85
Weeks of competitive work 6 months before baseline	0.57	2.03	0.81	2.16	0.68	2.09

## PATIENT PERSPECTIVES

"Mr. E" was a 28-year-old single high school graduate with schizophrenia who lived with his parents and received services from his local mental health center. In the 5 years before joining the Thinking Skills for Work program, Mr. E had been enrolled in supported employment six times, for periods ranging from 3 months to 6 months, seeking restaurant or stock work. When he began the program, he had been receiving supported employment for 5 months but had not worked during that period. His last job had been 9 months earlier, when he had worked part-time as a dishwasher until he was fired 2 months later because of frequent lateness and absences. Mr. E did not want to disclose his psychiatric problems to prospective or current employers, and the vocational team respected his preference by providing all services "behind the scenes."

The initial assessment was based on results from a neuropsychological battery, client self-report, and input from the employment specialist. Mr. E had marked impairments in sustained attention ("I zone out"), information processing speed ("people talk faster than I can listen"), and planning ("I miss appointments"), but he had relative strengths in verbal learning and social cognition. Other strengths included his motivation to work and family support. Mr. E's cognitive challenges interfered with his ability to regularly access vocational services (e.g., missing appointments because of scheduling conflicts), to follow through on the job search (e.g., not following up with prospective employers), and to present well in interviews (e.g., getting distracted easily). When he did obtain jobs, Mr. E had difficulty performing them because of poor time management, inattentiveness to work tasks, and frustration, which led to his being fired or quitting after only a few weeks. When Mr. E had problems on the job, such as being warned by his employer about his work performance, he did not reach out for help from his employment specialist or his family, which, combined with his choice not to disclose his mental illness to employers, limited the assistance he could receive from them.

Mr. E was easily engaged in the COGPACK computerized cognitive practice exercises by the cognitive specialist, who showed him how to track his performance over time, linked the exercises to his preferred type of job (stock work), and suggested strategies for improving his performance on specific exercises. Mr. E spontaneously identified several exercises involving sustained focus that he felt helped with his attention. Over the next few months, Mr. E's self-confidence grew as he gradually improved his sustained attention and response speed on the cognitive exercises—gains that were later confirmed by follow-up neuropsychological assessments.

Mr. E continued to meet with his employment specialist to look for work, and before completing the cognitive exercise curriculum, he obtained a seasonal job performing stock work. To further bolster his ability to focus on his job, the cognitive specialist taught him several coping skills. For

example, Mr. E learned how to self-verbalize the steps of a work task while performing them (e.g., "Sort by size, attach electronic sensor, put on hanger") in order to improve his attention, accuracy, and efficiency. Mr. E's employment specialist reviewed these coping strategies during weekly off-site meetings with him. Mr. E performed his job well, which ended as expected 2 months later, with the additional bonus of an excellent letter of reference.

After the job ended, Mr. E completed the cognitive training exercises and got another job doing stock work. Although Mr. E met regularly with his employment specialist, he did not tell his employer that he was unhappy with his assigned night and weekend shifts, and he abruptly quit the job after only 4 weeks. Mr. E's cognitive specialist and employment specialist worked with him to learn job-related problem-solving strategies. The primary strategy he was taught was how to recognize several specific problems (e.g., difficulty performing job duties, dissatisfaction with job), and then to request help from either his employment specialist or his supervisor. The cognitive specialist and employment specialist both engaged Mr. E in role plays to practice this strategy. Mr. E worked hard on learning these strategies, because he wanted to achieve his vocational goals of earning money and moving up the corporate ladder.

Several months later, Mr. E landed a maintenance job at a residential care facility. He had difficulty working fast enough on the job, and for the first time, he asked his employment specialist for help with a problem. With input from the cognitive specialist, the employment specialist taught Mr. E two strategies. First, Mr. E learned how to organize his work tools at the end of his shift so that he would not waste time finding them when his next shift began. Second, Mr. E and his employment specialist broke down his work responsibilities into four separate tasks and set realistic time limits for completing each one. Mr. E learned how to use the timer function on his watch to set an alarm for each work task to aid in its timely completion. As Mr. E became more familiar with the job and able to perform it faster, the employment specialist showed him how to use his watch alarm to gradually reduce the time allotted to each task.

Mr. E succeeded in maintaining this job for the remaining 9 months of the study, during which time his employer increased his hours of work and his hourly wage. At the end of the study, Mr. E provided the following feedback about the Thinking Skills for Work program: "The computer exercises got really hard, especially the mazes [which require planning and speed], but I got better at them. I liked the meetings with my cognitive specialist and employment specialist. When I asked questions, they gave me good feedback, and they helped me solve problems. I used my thinking skills at work, and it helped me stay on the job longer." A follow-up with the vocational team 3 years after Mr. E completed the study indicated that he was continuing to work at this job.

who completed six or more training sessions with participants in the enhanced supported employment only group. Changes in cognitive functioning were evaluated by fitting generalized linear mixed models on the composite cognitive score and individual cognitive test summary scores, with the baseline cognitive score and educational level as covariates, cognitive scores at the postintervention and follow-up assessments as the repeated dependent variables, and treatment group, diagnosis (schizophrenia spectrum versus other), time, and their interactions as independent variables. The main effect for treatment group is a test of whether participants in the Thinking Skills for Work condition differed in cognitive functioning at the postintervention and follow-up assessments from those in the enhanced supported employment only condition, controlling for baseline. The two- or three-way interactions with time were not significant and were dropped from the models. Similar generalized linear mixed model analyses were conducted to compare changes between the two groups in symptoms and quality of life measures.

Trends over time in employment were compared between the groups by dividing the 2-year study period into 6-month intervals and aggregating work/no work, weeks worked, and log of wages earned within each interval. General linear mixed models were fitted for both binary measures (with logit link function and binomial distribution specification) and continuous measures (with identity link function and normal distribution specification) (34, 35). The independent variables were treatment group, diagnosis, their interaction, time, and the group-by-time interaction. Education level and competitive work in the past 5 years were included as covariates, as was total score on the Positive and Negative Syndrome Scale (PANSS) at each assessment as a time-varying covariate. Competitive work (yes/no) and weeks of competitive work in the 6 months before baseline were also included as covariates in the corresponding analyses of work. Chi-square analyses were performed to compare the groups on any work during the 2-year study period. Mann-Whitney tests were used to compare the groups on cumulative 2-year employment data.

**TABLE 2. Summary of Treatment Group Effects and Group-by-Diagnosis Interactions for Cognitive Outcomes in the Intent-to-Treat Analysis (N=107)**

Measure	Treatment Group Effect				Group-by-Diagnosis Interaction		
	df	F	p	Effect Size	df	F	p
Composite cognitive score	1, 98	8.31	0.005	0.50	1, 98	3.59	0.06
Trail Making Test, part A	1, 96	2.23	0.13	-0.14	1, 96	0.26	0.60
Trail Making Test, part B	1, 95	10.93	0.001	-0.48	1, 95	2.59	0.11
Symbol coding (Brief Assessment of Cognition in Schizophrenia)	1, 107	1.41	0.23	0.14	1, 106	0.42	0.51
Hopkins Verbal Learning Test-Revised, delayed	1, 92	2.30	0.13	0.24	1, 91	0.83	0.70
Hopkins Verbal Learning Test-Revised, sum 1-3	1, 113	0.39	0.53	0.04	1, 112	0.84	0.36
Spatial span	1, 95	0.02	0.87	0.07	1, 94	1.57	0.21
Letter-number span	1, 94	0.16	0.68	0.02	1, 93	3.17	0.07
Mazes test (Neuropsychological Assessment Battery)	1, 91	0.15	0.69	0.08	1, 91	1.24	0.26
Brief Visuospatial Memory Test-Revised, delayed recall	1, 94	1.76	0.18	0.40	1, 94	0.00	0.94
Brief Visuospatial Memory Test-Revised, total trials 1-3	1, 97	4.69	0.03	0.50	1, 97	2.03	0.15
Category fluency	1, 88	1.42	0.23	0.17	1, 87	5.13	0.02
Mayer-Salovey-Caruso Emotional Intelligence Test	1, 92	0.51	0.47	0.07	1, 91	2.41	0.12
Continuous Performance Test, Identical Pairs version	1, 94	2.94	0.08	0.24	1, 94	3.87	0.05

## RESULTS

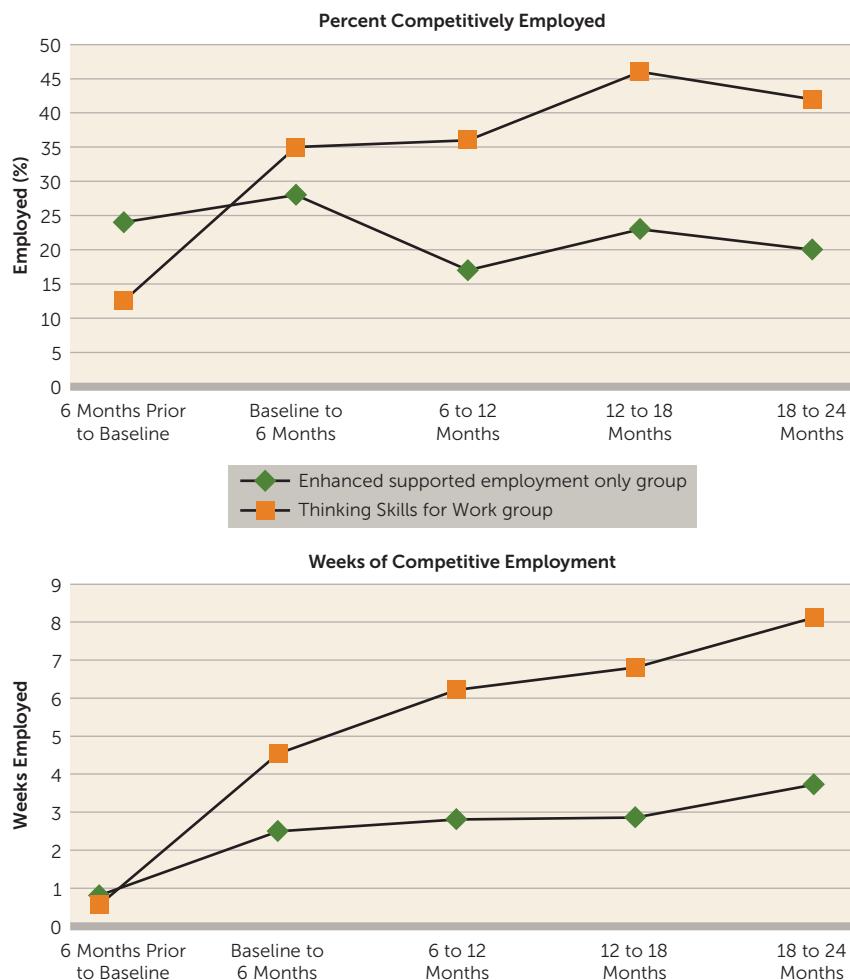
No adverse events related to the cognitive enhancement intervention occurred during the study. The groups did not differ on demographic, diagnostic, cognitive, or quality of life measures at baseline. One significant difference indicated that participants in the enhanced supported employment only group had higher baseline PANSS total scores than those in the Thinking Skills for Work group (mean=65.66 [SD=12.85] compared with mean=60.94 [SD=10.45];  $t=2.09$ ,  $df=105$ ,  $p=0.03$ ).

Forty of the 57 participants in the Thinking Skills for Work group (70%) completed six or more computer cognitive training sessions and thus were categorized as "treatment exposed." The treatment-exposed participants completed an average 21.95 (out of 24) computer training sessions, including 25.3 contacts with the cognitive specialist (mean=25.8 hours) over an average of 154.9 days. After completing computer cognitive training, the treatment-exposed participants had an average of 5.9 contacts with the cognitive specialist (mean=2.3 hours); 61.2% of contacts focused on job planning consultation and 37.3% on job support consultation.

Ninety-one of the 107 participants (85%) received supported employment for at least 6 months, and over the entire study, participants were enrolled in supported employment an average 520.2 days (no group differences). The numbers of participants enrolled in supported employment at each assessment are listed in Figure S1 in the online data supplement.

**TABLE 3.** Linear Trend Analysis for Work Outcomes Over 2-Year Study Period Comparing the Thinking Skills for Work and Enhanced Supported Employment Only Groups (Intent-to-Treat Sample, N=107)

Work Variable	Time Effect			Treatment Group Effect			Effect Size
	F	df	p	F	df	p	
Any competitive work	1.61	3, 235	0.18	8.97	1, 95	0.003	0.49
Weeks of competitive work	2.42	3, 235	0.06	6.24	1, 95	0.01	0.41
Wages from competitive work (log)	1.50	3, 237	0.21	7.15	1, 97	0.008	0.47
Any paid work	0.96	3, 235	0.41	6.20	1, 95	0.01	0.40
Weeks of paid work	3.32	3, 235	0.02	4.63	1, 95	0.03	0.41
Wages from paid work (log)	2.72	3, 237	0.21	4.84	1, 97	0.03	0.37

**FIGURE 1.** Percentage of Participants in Competitive Work and Mean Number of Weeks of Competitive Work in the Thinking Skills for Work and Enhanced Supported Employment Only Groups, During 6-Month Intervals Beginning Prior to Baseline and Over the 2-Year Study Period<sup>a</sup>

<sup>a</sup>The graphs are based on the intent-to-treat sample: 6 months prior to baseline and baseline to 6 months, N=107; 6–12 months, N=102; 12–18 months, N=96; 18–24 months, N=94.

### Cognitive Outcomes

Table 2 summarizes the treatment group effects and the group-by-diagnosis interactions for the generalized linear mixed model analyses of the cognitive outcomes for the intent-to-treat sample. Participants in the Thinking Skills for Work group had significantly better performance than those in the enhanced supported employment only group across the postintervention

and follow-up assessments on the overall composite cognitive score, score for Trails B, and total trials for Brief Visuospatial Memory Test-Revised, controlling for baseline. There were also significant group-by-diagnosis interactions for the category fluency test and the Continuous Performance Test, Identical Pairs version, indicating that participants with schizophrenia or schizoaffective disorder in the Thinking Skills for Work group improved more than those in the enhanced supported employment only group, compared with other diagnoses (see Figure S2A and S2B in the online data supplement).

Analyses of the exposed subsample yielded a similar but stronger pattern for both treatment group effects and group-by-diagnosis interactions (see Table S1 in the data supplement). Descriptive statistics for the cognitive variables at each assessment for each group are provided in Tables S2 and S3 in the data supplement.

### Work Outcomes

Table 3 summarizes the linear trend analyses on work over 2 years. Participants in the Thinking Skills for Work group had better outcomes for competitive work and for all paid work than those in the enhanced supported employment only group. Figure 1 illustrates changes in competitive work and weeks worked from the 6 months before study enrollment to the end of the 2-year follow-up period.

Table 4 summarizes the analyses of cumulative vocational outcomes. Participants in the Thinking Skills for Work group were more likely to work, worked more weeks and hours, and earned more wages over 2 years than those in the enhanced supported employment only group.

## Symptoms and Quality of Life

The groups did not differ significantly in changes in symptom or quality of life measures (intent-to-treat sample).

## DISCUSSION

Previous research has shown that the Thinking Skills for Work program and other cognitive enhancement interventions are effective in improving cognitive functioning and work outcomes in persons with severe mental illness who are new enrollees in supported employment (12, 13) or other vocational programs (8–11, 14, 15). This study differed from previous research by focusing on clients who were already enrolled in supported employment but had not benefited from it, which we defined as not having worked recently or having lost a briefly held job. Although participants had been enrolled in supported employment for an average of 22 months before study entry, only 18% had worked competitively in the previous 6 months, with an average of less than 1 week of work. Despite the prior lack of response to supported employment, participants who received the Thinking Skills for Work intervention improved significantly more in cognitive and vocational functioning than those who continued to receive only the supported employment intervention, which itself was newly enhanced by training employment specialists in recognizing and addressing cognitive challenges.

The increases in competitive work for the Thinking Skills for Work group were substantial in light of the poor history of vocational functioning among these participants, especially considering that the study took place during the financial crisis of 2008. Furthermore, these employment outcomes almost reach benchmarks established for high-fidelity individual placement and support programs (36). For example, 60% of participants in the Thinking Skills for Work group obtained competitive work, compared with the 70% benchmark rate for supported employment programs, whereas only 36% of participants in the enhanced supported employment only group obtained competitive work, compared with 26% of participants in control programs in the benchmark studies. Similarly, participants in the Thinking Skills for Work group worked an average of 6.0 weeks per 6-month period, compared with the benchmark average of 6.7 weeks for supported employment programs, whereas participants in the enhanced supported employment only group worked only 2.3 weeks

**TABLE 4. Cumulative Employment Outcomes for the Thinking Skills for Work and Enhanced Supported Employment Only Groups Over 2 Years (Intent-to-Treat Sample, N=107)**

Measure	Thinking Skills for Work (N=57)		Enhanced Supported Employment Only (N=50)		Analysis	
<b>Competitive employment</b>						
	Mean	SD	Mean	SD	Mann-Whitney (Z)	p
Number of jobs	0.98	1.09	0.76	1.34	1.90	0.05
Weeks worked	23.9	31.4	9.2	19.6	2.58	0.01
Wages earned (\$)	3,421	5,719	1,728	4,531	2.27	0.02
Hours worked	397	671	185	453	2.25	0.02
Duration of first job (weeks)	29.8	31.1	15.4	21.4	1.20	0.22
	N	%	N	%	$\chi^2$	p
Any competitive work	34	60	18	36	5.96	0.02
<b>All paid employment</b>						
	Mean	SD	Mean	SD	Mann-Whitney (Z)	p
Number of jobs	1.16	1.14	0.96	1.48	1.68	0.09
Weeks worked	26.7	32.6	13.1	25.2	2.27	0.02
Wages earned (\$)	3,512	5,713	2,171	4,900	2.00	0.04
Hours worked	420	671	231	495	2.03	0.04
Duration of first job (weeks)	29.9	31.1	13.1	20.0	1.93	0.05
	N	%	N	%	$\chi^2$	p
Any paid work	37	65	22	44	4.70	0.03

per 6-month period, and those in the control programs in the benchmark studies worked only 1.74 weeks. This average rate of about 6 weeks (and 99.2 hours) of competitive work per 6-month period for the whole Thinking Skills for Work group corresponds to an average of 10.4 weeks (and 166.9 hours) worked per 6-month period for the 60% of participants in the Thinking Skills for Work group who worked at some point during the 2-year study. There was also evidence of an upward trajectory in competitive work over the 2-year study period (Figure 1, Table 3), with participants in the Thinking Skills for Work group employed an average of 8.1 weeks during the final 6-month period, or an average of 19.3 weeks of work for the 42% of participants in the Thinking Skills for Work group who worked during the final 6-month period. Clearly, there is a need to continue to develop more and better interventions for helping people with serious mental illness who fail to get work, keep competitive jobs, or work few hours despite high-fidelity supported employment and integrated cognitive enhancement programs. Nevertheless, these results suggest that the Thinking Skills for Work program is effective in helping a significant proportion of clients who have not responded to high-fidelity supported employment enjoy the same financial, social, and clinical benefits of competitive work reaped by the many others who have benefited (37–39).

Participants in the Thinking Skills for Work group improved more on cognitive functioning than those in the enhanced supported employment only group, a finding that extends previous research (8, 10, 11, 13–15) to this previously unstudied population. Psychiatric diagnosis was related to some

improvements in cognitive functioning, but not to employment. In the intent-to-treat analyses, participants with schizophrenia or schizoaffective disorder in the Thinking Skills for Work group, but not those with other diagnoses, improved more than those in the enhanced supported employment only group on the Continuous Performance Test, Identical Pairs version and the category fluency test. For the exposure analyses, these interactions were stronger and were accompanied by a similar interaction for the letter-number span test (Table S1 in the data supplement). However, participants in the Thinking Skills for Work group improved equally in work outcomes, regardless of diagnosis. The impact of different components of the Thinking Skills for Work program (e.g., computer cognitive practice, teaching coping strategies) on specific areas of cognitive functioning and employment may vary among individuals and diagnostic groups.

It should be noted that about one-third of the potentially eligible clients chose not to participate in the study. We did not obtain the characteristics of those who did not provide consent, and thus it is important to better understand non-enrollment and the population to which our results in this trial generalize. To our knowledge, this is the first study of cognitive enhancement to focus on individuals who were operationally defined as not having benefited from an evidence-based psychosocial treatment. Although the rationale for cognitive enhancement is partly based on the association between impaired cognitive functioning and diminished response to psychosocial treatment (7, 28), most research has focused on people with little prior exposure to such treatment. The effectiveness of the Thinking Skills for Work program for persons who did not respond to supported employment suggests that cognitive enhancement may facilitate response to other psychosocial treatments in individuals who have not previously benefited from them (e.g., social skills training, teaching illness self-management). Directing cognitive enhancement to individuals who have not benefited from a psychosocial treatment could result in more efficient use of this limited resource.

In summary, the Thinking Skills for Work program, integrated with supported employment, led to better cognitive and employment outcomes in individuals who had previously not benefited from high-quality supported employment programs. The findings suggest that cognitive enhancement can increase the number of people who benefit from supported employment. While research is needed to better understand how the Thinking Skills for Work program works and whether it can be delivered in a more efficient or individually tailored approach, efforts to disseminate it have immediate potential for reducing the considerable burden of unemployment in this population.

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