

# Work, Recovery, and Comorbidity in Schizophrenia: A Randomized Controlled Trial of Cognitive Remediation

Susan R. McGurk<sup>1–3</sup>, Kim T. Mueser<sup>2–4</sup>, Thomas J. DeRosa<sup>5</sup>, and Rosemarie Wolfe<sup>2,3</sup>

<sup>2</sup>Department of Psychiatry, Dartmouth Medical School, NH; <sup>3</sup>Dartmouth Psychiatric Research Center, Main Building, 105 Pleasant Street, Concord, NH 03301; <sup>4</sup>Department of Community and Family Medicine, Dartmouth Medical School, NH; <sup>5</sup>Department of Vocational Services, The Mount Sinai School of Medicine

**Employment is central to the concept of recovery in severe mental illness. However, common comorbid conditions present significant obstacles to consumers seeking employment and benefiting from vocational rehabilitation. We review research on the effects of three common comorbid conditions on work and response to vocational rehabilitation, including cognitive impairment, substance abuse, and medical conditions, followed by research on vocational rehabilitation. We then present the results of a randomized controlled trial evaluating the effects of adding cognitive remediation to a vocational rehabilitation program compared with vocational rehabilitation alone in 34 consumers with severe mental illness. Consumers who received both cognitive remediation and vocational rehabilitation demonstrated significantly greater improvements on a cognitive battery over 3 months than those who received vocational rehabilitation alone and had better work outcomes over the 2-year follow-up period. Substance abuse was associated with worse employment outcomes, but did not interact with treatment group, whereas medical comorbidity was not related to work outcomes. More research is warranted to evaluate the interactions between substance abuse and medical comorbidity with vocational rehabilitation and cognitive remediation.**

*Key words:* recovery/vocational rehabilitation/medical comorbidities/substance abuse/severe mental illness/cognitive remediation

## Introduction

In recent years, new perspectives on the concept of recovery from schizophrenia and other severe mental illnesses

have stirred debate, renewed hope, invigorated the peer support movement, and challenged treatment providers to adopt a more optimistic attitude and collaborative approach in their work with consumers and their loved ones.<sup>1–4</sup> While the word *recovery* means many different things to different people, work is a common theme that cuts across all definitions of recovery. Work is valued by consumers and other stakeholders alike as it connotes contribution to society and respect and offers the promise of liberating consumers from financial dependence on others and opening the door to more rewarding relationships based on reciprocity and shared responsibility.<sup>5–7</sup> In addition to the importance of work to recovery, enthusiasm has been buoyed by progress in vocational rehabilitation that has made work a real possibility for more consumers than ever before.<sup>8</sup>

Coinciding with the emergence of the recovery paradigm as a guiding vision for self-empowerment, treatment, and rehabilitation, there has been a growing awareness of the extent of comorbidity in schizophrenia. Comorbid problems such as cognitive impairment,<sup>9</sup> substance abuse,<sup>10</sup> and medical disorders<sup>11</sup> are now recognized as highly prevalent in schizophrenia and are associated with a host of negative clinical, health, and functional outcomes, including work. Realizing the goal of recovery requires the recognition, management, and treatment and rehabilitation of comorbid conditions. In this article, we address the impact of comorbidity on recovery of work functioning and response to vocational rehabilitation, describe strategies for minimizing its effects, and provide data from a new study targeting the problem of cognitive impairment in order to improve employment outcomes in vocational rehabilitation.

We begin with a discussion of the importance of work for recovery and the problem of unemployment in schizophrenia. Next, we discuss the effects of comorbidity on work functioning, with a primary focus on 3 of the most pervasive conditions in schizophrenia: cognitive impairment, substance abuse, and medical disorders. We then summarize different vocational rehabilitation models for this population, followed by a review of research on the impact of comorbidity on benefit from rehabilitation. Because research points more strongly to the negative effects of cognitive impairment on employment and

<sup>1</sup>To whom correspondence should be addressed; tel: 603-271-5369, fax: 603-271-5265, e-mail: susan.r.mcgurk@dartmouth.edu.

response to vocational rehabilitation, we describe approaches to cognitive remediation, their effects on work, and recent research integrating cognitive remediation with vocational rehabilitation. We then present data from a recently completed randomized controlled trial evaluating the impact of adding cognitive remediation to vocational rehabilitation and explore the effects of comorbid substance abuse and medical disorders on work outcomes and response to the treatment program. Results are discussed, and future directions for reducing the impact of comorbidity on recovery of work functioning are addressed.

### *Work and Recovery*

Definitions of recovery vary greatly across different individuals, stakeholder groups (eg, consumers, family members, clinicians, researchers), and organizations.<sup>12,13</sup> One critical dimension along which definitions of recovery vary is their emphasis on objective vs subjective criteria. At one end of this dimension lie definitions of recovery that seek to be purely objective and employ criteria based on the same signs and symptoms used to diagnose a psychiatric disorder, which yield categorical judgments as to whether a person has or has not *recovered* from the disorder. Examples of such definitions include the operational criteria for recovery from schizophrenia proposed by Liberman et al<sup>14</sup> and the consensus definition provided by the Remission in Schizophrenia Working Group.<sup>15</sup>

At the opposite end of this dimension are purely subjective definitions of recovery described as a deeply personal experience that defies standard measurement.<sup>16</sup> For example, Anthony defines recovery as “the development of new meaning and purpose in one’s life, beyond the impact of mental illness.”<sup>17</sup> Still other definitions of recovery combine objective and subjective aspects. For example, Noordsy et al<sup>18</sup> proposed 3 broad criteria for recovery: hope, taking responsibility (eg, illness management), and getting on with life (eg, relationships, work).

Despite the apparent differences in definitions of recovery, work is frequently included as a critical element. Because impaired role functioning is included in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* diagnostic criteria for schizophrenia,<sup>19</sup> objective definitions of recovery or remission from the disorder specify work.<sup>14,15</sup> At the other end of the continuum, numerous first-person accounts of the experience of recovery echo the importance of work in terms of self-esteem, connection with others, meeting responsibilities, learning how to manage stress, and self-sufficiency.<sup>7,20–22</sup> Conceptualizations of recovery as a process including objective and subjective aspects usually include some reference to work.<sup>4</sup> For example, based on longitudinal qualitative assessments of consumers with schizophrenia participating in rehabilitation, Spanoil et al<sup>23</sup> identified 3 tasks of recovery: developing an

explanatory framework for understanding schizophrenia, gaining some control over the illness, and moving into “roles that are meaningful, productive, and valued in the larger society.” The importance of work to recovery is also emphasized in the Final Report of the President’s New Freedom Commission on Mental Health: “Recovery is the process in which people are able to live, work, learn, and participate fully in their communities.”<sup>24</sup>

### *Unemployment in Schizophrenia*

Competitive employment rates in schizophrenia are low compared with the general population, with most estimates in the United States and Europe indicating fewer than 20% of people with schizophrenia are working.<sup>25–28</sup> Surveys of consumers with schizophrenia indicate dissatisfaction with the low employment rates, with 55%–70%, indicating an interest in work.<sup>29–31</sup>

The costs of unemployment are high in this population. Aside from the obvious benefits of improved financial resources and assuming a socially value role, work has been linked to modest clinical benefits in people with severe mental illness, including better self-esteem, and less severe symptoms.<sup>32–34</sup> While the impact of work on clinical functioning is not dramatic, there does appear to be some support for the old adage that “work is good therapy.”<sup>35</sup> Furthermore, the promise of work holds the potential for reducing or eliminating disability income payments to at least some people in this population.

### *Comorbidity and Work*

A wide range of comorbid conditions are common in schizophrenia and have the potential to affect employment and response to vocational rehabilitation. In this section, we briefly review 3 of the most important and studied comorbidities in schizophrenia: cognitive impairment, substance abuse, and medical disorders. We did not include depression as a comorbid condition in our review because the symptoms of depression play a role in the differential diagnosis of specific schizophrenia spectrum and mood disorders. We also did not review the research on anxiety disorders in schizophrenia because awareness of this problem has only recently come to light.<sup>36–39</sup> However, preliminary evidence suggests that trauma history and posttraumatic stress disorder may be associated with an attenuated response to vocational rehabilitation.<sup>40,41</sup>

*Cognitive Impairment.* Cognitive impairment is common in schizophrenia and is evident in a broad range of domains such as attention, memory, executive functioning, and information processing speed.<sup>42–44</sup> Further, significant research has demonstrated its clinical and functional significance. Because of the pervasiveness, severity, and contribution to functional compromise, cognitive impairment is often considered a core feature of schizophrenia. However, cognitive impairment has yet

to accepted as a critical feature to the diagnosis of the illness.<sup>19</sup> Therefore, we conceptualize it in this review as a comorbid condition.

Research has repeatedly demonstrated that cognitive impairment is a strong predictor of psychosocial functioning, including work, in schizophrenia.<sup>45-47</sup> In a review of 33 studies examining correlates and predictors of competitive employment in severe mental illness, McGurk and Mueser<sup>48</sup> found strong evidence for the importance of cognitive functioning. Among retrospective, cross-sectional, or prospective studies of general samples of people with schizophrenia or other severe mental illnesses (ie, not including consumers in vocational rehabilitation), 100% of the studies examining cognitive functioning found it predicted work, compared with 87% of studies examining negative symptoms, 78% of studies evaluating psychotic symptoms, and 64% of studies of general symptoms. Among samples of consumers who were receiving vocational rehabilitation services, 56% of the studies examining cognitive functioning found it predicted work, compared with 58% of studies examining negative symptoms, 17% of studies evaluating psychotic symptoms, and 54% of studies of general symptoms. The authors interpreted the significant but attenuated prediction of work from cognitive impairment (and symptoms) in the studies of vocational rehabilitation samples as suggesting that vocational services and the less demanding characteristics of noncompetitive work available in some vocational rehabilitation models (eg, transitional and sheltered employment), may partly, but not entirely, compensate for the effects of these limitations on employability and work performance.<sup>48</sup>

Since publication of this review, further research has underscored the importance of cognitive functioning to work outcomes in severe mental illness.<sup>49,50</sup> Cognitive functioning has been shown to be related to involvement in work and school in persons with first-episode psychosis.<sup>51,52</sup> An analysis of baseline data from the large Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) study ( $N = 1438$ ) provided additional evidence for the negative effect of cognitive impairment on competitive employment in schizophrenia.<sup>27</sup>

Recent research has also shed light on the role of cognitive functioning in response to work rehabilitation programs provided by Veterans Administration services. Lysaker et al<sup>53</sup> reported that consumers with more cognitive impairments at the beginning of participating in the vocational program had fewer improvements in work performance over time than less impaired consumers. In addition, better cognitive functioning at baseline for veterans participating in work rehabilitation was related to more improvements in the coherence of personal narratives.<sup>54</sup> This study suggests that veterans with better cognitive functioning may benefit more from work rehabilitation, both vocationally and cognitively, than those with worse cognitive functioning.

*Substance-Use Disorders.* Substance abuse and dependence are highly prevalent in schizophrenia, with most estimates suggesting about 50% of consumers have a lifetime substance-use disorder, compared with only 15% in the general population.<sup>55</sup> Substance-use disorders have been linked to a worse course of severe mental illness, including more relapses and hospitalizations, poorer psychosocial functioning, and more legal, health, and housing problems.<sup>56</sup> In addition, one of the *DSM-IV* criteria for substance-use disorder is a pattern of use that interferes with school or work. Therefore, comorbid substance-use disorders would be expected to be related to work functioning.

Some research supports the relationship between substance abuse and work,<sup>57-59</sup> including in persons with a first episode of psychosis.<sup>60</sup> A longitudinal study of 152 consumers with schizophrenia or schizoaffective disorder who were participants in a study of integrated dual disorder treatment reported a steady rate of improvement in competitive employment as their substance-use disorder remitted.<sup>61</sup> However, the research is surprisingly mixed, with some studies finding no relationship between substance-use disorder and employment<sup>52,62</sup> or even associations in the opposite expected direction.<sup>63</sup> Inconsistencies between studies in the relationship between substance abuse and work in schizophrenia may be partly due to the fact that substance-use disorders are more common in persons with *better* premorbid social functioning<sup>64,65</sup> and *less* severe negative symptoms,<sup>66-68</sup> which are predictors of better vocational functioning.<sup>48</sup>

Research on the effects of substance abuse on response to vocational rehabilitation has not demonstrated a clear impact. In a review of the relationship between substance abuse and work in 5 rehabilitation programs for persons with severe mental illness, including 2 supported employment programs, Sengupta et al<sup>69</sup> concluded that having a substance-use disorder did not confer worse vocational outcomes. Rogers et al<sup>70</sup> reported similar findings across 3 vocational rehabilitation programs, as did Bell et al<sup>71</sup> in a veteran sample participating in a vocational rehabilitation program. However, it should be noted that lifetime substance use diagnoses were examined in the study by Bell et al. and that the majority of consumers were abstinent during their participation in the program. Drebing et al,<sup>72</sup> studying the Compensated Work Therapy program in the Veterans Administration reported that consumers with psychiatric and substance-use disorders had higher levels of participation in the program and better vocational outcomes than consumers with only psychiatric disorders. The authors interpreted their findings in light of the previously discussed relationship between substance abuse and better premorbid functioning in severe mental illness. Finally, in the large Employment Intervention Demonstration Project (EIDP) study of different models of supported employment, substance-use disorder diagnosis was not related to the probability

of obtaining competitive work and was only marginally significantly related to working fewer hours and earning lower wages.<sup>73</sup> Similar to the Bell study, this study examined lifetime history of substance abuse rather than current substance-use disorder.

### *Physical Illness*

Medical comorbidity is a substantial problem for people with schizophrenia and other severe mental illnesses that is largely blamed for the premature mortality of this population.<sup>11,74</sup> A combination of factors may contribute to this high vulnerability to medical problems, including metabolic effects of antipsychotic medications,<sup>75</sup> receipt of fewer and poorer health care services,<sup>76,77</sup> and an unhealthy lifestyle, as reflected by behaviors such as high rates of smoking,<sup>78</sup> inactivity,<sup>79</sup> and poor diet.<sup>80</sup> Chronic physical illnesses have a major impact on work functioning in the general population, often necessitating supplemental disability income. Therefore, it would be surprising if medical comorbidity was not related to work in people with severe mental illness.

Research does support a relationship between physical health and work in schizophrenia, with greater medical comorbidity related to lower rates of work, both concurrently and prospectively.<sup>81–83</sup> An analysis of baseline data from the CATIE study provided partial support for the association: days worked in the past 30 days and instrumental role functioning on the Quality of Life Scale<sup>84</sup> were both related to self-reported physical functioning on the SF-12,<sup>85</sup> but not to number of medical conditions.<sup>86</sup> Furthermore, in a 10-year study from China in people with schizophrenia, physical illness, and inability to work were both significant predictors of mortality.<sup>87</sup>

Despite the established relationship between medical problems and work in severe mental illness, less attention has focused on whether physical comorbidity is related to employment outcomes in vocational rehabilitation programs. Prospective data from the EIDP study of supported employment programs did show that the presence of a physical comorbid condition (identified through chart review) was predictive of lower rates of competitive employment, fewer hours worked, and lower wages earned over the 2-year follow-up period.<sup>88</sup> Thus, health problems appear to have an important impact on vocational functioning in persons with severe mental illness, although they have been a neglected area of study in research on vocational rehabilitation.

### *Rehabilitation*

Over the past several decades, a growing number of psychiatric rehabilitation methods have been developed and empirically validated for improving the course of severe mental illness, including reducing symptoms, relapses and rehospitalizations, and improving social functioning, role functioning, self-care, and capacity for independent living.<sup>89</sup> Although these areas are broadly considered outcomes of schizophrenia, the different domains of

functioning are semi-independent and tend to be only weakly or moderately intercorrelated with each other.<sup>90,91</sup> Furthermore, the impact of psychiatric rehabilitation tends to be specific to the domain targeted by the program, with limited carry-over to other domains of functioning.<sup>92</sup> Thus, the preponderance of evidence on the effects of psychiatric rehabilitation on work is based on vocational rehabilitation programs.

Although psychosocial treatments tend to yield domain-specific effects, rehabilitation programs targeting nonvocational domains can produce modest improvements in employment. For example, a randomized controlled trial of social skills training in China aimed at teaching interpersonal skills to promote living in the community in hospitalized consumers with schizophrenia reported significantly greater improvements in social relationships, symptoms, and employment and lower rates of relapse and rehospitalization over 2 years following discharge into the community compared with psychoeducation.<sup>93</sup> Similarly, some studies of family psychoeducation have reported beneficial effects on work,<sup>94–96</sup> as well as integrated treatment for cooccurring substance abuse.<sup>61,97</sup> The effects of these interventions on work outcomes appear to be driven, at least in part, by improving symptom control and reducing relapses and rehospitalizations, which are well known to affect employment.<sup>27,98</sup>

Because most of the research on improving work functioning is based on studies of vocational rehabilitation, we briefly review that literature in the following section. In addition, considering the wealth of evidence previously reviewed that cognitive impairment is related to work and response to vocational rehabilitation, we also review research on cognitive remediation, including efforts to combine it with vocational programs.

*Vocational Rehabilitation.* A variety of different approaches to vocational rehabilitation have been developed and evaluated over the past several decades, including skills training methods, sheltered workshops, transitional employment, and supported employment.<sup>89</sup> Over the past decade, a wealth of evidence has accumulated demonstrating the effectiveness of supported employment for severe mental illness. In a recent review of randomized controlled trials, Bond *et al*<sup>8</sup> reported that 15 of 16 studies found superior work outcomes for consumers who received supported employment compared with other vocational models, with an overall medium-large effect size of 0.74.

The term *supported employment* is broadly used in the field to describe an approach to vocational rehabilitation that emphasizes providing supports and assistance to consumers in order to help them find competitive jobs in the community as soon as possible, and to keep those jobs.<sup>89</sup> Supported employment is distinguished from other vocational models in its emphasis on rapid job search for competitive jobs and provision of ongoing

services after successful job acquisition and its de-emphasis on prevocational assessment and skills training. The most widely accepted standardization of supported employment was provided by Becker and Drake,<sup>99</sup> which was adapted for the Substance Abuse and Mental Health Services Administration (SAMHSA) evidence-based practice toolkit on supported employment.<sup>100</sup>

The guidelines for supported employment can be summarized by 7 basic principles: (1) zero exclusion (ie, participation in supported employment is determined by consumer choice alone and no other “readiness” criteria), (2) focus on competitive jobs in integrated community settings, owned by the consumer, that pay competitive wages (rather than sheltered employment reserved for people with disabilities or transitional jobs owned by the agency that consumers work at temporarily), (3) rapid job search, usually commencing within a month of enrolling in the program, (4) respect for consumer preferences in terms of the nature of job sought and types of support services provided, (5) provision of follow-along supports after work is obtained to facilitate maintenance or transition to another job, (6) integration of mental health and vocational services at the level of the treatment team to ensure coordinated delivery of treatment and rehabilitative services and mutual understanding of the importance of work as a consumer goal, and (7) benefits counseling to inform consumers about the impact of work on any disability benefits they may receive or be eligible for, such as supplemental Social Security income and medical insurance. In addition to the standardization of these guidelines in a book<sup>99</sup> and resource kit,<sup>100</sup> a fidelity scale has been developed to measure adherence to these principles.<sup>100,101</sup> Although “pure” supported employment programs are growing in number, in many agencies some of the principles of supported employment are provided in combination with, or adapted to, other vocational models.<sup>102</sup>

While supported employment is the most empirically validated approach to vocational rehabilitation for severe mental illness, there is still ample room for improving its effectiveness. Across most studies, 25%–50% of consumers enrolled in supported employment do not work at all during the 1- to 2-year follow-up period, and among those who do work, unsuccessful job endings and brief job tenures are common.<sup>8,103</sup> Social skills training aimed at improving job tenure in supported employment programs has shown minimal success.<sup>104,105</sup>

The limits of supported employment have led to interest in improving its impact on vocational outcomes. Because of the abundant evidence linking impaired cognitive functioning with poorer work outcomes in consumers receiving vocational rehabilitation,<sup>48</sup> including supported employment,<sup>106,107</sup> recent interest has turned to cognitive remediation as a strategy for improving response to supported employment and other models of vocational rehabilitation.

*Cognitive Remediation.* Cognitive training strategies designed to improve cognitive functioning in schizophrenia were first adapted from approaches developed for traumatic brain injury.<sup>108,109</sup> Cognitive remediation methods often employ individual computer training exercises that target and practice specific cognitive skills (eg, attention, psychomotor speed, memory), although some utilize paper-and-pencil tasks, over training periods ranging from 3 to 6 months or more. While an emphasis of the programs is on improving cognitive functioning, some also teach compensatory strategies for minimizing the effects of persistent cognitive difficulties. Some programs also provide group practice exercises.

A recent meta-analysis of research on cognitive remediation in schizophrenia<sup>110</sup> reported a moderate effect size (0.40) for improved cognitive functioning and somewhat lower but nevertheless significant effect sizes for psychosocial functioning (0.36) and symptom severity (0.28). Although the effect of different cognitive remediation programs on overall cognitive functioning was relatively homogeneously distributed and, therefore, no moderators of treatment effectiveness could be identified, there was significant variability across studies on effects on psychosocial functioning. A significant moderator of the impact of cognitive remediation on functional outcomes was the provision of adjunctive psychiatric rehabilitation: studies that evaluated the effects of adding cognitive remediation to a specific psychiatric rehabilitation program reported significant improvements in psychosocial functioning, whereas studies that compared cognitive remediation alone to usual services did not.

The results of the meta-analysis suggest that combining cognitive remediation with vocational rehabilitation is a more promising approach to improving employment outcomes than providing cognitive remediation alone. The meta-analysis included 2 randomized controlled trials that evaluated the effects on work of adding cognitive remediation to vocational rehabilitation. McGurk and colleagues<sup>111,112</sup> reported that a cognitive remediation program, based partly on COGPACK cognitive training software (COGPACK, version 6.0, Marker Software, Ladenburg, Germany, <http://www.cogpack.de/>) and provided in addition to supported employment, resulted in significantly greater improvement in cognitive functioning over the 3-month computer cognitive training component and better competitive work outcomes 2–3 years later. Vauth et al<sup>113</sup> reported that cognitive remediation, also based partly on COGPACK, improved cognitive functioning during an inpatient cognitive remediation and vocational rehabilitation program and that following discharge and over 1 year of receiving outpatient vocational rehabilitation services, those consumers who had received both programs had higher rates of paid employment than those who received vocational rehabilitation alone.

Since publication of the meta-analysis, 3 more randomized controlled trials have evaluated the effects on work of adding cognitive remediation to vocational rehabilitation. Bell and colleagues evaluated the effects of adding neurocognitive enhancement therapy (NET) to a work therapy program.<sup>114–118</sup> Cognitive remediation resulted in significantly greater improvements in cognitive functioning over the 6-month training period and at a 6-month follow-up and greater work productivity over the follow-up period. In a second study, Bell and colleagues examined the effect of 1 year of NET in addition to a hybrid transitional and supported employment program that also involved the provision of transitional funds to employers to facilitate job placement in community-based jobs over a 2-year period.<sup>117,119</sup> Postcognitive remediation assessments at 1 year indicated significantly greater improvement in cognitive functioning for the consumers who received NET. Furthermore, consumers who received NET demonstrated significantly more competitive work from the fifth to eighth quarters of the study compared with consumers who received vocational services only.

Finally, Lindenmeyer and colleagues<sup>120</sup> compared the impact of a 3-month computer-based cognitive remediation program based on COGPACK combined with weekly discussion groups to an equally intensive computer control intervention in inpatients participating in a vocational program providing paid work in the hospital. The results indicated that consumers who received cognitive remediation improved significantly more in cognitive functioning at the 3-month posttraining assessment than the control consumers and had better work outcomes in the vocational program over the 1-year follow-up period. Taken together, the findings from these 5 studies suggest that the addition of cognitive remediation to vocational rehabilitation programs may improve both cognitive and employment outcomes.

### *The Present Study*

Ample evidence shows that cognitive impairment is an important comorbid condition in schizophrenia and other severe mental illnesses that interferes with recovery of work functioning and improvement in vocational rehabilitation. Recent research indicates that cognitive remediation may be a useful adjunctive treatment that can enhance the impact of vocational rehabilitation, although only 1 study has evaluated its effects in supported employment<sup>111,112</sup> and a second study in a hybrid supported employment program.<sup>117,119</sup> Considering the evidence for impact of supported employment on work,<sup>8</sup> there is a need to better understand the beneficial effects of cognitive remediation on both “high fidelity” and hybrid supported employment programs.<sup>102,121</sup> In addition, while comorbid conditions such as substance abuse or medical disorders can affect work functioning, little at-

ention has been paid to whether they influence the ability of consumers to benefit from combined vocational rehabilitation and cognitive remediation programs.

This study addressed these questions by using a randomized controlled trial to evaluate the impact of adding cognitive remediation to a hybrid vocational rehabilitation program that combined paid internship jobs affiliated with a large medical center with supported employment. In addition to evaluating the impact of adjunctive cognitive remediation on cognitive functioning and work outcomes, the effects of substance abuse and comorbid medical conditions on vocational functioning were also explored.

### **Methods**

The study design was a randomized controlled trial evaluating the impact of adding cognitive remediation to an internship-based vocational rehabilitation program. The study took place at a vocational rehabilitation program affiliated with an urban medical center. All study procedures were approved by the Mount Sinai Institutional Review Board. Study participants provided written informed consent for all study procedures.

#### *Participants*

Inclusion criteria for study participants were (1) 18 years or older, (2) severe mental illness as defined by the New York Office of Mental Health (New York State Chartbook of Mental Health Information. Office of Mental Health. Available at <http://www.omh.state.ny.us/omhweb/chartbook/text.htm>), (3) interest in obtaining work, (4) history of unsatisfactory job ending, defined as either being fired from a job or quitting a job prior to securing another job.

Consumers were enrolled in the study between March, 2002, through December, 2004. A total of 34 consumers signed consent and completed baseline evaluation. Demographic and background characteristics of participants per group are summarized in table 1.

#### *Measures*

Cognitive and psychopathology assessments were conducted at baseline and approximately 3 months later, coinciding with the end of the computer training component of the cognitive remediation program. Psychiatric diagnoses and background information such as educational level and other demographic characteristics were drawn from consumer and staff interviews and medical record review. Assessments were conducted by an evaluator who was blind to treatment assignment. Employment activities were tracked weekly for 2 years following randomization.

**Table 1.** Demographic and Diagnostic Difference of Participants by Treatment Group (VR + CR; VR Only)

Variable	VR + CR (N = 18)		VR Only (N = 16)	
	N	%	N	%
<b>Categorical Variables</b>				
<b>Gender</b>				
Male	11	61	9	56
Female	7	39	7	44
<b>Ethnicity</b>				
African American	11	61	10	63
Hispanic	2	11	3	19
Caucasian	4	22	3	19
Native American	1	6	0	0
<b>Marital Status</b>				
Never Married	14	78	12	75
Ever Married	4	22	4	25
<b>Diagnosis</b>				
Schizophrenia	12	75	9	60
Bipolar	0	0	2	13
Depression/Anxiety	4	25	4	27
<b>Current Alcohol Use</b>				
<b>Disorder</b>				
No	15	83	10	63
Yes	3	17	6	38
<b>Current Drug Use</b>				
<b>Disorder</b>				
No	14	78	9	56
Yes	2	22	7	44
<b>Comorbidity</b>				
No	6	33	3	19
Yes	12	67	13	81
<b>Continuous Variables</b>				
	Mean (SD)		Mean (SD)	
Age	45.5 (9.58)		42.44 (8.52)	
Years of Education	12.22 (2.73)		11.75 (1.81)	
Age at First Hospitalization	22.30 (6.20)		27.29 (9.65)	
Month Since Last Job	66.44 (75.10)		63.44 (47.52)	

**Symptomatology.** Symptoms were assessed with interviews using the Positive and Negative Syndrome Scale (PANSS)<sup>122</sup> pertaining to the prior week. Outcomes on the PANSS were analyzed using the 5-factor solution described by White et al,<sup>123</sup> which includes the following subscales: positive, negative, depression, autistic preoccupation, and activation. Regular reliability checks were conducted with 2 raters, and ratings were discussed, but interrater reliability coefficients were not calculated.

**Cognitive Battery.** A broad range of cognitive functions were assessed at baseline and at the 3-month follow-up, including attention and concentration, psychomotor speed, learning and memory, and executive functions.

**Premorbid academic achievement** was measured with the Wide Range Achievement Test-III (WRAT), Reading subtest.<sup>124</sup> This instrument measures word recognition

reading performance. Performance on this test is relatively preserved in schizophrenia, providing an index of premorbid educational attainment.<sup>125</sup> The WRAT-III measure is the total score for words read correctly, converted to the grade-equivalent score. This measure was only administered at baseline.

**Short-term memory** was measured with the Digit Span (Wechsler Adult Intelligence Scale-R).<sup>124</sup> Subjects are given a number string and asked to repeat it in the same order of presentation (Digit Span Forward) or backward (Digit Span Backward). The measure used was number correct for each condition.

**Psychomotor speed** was measured with Trail Making Test Part A.<sup>126</sup> Trail Making Part A is a timed measure of visual scanning ability and psychomotor speed that requires subjects to connect numbers in order. The measure used was time, in seconds, to complete the task.

**Information processing speed** was assessed with the Digit Symbol Substitution Test (DSST) from the Wechsler Adult Intelligence Scale-R.<sup>127</sup> For the DSST, subjects are asked to copy unique symbols below individual numbers (1–9) for 120 s. Total number of symbols accurately copied is the dependent variable.

**Verbal learning and memory** was assessed with the California Verbal Learning Test (CVLT).<sup>128</sup> The CVLT involves the repeated presentation of a word list that consists of common items that are semantically related to 4 common conceptual categories (food, clothing, spices, or tools). The measures of interest were acquisition, determined by the total words recalled during the 5 acquisition trials (CVLT 1–5), and retention, determined by the total words recalled in the long-delay free recall (LDFR) which occurs 20 min after the last acquisition trial.

**Executive functioning** was assessed with the Trail Making Test, Part B, and the Wisconsin Card Sorting Test (WCST).<sup>129</sup> Trail Making Part B is similar to Part A but is a more challenging task because it requires subjects to connect consecutively numbered and lettered circles by alternating between the 2 sequences. The measure used was seconds to complete Trail Making B. The WCST is a commonly used test of executive functioning that measures cognitive flexibility and problem-solving skills. Subjects are asked to match a series of cards to a set of 4 target stimuli, which are also cards. Subjects are provided with feedback on an item-by-item basis after they sort each of the item cards. After they determine one of the correct dimensions, referred to as “Categories,” 10 correct responses are required before the correct category is shifted to the next one. Continued matching to a category that is no longer correct is considered a perseverative error. The variables of interest were the number of categories achieved (WCST Categories) and percent perseverative errors (WCST PE).

A composite measure of overall cognitive functioning (not including the WRAT) was computed by standardizing each of the cognitive measures (ie, computing  $z$

scores) and averaging those scores, separately for the baseline and follow-up assessments.

### *Comorbidity*

Information about current and past alcohol- and drug-use disorders was obtained from a combination of chart review, consumer interview, and discussion with the treatment team. Based on this information, diagnoses of current and past alcohol or drug disorders (abuse or dependence) were made based on *DSM-IV* criteria.

Information about current medical conditions was obtained in a similar fashion to that described for substance use information. Each medical condition was recorded separately. Medical conditions in the order of frequency of occurrence and the number of people having more than 1, 2, or 3 conditions are listed in table 2. For the purposes of statistical analysis, a mean split was performed (mean [M] = 1.76) with analyses comparing people with 1 or fewer conditions to those with 2 or more.

### *Work*

All paid employment was tracked on a weekly basis through a combination of interviews with consumers and vocational staff members over the 2-year study period. Two types of paid work occurred in the vocational program, including work at hospital-based internship jobs and competitive work in the community. Because internship jobs were reserved for individuals with a psychiatric disability, based on the SAMHSA definition of competitive employment,<sup>121</sup> these jobs were considered noncompetitive employment. For each job, the following information was obtained: job type, competitive/non-competitive, hours worked, and wages earned.

### *Treatment Programs*

All study participants were in a combined vocational and day treatment program that focused on work and accepted only consumers with work goals. Available services included case management, pharmacological treatment, day treatment activities, housing support services, volunteer work at the site, paid internships at the hospital, and supported employment. The day treatment program activities were organized around preparing and facilitating work attainment. Individual counseling, group, and day treatment activities focused on work preparatory activities such as job interviewing skills, career exploration, and identifying and overcoming obstacles to career goals. Participation in the group activities of the day treatment program was voluntarily and not a prerequisite for receiving other vocational services described below.

As a part of their involvement in the combined day treatment-vocational program, all consumers were expected to participate in a range of nonpaid work experiences related to the operation of the overall program.

**Table 2.** Study Participants Medical Comorbidities

Medical Condition	N	%
Hypertension	10	29.4
Diabetes	6	18.6
High cholesterol	6	18.6
Hepatitis C	5	14.7
Chronic back problems	4	11.8
Seizure disorder	4	11.8
Cardiac condition	3	8.8
Gastroesophageal reflux disease	3	8.8
Asthma	2	5.9
Arthritis	1	2.9
Blind in one eye	1	2.9
Cataracts	1	2.9
Cholecystomy	1	2.9
Deep vein thrombosis	1	2.9
Gastric ulcer	1	2.9
Gout	1	2.9
Leucopenia	1	2.9
Tinnitus	1	2.9
Ulcerative colitis	1	2.9
Urinary incontinence	1	2.9
No. of conditions		
1 Comorbidity	7	20.6
2 Comorbidities	8	23.5
3 Comorbidities	6	17.6
More than 3 comorbidities	4	11.7

Whenever possible, work tasks were matched to vocational interests and also gave those who were unsure about their work interests an opportunity to sample a variety of work tasks and environments. Nonpaid work activities included clerical, meal preparation, porter-maintenance, and courier work. Vocational services are described in the next section.

*Vocational Services Program.* The vocational program provided 2 types of services: internships and supported employment, each served by a separate team of vocational staff. The internship program was an innovative vocational rehabilitation model that provided work experience in time limited (up to 9 months), part-time (up to 15 h), integrated (at the Mount Sinai Hospital) jobs, paying predominantly competitive wages or higher, depending on the participants' ability to perform the job duties. There were no prerequisites for participating in the internship jobs other than completing a satisfactory interview. Consumers had a choice of the type of work experience, including clerical, messenger/courier, house-keeping, nursing aid, or food service, where, following



a successful interview, they worked alongside hospital employees in a variety of medical center departments. Internship supervisors who interviewed consumers for jobs were not informed about the nature of the study or about consumers' assignments to treatment conditions in the study. Upon completing an internship work experience, consumers could choose another internship experience or supported employment.

Supported employment was available to participants who had satisfactory performance in an internship job. The supported employment program adhered to most of the principles described in the introduction to this article,<sup>99</sup> including integration of clinical and vocational services, matching jobs to consumers' preferences, skills, and experiences, and ongoing, time-unlimited support from employment specialists, who carried an average caseload of 25 consumers. The program deviated from the zero exclusion and rapid job search principles of supported employment because consumers were encouraged to complete an internship job before enrolling in supported employment. In addition, job development and job support were provided by different vocational staff, in contrast to most supported employment programs in which the same specialist provides the full range of vocational services.

*Cognitive Remediation Program.* Consumers were engaged in approximately 24 h of computer-based cognitive exercises (COGPACK, version 6.0, Marker Software), which provided practice across the broad range of cognitive functions, including attention and concentration, psychomotor speed, learning and memory, and executive functions. Exercises practicing all these areas of cognitive functioning are included within the first 6 cognitive training sessions, with additional sessions then focusing on further practice. The cognitive training specialist instructed consumers on how to complete the cognitive exercises, provided encouragement, and suggested strategies for improving performance on challenging exercises. Sessions required 45–60 min, with consumers usually completing 2 sessions per week for about 16 weeks. Consumers received performance scores on their accuracy and speed after completing each exercise, which they recorded and was used to reinforce them for progress on their performance. Computer exercises were designed to be enjoyable and reinforcing to complete, with difficulty gradually increasing over time.

In addition to computer exercises, consumers participated in a weekly group. Topics in the group included the role of cognition in job performance and problem solving about compensatory strategies for dealing with common challenges on the job, such as remembering tasks, remaining focused, and improving work speed. Employment specialists were asked to attend the group if their consumer was having job performance difficulties so that they could provide input regarding the work prob-

lem and to contribute to the development of strategies or their implementation.

### *Procedures*

Referrals to the study were made by therapists and work services personnel. Prospective participants met with a member of the research team who described the study procedures and, if the consumer was interested, signed informed consent and had a baseline assessment scheduled. Consumers were not paid for assessments. Following completion of the assessments, consumers were randomized to either vocational rehabilitation alone (VR) or vocational rehabilitation and cognitive remediation (VR + CR) by the project coordinator using a computer-generated randomization program. Treatment assignment was not known in advance by study personnel.

### *Statistical Analyses*

First we compared the groups at baseline on the demographic, clinical, and cognitive measures using *t*-tests (continuous variables) and  $\chi^2$  analyses (categorical variables). Second, we computed the percentage of consumers who were exposed to the cognitive remediation program, defined as completing 6 or more cognitive remediation sessions,<sup>112</sup> the average number of sessions completed, and the number of weeks to complete them. Third, in order to evaluate changes over the treatment period in cognitive functioning and clinical variables, we performed a series of analyses of covariance (ANCOVAs), with the cognitive/symptom measures at posttreatment as the dependent variables, the cognitive/symptom measures at baseline as the covariate, and treatment group as the independent variable.

Fourth, we evaluated work outcomes. Because continuous work outcomes were highly positively skewed, main treatment effects were evaluated by performing Mann-Whitney *U* tests comparing the 2 treatment groups on wages earned and hours and weeks worked. To evaluate whether substance abuse directly influenced vocational outcomes or interacted with treatment group, separate analyses were performed for current drug-use disorder and alcohol-use disorder. For these analyses, the work variables were log transformed to minimize skew. For each series of analyses, analyses of variance were performed with current drug-use disorder (or current alcohol-use disorder), treatment group, and their interactions as the independent variables and the work outcomes as the dependent variables. The main effect for drug-use disorder (or alcohol-use disorder) in these analyses is a test of whether the disorder had an overall impact on vocational outcomes, whereas the drug-use disorder (or alcohol-use disorder) by treatment group interaction effect is a test of whether the outcomes of the treatment groups differed significantly as a function of the disorders.

**Table 3.** Changes in Cognitive Functioning From Baseline to Post by Treatment Group (VR + CR; VR Only)

Instrument	Time	VR + CR, Mean (SD)	VR Only, Mean (SD)	F test	df	P	Effect Size
Digit Span Wechsler Adult Intelligence Scale-III Forward	Baseline	6.83 (2.18)	6.86 (1.96)	4.60	1,29	.041*	-0.59
	Post	6.94 (1.80)	8.14 (2.03)				
Backward	Baseline	4.72 (1.99)	5.21 (2.19)	1.37	1,29	.252	0.27
	Post	5.44 (1.98)	5.00 (1.66)				
Digit Symbol Wechsler Adult Intelligence Scale-III	Baseline	35.83 (12.12)	36.00 (9.88)	0.41	1,29	.528	0.13
	Post	36.33 (11.72)	35.21 (8.70)				
Trail Making Part A	Baseline	50.06 (19.75)	51.21 (21.80)	0.031	1,29	.862	0.00
	Post	48.00 (14.86)	47.93 (23.61)				
Part B	Baseline	170.39 (98.75)	181.00 (97.78)	4.14	1,31	.050*	-0.49
	Post	134.33 (83.65)	185.63 (103.78)				
California Verbal Learning Test Trial 1	Baseline	3.94 (1.76)	4.07 (2.09)	0.13	1,29	.718	0.10
	Post	5.50 (2.57)	5.21 (2.81)				
Trials 1–5	Baseline	35.39 (11.27)	37.29 (12.69)	5.15	1,29	.031*	0.28
	Post	41.89 (9.17)	37.79 (14.44)				
Long-Delay Free Recall	Baseline	5.94 (3.26)	6.73 (3.99)	9.43	1,30	.005**	0.44
	Post	8.17 (3.42)	6.60 (3.58)				
Wisconsin Card Sorting Test Total Categories	Baseline	1.56 (2.00)	2.00 (1.76)	0.01	1,25	.935	-0.21
	Post	1.81 (2.20)	2.25 (2.14)				
% Perseverative Errors	Baseline	34.14 (13.63)	29.23 (7.97)	0.04	1,25	.850	0.39
	Post	33.76 (19.14)	29.06 (11.97)				
% Conceptual Level of Responses	Baseline	23.72 (20.55)	30.28 (21.28)	0.04	1,23	.840	-0.19
	Post	25.29 (22.07)	28.79 (18.79)				
Cognitive Composite Score	Baseline	.01 (.64)	-0.01 (.73)	1.65	1,31	.209	0.26
	Post	0.03 (.66)	-0.17 (.78)				
Cognitive Composite Score (excluding Digit Span Forward)	Baseline	0.00 (.61)	-0.01 (.78)	3.13	1,31	.087	0.33
	Post	0.06 (.67)	-0.21 (.82)				

\* $P < .05$ ; \*\* $P < .01$ .

Fifth, the same approach was used to evaluate whether higher levels of medical comorbidity influenced vocational outcomes or interacted with treatment group. Last, we explored whether baseline cognitive performance was more predictive of work over the course of the study among the consumers in the control group than those who received cognitive remediation because only the latter group were expected to improve their cognitive functioning and to learn strategies for compensating for persistent impairments at work during the program, rendering their initial cognitive performance less informative about their work capabilities. This was conducted by computing Spearman correlations between overall cognitive functioning at baseline within each treatment group and total hours, wages, and weeks worked during the study. Stronger correlations between baseline cognitive performance and work during the study for the control group than experimental group would support this hypothesis.

## Results

Statistical tests comparing consumers assigned to VR only or VR + CR indicated no significant differences

in any demographic, diagnostic, or baseline clinical or cognitive performance measures. All participants completed baseline assessment, 32 (94%) completed the 3-month assessment, and 25 (74%) were followed up for 24 months. Participants in the VR + CR group completed an average of 21 (SD = 4.1) computer sessions over an average of 20 (SD = 8.1) weeks. Of the 18 consumers enrolled in the VR + CR group, all (100%) completed at least 6 computer cognitive training sessions and were, thus, exposed to the program.

The results of the ANCOVAs comparing changes over time in cognitive functioning and symptoms between consumers who received cognitive remediation and those who did not are summarized in tables 3 and 4. Significant improvements favoring cognitive remediation were found for several cognitive measures, including Trail Making, Part B, CVLT 1–5, and LDFR. An effect on Digit Span Forward favored the control group as a result of improvement in performance in this group. Because this effect was unexpected given the evidence of stability of cognitive functions in outpatient samples in the absence of cognitive enhancing treatments<sup>130</sup> and the lack of change on Digit Span in both treatment and control

**Table 4.** Changes in Positive and Negative Syndrome Scale Scores from Baseline to Post by Treatment Group (VR + CR; VR Only)

Subscale	Time	VR + CR	VR Only	<i>F</i>	Test <i>df</i>	<i>P</i>
		Mean (SD)	Mean (SD)			
Negative	Baseline	2.51 (0.93)	2.15 (0.70)	2.18	1,28	.151
	Post	2.22 (0.76)	2.16 (0.71)			
Positive	Baseline	1.84 (0.70)	2.09 (0.79)	0.13	1,28	.722
	Post	2.04 (0.68)	2.11 (0.88)			
Activation	Baseline	1.53 (0.62)	1.77 (0.72)	1.3	1,28	.297
	Post	1.42 (0.46)	1.71 (0.64)			
Depression	Baseline	2.48 (0.65)	2.77 (0.86)	0.01	1,28	.935
	Post	2.4 (0.68)	2.67 (0.95)			
Autistic Preoccupation	Baseline	1.8 (0.49)	1.5 (0.44)	0.9	1,28	.351
	Post	1.75 (0.45)	1.69 (0.49)			

groups in prior studies using COGPACK,<sup>112,120</sup> the cognitive composite score was also recomputed without this test. Table 3 includes findings for the composite score both with and without Digit Span Forward.

Results of the Mann-Whitney *U* tests comparing work outcomes for the 2 groups are presented in table 5. The findings indicated that the VR + CR group worked significantly more internship weeks and hours and earned more wages than the VR-only group. The VR + CR group also worked significantly more weeks than VR only, and there was a trend for them to earn more wages, although hours worked did not differ between the groups. Number of weeks or hours of competitive work did not differ between the 2 groups nor did wages earned. Overall rates of competitive rates were 39% for the VR + CR group vs 31% for the VR-only group, which did not differ significantly.

Analyses of relationship of substance-abuse disorder and medical comorbidity focused on total (log transformed) hours worked for each vocational outcome.

Alcohol-use disorder was marginally significantly related to total hours worked ( $F = 4.0$ ,  $df = 1,30$ ,  $P < .05$ ), with the absence of current alcohol-use disorder ( $N = 25$ ) associated with more hours worked ( $M = 487.92$ ,  $SD = 404.18$ ) compared with the presence of an alcohol-use disorder ( $N = 9$ ,  $M = 174.55$ ,  $SD = 210.82$ ). Drug-use disorder was also related to total hours worked ( $F = 5.13$ ,  $df = 1,30$ ,  $P = .031$ ), with absence of current drug-use disorder ( $N = 23$ ) associated with more hours worked ( $M = 496.08$ ,  $SD = 417.09$ ) compared with the presence of a drug-use disorder ( $N = 11$ ,  $M = 214.45$ ,  $SD = 225.55$ ). There were no interactions between either alcohol or drug-use disorder and treatment group, suggesting that the addition of cognitive remediation to vocational services was just as helpful in the consumers with a substance-use disorder as those without.

A similar analysis of total hours worked comparing consumers with high levels of medical comorbidity to those with low levels indicated that both the main effect for medical comorbidity and the interaction with treatment group were not significant. Thus, consumers with higher medical comorbidity burden appeared to have comparable vocational outcomes compared with those with less such burden.

For the VR-only group, Spearman correlations between overall cognitive performance at baseline (excluding Forward Digit Span) and total work over the study period were significant for total hours worked ( $r = .64$ ,  $P = .008$ ) and wages earned ( $r = .52$ ,  $P = .04$ ) and marginally significant for number of weeks worked ( $r = .44$ ,  $P = .09$ ), whereas for the VR + CR group, none of these correlations were significant ( $r_s = .33$ ,  $.36$ ,  $-.01$ , respectively). Thus, cognitive performance at baseline was more predictive of work in the study for consumers in the control group than those in the cognitive remediation group.

**Table 5.** Work Outcomes Over 1 Year by Treatment Group (VR + CR; VR Only)

Work Outcome	VR + CR		VR Only		Mann-Whitney <i>U</i> Test	<i>P</i>	Effect Size
	<i>N</i>	Mean (SD)	<i>N</i>	Mean (SD)			
<b>Weeks</b>							
Competitive	18	10.39 (16.38)	16	9.25 (15.54)	68.00	.868	0.07
Internship	18	29.83 (19.62)	16	13.63 (15.39)	140.00	.009**	0.91
Total	18	40.22 (25.40)	16	22.88 (18.88)	86.50	.047*	0.77
<b>Hours</b>							
Competitive	18	213.56 (417.13)	16	151.00 (250.53)	134.50	.701	0.18
Internship	18	293.94 (196.23)	16	138.63 (187.86)	72.50	.013*	0.81
Total	18	507.50 (445.91)	16	289.63 (276.15)	101.00	.138	0.58
<b>Wages</b>							
Competitive	18	1259.93 (2718.83)	16	775.13 (1594.21)	71.00	.642	0.21
Internship	18	1410.87 (1084.26)	16	620.68 (935.68)	132.5	.012*	0.78
Total	18	2670.80 (2867.01)	16	1395.81 (1663.37)	96.00	.098	0.54

\*  $P < .05$ ; \*\* $P < .01$

## Discussion

Consumers who participated in the cognitive remediation program demonstrated significant improvements in several areas of cognitive functioning, including verbal learning and memory and executive functioning. Improvements in these areas of functioning, and their magnitude (see effect sizes in table 3), are consistent with 3 other studies of vocational rehabilitation and cognitive remediation using COGPACK software.<sup>112,120,131</sup> These findings, together with other research on COGPACK, demonstrate the strength of this cognitive remediation package in consumers with schizophrenia and other severe mental illnesses. The results are also consistent with cognitive improvements found in NET.<sup>132,133</sup> In addition to improved verbal learning and memory and executive functioning, NET has improved performance on measures of working memory but not sustained attention. The effects of COGPACK on sustained attention have not yet been reported but are of interest given the importance of this skill in community functioning.<sup>45</sup>

Participants in vocational rehabilitation and cognitive remediation worked more hours and earned more wages for all types of work compared with consumers who received vocational rehabilitation alone. The superior work outcomes of consumers who participated in cognitive remediation are consistent with the 5 other studies evaluating cognitive remediation and vocational rehabilitation.<sup>112,113,116,117,120,132</sup> Overall, the findings provide additional support for the effect of cognitive remediation on improving work outcomes in consumers participating in vocational rehabilitation.

Cognitive functioning at baseline was predictive of amount of work over the follow-up period for the control group but not for consumers who received cognitive remediation. This difference was expected for 2 reasons. First, consumers who received cognitive remediation were expected to experience some improvement in their cognitive functioning, rendering their baseline cognitive performance less informative about their cognitive abilities over the course of follow-up work period. Second, attention was paid in the cognitive remediation program to teaching consumers strategies for compensating with persistent cognitive impairments (eg, reducing distractions in one's work environment to minimize the effects of poor attention on work performance). These results suggest that cognitive remediation has the potential to reduce the well-established predictive relationship between cognitive functioning and work.<sup>48</sup>

The effect sizes of cognitive remediation program were stronger for work than for cognitive performance (see tables 3 and 5), consistent with 2 previous studies of cognitive remediation and work,<sup>112,120</sup> and with the work of Silverstein et al on attention shaping and social skill acquisition.<sup>134</sup> This suggests that improved cognitive functioning alone does not entirely account for the improved

work outcomes, as expected from the dual emphasis of this program on teaching compensatory skills for coping with cognitive difficulties. The findings are also consistent with research on cognitive rehabilitation for traumatic brain injury, where teaching compensatory strategies has been found to improve functional outcomes in the absence of improved cognitive performance.<sup>135</sup> Furthermore, other factors related to participation in the cognitive remediation program may have also contributed to better vocational functioning, such as improved self-efficacy, self-esteem, and self-confidence associated with completing the computer cognitive training exercises.

Although consumers who participated in cognitive remediation program worked more than those who received vocational rehabilitation alone, there were no differences between the groups in competitive work outcomes. This lack of differences appears due in part to the relatively low rates of competitive employment in both groups, with 39% in the VR + CR group obtaining competitive work over the follow-up period, compared with 31% in the VR-only group. The relatively high levels of work activity in the internship program, and the fact that most of these jobs paid competitive wages and were in integrated work settings, suggests that these jobs were attractive to consumers and may served as a disincentive to moving onto seeking competitive jobs in supported employment. Of note, among the 5 previous studies evaluating cognitive remediation and vocational rehabilitation, only one was conducted in a supported employment program,<sup>112</sup> and only that study demonstrated superior outcomes in competitive work for those consumers who received cognitive remediation. More research is needed to evaluate the impact of cognitive remediation on competitive work outcomes in supported employment programs that do not provide alternative employment options.

Analyses of the effects of comorbid disorders indicated that consumers with a current alcohol or drug-use disorder had worse employment outcomes across both treatment groups than those without a substance-use disorder. As reviewed in the Introduction, research on the relationship between substance-use disorders and work or school functioning in people in severe mental illness has been inconsistent, and the limited research on consumers participating in vocational rehabilitation is even less conclusive. The fact that consumers with substance use problems had worse work outcomes is consistent with the diagnostic criteria for these disorders in *DSM-IV*<sup>19</sup> and points to the need for more focused research on the interactions between substance abuse, vocational rehabilitation, and work in people with severe mental illness. While consumers with substance use problems worked less, there were no interactions between treatment group and substance-use disorder, suggesting that even consumers with active substance abuse benefited from the cognitive

remediation program. However, statistical power to detect interactions between treatment and substance abuse was limited due to the small sample size, and thus, more research with larger samples sizes is needed to address this issue. In addition, substance abuse was not assessed over the course of the study nor were more sensitive measures of substance use employed, including either quantitative indices of substance use such as the Timeline Follow-back Interview<sup>136</sup> or standard measures of substance abuse such as the Addiction Severity Index<sup>137</sup> or the Alcohol/Drug Use Scales,<sup>138</sup> further limiting the ability of the study to detect interactions between substance abuse and the cognitive remediation program.

Rates of medical comorbidity were remarkably high in the study sample, with consumers having a mean of 1.76 comorbid medical conditions. While medical comorbidity is an established problem contributing to increased mortality in schizophrenia and other severe mental illnesses,<sup>139,140</sup> this rate nevertheless appears high. For example, 73.4% of the study sample had at least 1 medical disorder and 52.8% had 2 or more disorders, compared with 58% of 1460 consumers with schizophrenia who had at least 1 medical disorder in the survey by Chwastiak et al<sup>86</sup> and 32% who had 2 or more disorders (mean age was slightly older in this sample than Chwastiak's: 44 vs 40.6, respectively). Similarly, in a sample of 304 smokers with severe mental illness (average age 44.3 years), Dixon et al<sup>141</sup> reported that 64.6% had at least 1 current comorbid medical disorder and 34% had 2 or more disorders (L. Dixon, personal communication). One potential reason for the high rate of medical comorbidity is that this study took place at a treatment center affiliated with a medical school that provided a full range of rehabilitative, psychiatric, and medical services in an integrated fashion. Rates of comorbidity for any disorders (ie, psychiatric, medical, substance abuse) have been shown to be higher in treatment settings and in general population samples because any of the disorders in question may propel people into treatment.<sup>142</sup> Thus, high levels of comorbidity in the present sample may be partly due to the fact that consumers were able to access services for the broad range of psychiatric and medical disorders they were experiencing.

Although the rate of comorbid medical disorders was high in the sample, consumers with greater medical comorbidity did not have worse employment outcomes than those with fewer disorders. As reviewed in the Introduction, medical comorbidity is strongly related to work functioning in severe mental illness. However, little research has evaluated the effects of medical comorbidity on work in consumers participating in vocational rehabilitation, with only the multiprogram EIDP study reporting a modest effect of medical comorbidity on lower work outcomes.<sup>73</sup> The EIDP study focused predominantly on competitive work as the primary outcome, whereas in this study most work took place at internship jobs reserved

for consumers. This raises the question of whether medical comorbidity poses a greater obstacle to competitive employment than performing in protected jobs, such as the internship positions in this study. An additional consideration is that neither this study nor the EIDP study attempted to quantify the severity of the medical conditions, suggesting that a more precise measure of medical-related disability could yield stronger associations with work than found in these studies.

In summary, the present study provides further evidence that providing cognitive remediation in addition to vocational rehabilitation can improve both cognitive functioning and employment outcomes in consumers with severe mental illness, facilitating the recovery of work functioning in this population. Comorbid substance abuse was found to have an important impact on attenuating work outcomes, while medical comorbidity was not, although the small sample size and lack of more refined measures of comorbidity limited sensitivity to detecting the effects of comorbid conditions and their interactions with treatment. More research is needed both to evaluate the impact of comorbidity on work functioning in vocational rehabilitation and its interactions with cognitive remediation provided in the context of such rehabilitation programs.

## Funding

New York State Office of Mental Health.

## Acknowledgments

We appreciate the assistance of the following people for their help on this project: Rebecca Fuld, Tamar Kairy, and Irena Morin.

## References

1. Davidson L. Recovery, self management and the expert patient—changing the culture of mental health from a UK perspective. *J Ment Health*. 2005;14:25–35.
2. Farkas M. The vision of recovery today: what it is and what it means for services. *World Psychiatry*. 2007;6:4–10.
3. Silverstein SM, Bellack AS. A scientific agenda for the concept of recovery as it applies to schizophrenia. *Clin Psychol Rev*. 2008;28:1108–1124.
4. Wilken JP. Understanding recovery from psychosis: a growing body of knowledge. *J Norwegian Psychol Assoc*. 2007;44:658–666.
5. Arns PG, Linney JA. Work, self, and life satisfaction for persons with severe and persistent mental disorders. *Psychosoc Rehabil J*. 1993;17:63–79.
6. Blustein DL. The role of work in psychological health and well-being: a conceptual, historical, and public policy perspective. *Am Psychol*. 2008;63:228–240.
7. Provencher HP, Gregg R, Mead S, Mueser KT. The role of work in recovery of persons with psychiatric disabilities. *Psychiatr Rehabil J*. 2002;26:132–144.

8. Bond GR, Drake RE, Becker DR. An update on randomized controlled trials of evidence-based supported employment. *Psychiatr Rehabil J.* 2008;31:280–290.
9. Harvey PD, Green MF, Keefe RS, Velligan DI. Cognitive functioning in schizophrenia: a consensus statement on its role in the definition and evaluation of effective treatments for the illness. *J Clin Psychiatry.* 2004;65:361–372.
10. Mueser KT, Yarnold PR, Rosenberg SD, Swett C, Miles KM, Hill D. Substance use disorder in hospitalized severely mentally ill psychiatric patients: prevalence, correlates, and subgroups. *Schizophr Bull.* 2000;26:179–192.
11. Sokal J, Messias E, Dickerson FB, et al. Comorbidity of medical illnesses among adults with serious mental illness who are receiving community psychiatric services. *J Ment Dis.* 2004;192:421–427.
12. Bellack AS. Scientific and consumer models of recovery in schizophrenia: concordance, contrasts, and implications. *Schizophr Bull.* 2006;32:432–442.
13. Davidson L, Lawless MS, Leary F. Concepts of recovery: competing or complementary? *Curr Opin Psychiatry.* 2005;18:664–667.
14. Liberman RP, Kopelowicz A, Ventura J, Gutkind D. Operational criteria and factors related to recovery from schizophrenia. *Int Rev Psychiatry.* 2002;14:256–272.
15. Andreasen NC, Carpenter WT, Jr, Kane JM, Lasser R, Marder SR, Weinberger DR. Remission in schizophrenia: proposed criteria and rationale for consensus. *Am J Psychiatry.* 2005;162:441–449.
16. Deegan PE. Recovery as a journey of the heart. *Psychosoc Rehabil J.* 1996;19:91–97.
17. Anthony WA. Recovery from mental illness: the guiding vision of the mental health service system in the 1990s. *Psychosoc Rehabil J.* 1993;16:11–23.
18. Noordsy DL, Torrey WC, Mueser KT, Mead S, O'Keefe CO, Fox L. Recovery from severe mental illness: an interpersonal and functional outcome definition. *Int Rev Psychiatry.* 2002;14:318–326.
19. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) 4th ed.* Washington, DC: American Psychiatric Association; 1994.
20. Dunn EC, Wewiorski NJ, Rogers ES. The meaning and importance of employment to people in recovery from serious mental illness: results of a qualitative study. *Psychiatr Rehabil J.* 2008;32:59–62.
21. Krupa T. Employment, recovery, and schizophrenia: integrating health and disorder at work. *Psychiatr Rehabil J.* 2004;28:8–15.
22. Ralph RO, Corrigan PW, eds. *Recovery in Mental Illness: Broadening Our Understanding of Wellness.* Washington, DC: American Psychiatric Association; 2005.
23. Spanoil L, Wewiorski NJ, Gagne C, Anthony WA. The process of recovery from schizophrenia. *Int Rev Psychiatry.* 2002;14:327–336.
24. President's New Freedom Commission on Mental Health. *Achieving the Promise: Transforming Mental Health Care in America: Final Report DHHS Publication No. SMA-03-3832.* Rockville, MD: Substance Abuse and Mental Health Services Administration; 2003.
25. Marwaha S, Johnson S. Schizophrenia and employment: a review. *Soc Psychiatry Psychiatr Epidemiol.* 2004;39:337–349.
26. Marwaha S, Johnson S, Bebbington P, et al. Rates and correlates of employment in people with schizophrenia in the UK, France and Germany. *Br J Psychiatry.* 2007;191:30–37.
27. Rosenheck R, Leslie D, Keefe R, et al. Barriers to employment for people with schizophrenia. *Am J Psychiatry.* 2006;163:411–417.
28. Salkever DS, Karakus MC, Slade EP, et al. Measures and predictors of community-based employment and earnings of persons with schizophrenia in a multi-site study. *Psychiatr Serv.* 2007;58:315–324.
29. Holley HL, Hodges P, Jeffers B. Moving psychiatric patients from hospital to community: views of patients, providers and families. *Psychiatr Serv.* 1998;49:513–517.
30. Mueser KT, Salyers MP, Mueser PR. A prospective analysis of work in schizophrenia. *Schizophr Bull.* 2001;27:281–296.
31. Rogers ES, Walsh D, Masotta L, Danley K. *Massachusetts Survey of Client Preferences for Community Support Services (Final Report).* Boston, MA: Center for Psychiatric Rehabilitation; 1991.
32. Bell MD, Lysaker PH, Milstein RM. Clinical benefits of paid work activity in schizophrenia. *Schizophr Bull.* 1996;22:51–67.
33. Bond GR, Resnick SG, Drake RE, Xie H, McHugo GJ, Bebout RR. Does competitive employment improve nonvocational outcomes for people with severe mental illness? *J Consult Clin Psychol.* 2001;69:489–501.
34. Mueser KT, Becker DR, Torrey WC, et al. Work and nonvocational domains of functioning in persons with severe mental illness: a longitudinal analysis. *J Nerv Ment Dis.* 1997;185:419–426.
35. Harding C, Strauss J, Hafez H, Liberman P. Work and mental illness I. Toward an integration of the rehabilitation process. *J Nerv Ment Dis.* 1987;175:317–326.
36. Hofmann SG. Cognitive mediation of treatment change in social phobia. *J Consult Clin Psychol.* 2004;72:393–399.
37. Mueser KT, Rosenberg SD, Goodman LA, Trumbetta SL. Trauma, PTSD, and the course of schizophrenia: an interactive model. *Schizophr Res.* 2002;53:123–143.
38. Penn DL, Hope DA, Spaulding W, Kucera J. Social anxiety in schizophrenia. *Schizophr Res.* 1994;11:277–284.
39. Tibbo P, Kroetsch M, Chue P, Warneke L. Obsessive-compulsive disorder in schizophrenia. *J Psychiatr Res.* 2000;34:139–146.
40. Lysaker PH, Beattie NL, Strasburger AM, Davis LW. Reported history of child sexual abuse in schizophrenia: associations with heightened symptom levels and poorer participation over four months in vocational rehabilitation. *J Nerv Ment Dis.* 2005;193:790–795.
41. Mueser KT, Essock SM, Haines M, Wolfe R, Xie H. Post-traumatic stress disorder, supported employment, and outcomes in people with severe mental illness. *CNS Spectrums.* 2004;9:913–925.
42. Gold J, Harvey P. Cognitive deficits in schizophrenia. *Psychiatr Clin North Am.* 1993;16:295–313.
43. Goldberg TE, Torrey EF, Gold JM, et al. Genetic risk of neuropsychological impairment in schizophrenia: a study of monozygotic twins discordant and concordant for the disorder. *Schizophr Res.* 1995;17:77–84.
44. Saykin AJ, Shtasel DL, Gur RE, et al. Neuropsychological deficits in neuroleptic naive patients with first-episode schizophrenia. *Arch Gen Psychiatry.* 1994;51:124–131.
45. Green MF. What are the functional consequences of neurocognitive deficits in schizophrenia? *Am J Psychiatry.* 1996;153:321–330.

46. Green MF. Cognitive impairment and functional outcome in schizophrenia and bipolar disorder. *J Clin Psychiatry*. 2006;67(suppl 9):3–8.
47. Mueser KT. Cognitive functioning, social adjustment and long-term outcome in schizophrenia. In: Sharma T, Harvey P, eds. *Cognition in Schizophrenia: Impairments, Importance, and Treatment Strategies*. Oxford: Oxford University Press; 2000:157–177.
48. McGurk SR, Mueser KT. Cognitive functioning, symptoms, and work in supported employment: a review and heuristic model. *Schizophr Res*. 2004;70:147–174.
49. Dickerson FB, Boronow JJ, Stallings CR, Origoni AE, Cole S, Yolken RH. Association between cognitive functioning and employment status of persons with bipolar disorder. *Psychiatr Serv*. 2004;55:54–58.
50. Evans JD, Bond GR, Meyer PS, et al. Cognitive and clinical predictors of success in vocational rehabilitation in schizophrenia. *Schizophr Res*. 2004;70:331–342.
51. Addington J, Addington D. Social and cognitive functioning in psychosis. *Schizophr Res*. 2008;99:176–181.
52. Dickerson FB, Stallings C, Origoni A, Boronow JJ, Sullens A, Yolken R. Predictors of occupational status six months after hospitalization in persons with a recent onset of psychosis. *Psychiatry Res*. 2008;160:278–284.
53. Lysaker PH, Bryson GJ, Davis LW, Bell MD. Relationship of impaired processing speed and flexibility of abstract thought to improvements in work performance over time in schizophrenia. *Schizophr Res*. 2005;75:211–218.
54. Lysaker PH, Wickett AM, Davis LW. Narrative qualities in schizophrenia: associations with impairments in neurocognition and negative symptoms. *J Nerv Ment Dis*. 2005;193:244–249.
55. Regier DA, Farmer ME, Rae DS, et al. Comorbidity of mental disorders with alcohol and other drug abuse: results from the Epidemiologic Catchment Area (ECA) study. *J Am Med Assoc*. 1990;264:2511–2518.
56. Drake RE, Brunette MF. Complications of severe mental illness related to alcohol and other drug use disorders. In: Galanter M, ed. *Recent Developments in Alcoholism: Consequences of Alcoholism*. New York, NY: Plenum Publishing Company; Vol 14 (1998)285–299.
57. Kozaric-Kovacic D, Folnegovic-Smalc V, Folnegovic Z, Marusic A. Influence of alcoholism on the prognosis of schizophrenic patients. *J Stud Alcohol*. 1995;56:622–627.
58. Swartz JA, Lurigio AJ, Goldstein P. Severe mental illness and substance use disorders among former Supplemental Security Income beneficiaries for drug addiction and alcoholism. *Arch Gen Psychiatry*. 2000;57:701–707.
59. Todd J, Green G, Harrison M, et al. Social exclusion in clients with comorbid mental health and substance misuse problems. *Soc Psychiatry Psychiatr Epidemiol*. 2004;39:581–587.
60. Larsen TK, Melle I, Auestad B, et al. Substance abuse in first-episode non-affective psychosis. *Schizophr Res*. 2006;88:55–62.
61. Xie H, McHugo GJ, Helmstetter BS, Drake RE. Three-year recovery outcomes for long-term patients with co-occurring schizophrenic and substance use disorders. *Schizophr Res*. 2005;75:337–348.
62. Goldberg RW, Lucksted A, McNary S, Gold JM, Dixon L, Lehman A. Correlates of long-term unemployment among inner-city adults with serious and persistent mental illness. *Psychiatr Serv*. 2001;52:101–103.
63. Cantwell R. Substance use and schizophrenia: effects on symptoms, social functioning and service use. *Br J Psychiatry*. 2003;182:324–329.
64. Arndt S, Tyrrell G, Flaum M, Andreasen NC. Comorbidity of substance abuse and schizophrenia: the role of pre-morbid adjustment. *Psychol Med*. 1992;22:379–388.
65. Ringen PA, Melle I, Birkenaes AB, et al. The level of illicit drug use is related to symptoms and premorbid functioning in severe mental illness. *Acta Psychiatr Scand*. 2008;118:297–304.
66. Batki SL, Leontieva L, Dimmock JA, Ploutz-Snyder R. Negative symptoms are associated with less alcohol use, craving, and “high” in alcohol dependent patients with schizophrenia. *Schizophr Res*. 2008;105:201–207.
67. Kirkpatrick B, Amador XF, Flaum M, et al. The deficit syndrome in the DSM-IV field trial: I. alcohol and other drug abuse. *Schizophr Res*. 1996;20:69–77.
68. Mueser KT, Yarnold PR, Levinson DF, et al. Prevalence of substance abuse in schizophrenia: demographic and clinical correlates. *Schizophr Bull*. 1990;16:31–56.
69. Sengupta A, Drake RE, McHugo GJ. The relationship between substance use disorder and vocational functioning among persons with severe mental illness. *Psychiatr Rehabil J*. 1998;22:41–45.
70. Rogers ES, Anthony WA, Cohen M, Davies RR. Prediction of vocational outcome based on clinical and demographic indicators among vocationally ready clients. *Commun Ment Health J*. 1997;33:99–112.
71. Bell M, Greig T, Gill P, Whelahan H, Bryson G. Work rehabilitation and patterns of substance use among persons with schizophrenia. *Psychiatr Serv*. 2002;53:63–69.
72. Drebing CE, Fleitas R, Moore A, et al. Patterns in work functioning and vocational rehabilitation associated with coexisting psychiatric and substance use disorders. *Rehabil Couns Bull*. 2002;46:5–13.
73. Cook JA, Razzano LA, Burke-Miller JK, et al. Effects of co-occurring disorders on employment outcomes in a multisite study of supported employment for people with severe mental illness. *J Rehabil Res Dev*. 2007;44:837–850.
74. Brown S. Excess mortality of schizophrenia: a meta-analysis. *Br J Psychiatry*. 1997;171:502–508.
75. Meyer JM, Davis VG, Goff DC, et al. Change in metabolic syndrome parameters with antipsychotic treatment in the CATIE Schizophrenia Trial: prospective data from phase 1. *Schizophr Res*. 2008;101:273–286.
76. Desai MM, Rosenheck RA, Druss BG, Perlin JB. Medical disorders and quality of diabetes care in the veterans health administration. *Am J Psychiatry*. 2002;159:1584–1590.
77. Druss BG, Bradford DW, Rosenheck RA, Radford MJ, Krumholz HM. Mental disorders and use of cardiovascular procedures after myocardial infarction. *J Am Med Assoc*. 2000;283:506–511.
78. de Leon J, Diaz FJ. A meta-analysis of worldwide studies demonstrates an association between schizophrenia and tobacco smoking behaviors. *Schizophr Res*. 2005;76:135–157.
79. Daumit GL, Goldberg RW, Anthony C, et al. Physical activity patterns in adults with severe mental illness. *J Nerv Ment Dis*. 2005;193:641–646.
80. Fontaine KR, Heo M, Harrigan EP, et al. Estimating the consequences of anti-psychotic induced weight gain on health and mortality rate. *Psychiatry Res*. 2001;101:277–288.
81. Chafetz L, White MC, Collins-Bride G, Nickens J, Cooper BA. Predictors of physical functioning among adults with severe mental illness. *Psychiatr Serv*. 2006;57:225–231.

82. Dixon L, Goldberg R, Lehman A, McNary S. The impact of health status on work, symptoms, and functional outcomes in severe mental illness. *J Nerv Ment Dis.* 2001;189:17–23.
83. Waghorn G, Lloyd C, Abraham B, Silvester D, Chant D. Comorbid physical health conditions hinder employment among people with psychiatric disabilities. *Psychiatr Rehabil J.* 2008;31:243–246.
84. Heinrichs DW, Hanlon TE, Carpenter WTJ. The Quality of Life Scale: an instrument for rating the schizophrenia deficit syndrome. *Schizophr Bull.* 1984;10:388–396.
85. Ware JEJ, Kosinski M, Keller SD. *SF-12: How to Score the SF-12 Physical and Mental Health Summary Scales, Third Edition.* Lincoln, RI: Quality Metric, Inc.; 1998.
86. Chwastiak LA, Rosenheck RA, McEvoy JP, Keefe RS, Swartz MS, Lieberman JA. Interrelationships of psychiatric symptom severity, medical comorbidity, and functioning in schizophrenia. *Psychiatr Serv.* 2006;57:1102–1109.
87. Ran M-S, Chen EY-H, Conwell Y, et al. Mortality in people with schizophrenia in rural China. *Br J Psychiatry.* 2007;190:237–242.
88. Cook JA, Blyler CR, Leff HS, et al. The employment intervention demonstration program: major findings and policy implications. *Psychiatr Rehabil J.* 2008;31:291–295.
89. Corrigan PW, Mueser KT, Bond GR, Drake RE, Solomon P. *The Principles and Practice of Psychiatric Rehabilitation: An Empirical Approach.* New York, NY: Guilford Press; 2008.
90. Strauss JS, Carpenter WTJ. The prediction of outcome in schizophrenia I. Characteristics of outcome. *Arch Gen Psychiatry.* 1972;27:739–746.
91. Strauss JS, Carpenter WT. Prediction of outcome in schizophrenia III. Five-year outcome and its predictors. *Arch Gen Psychiatry.* 1977;34:159–163.
92. Mueser KT, Drake RE, Bond GR. Recent advances in psychiatric rehabilitation for patients with severe mental illness. *Harvard Rev Psychiatry.* 1997;5:123–137.
93. Xiang Y-T, Weng Y-Z, Li W-Y, et al. Efficacy of the community re-entry module for patients with schizophrenia in Beijing, China: outcome at 2-year follow-up. *Br J Psychiatry.* 2007;190:49–56.
94. Falloon IR, McGill CW, Matthews SM, Keith SJ, Schooler NR. Family treatment for schizophrenia: the design and research application of therapist training models. *J Psychother Pract Res.* 1996;5:45–56.
95. Falloon IRH, McGill CW, Boyd JL, Pederson J. Family management in the prevention of morbidity of schizophrenia: social outcome of a two-year longitudinal study. *Psychol Med.* 1987;17:59–66.
96. McFarlane WR, Dushay RA, Deakins SM, et al. Employment outcomes in family-aided assertive community treatment. *Am J Orthopsychiatry.* 2000;70:203–214.
97. Brooks AJ, Penn PE. Comparing treatments for dual diagnosis: twelve-step and self-management and recovery training. *Am J Drug Alcohol Abuse.* 2003;29:359–383.
98. Catty J, Lissouba P, White S, et al. Predictors of employment for people with severe mental illness: results of an international six-centre randomised controlled trial. *Br J Psychiatry.* 2008;192:224–231.
99. Becker DR, Drake RE. *A Working Life for People with Severe Mental Illness.* New York, NY: Oxford University Press; 2003.
100. Becker DR, Bond GR, eds. *Supported Employment Implementation Resource Kit.* Rockville, MD: Center for Mental Health Services, Substance Abuse and Mental Health Services Administration; 2004.
101. Bond GR, Becker DR, Drake RE, Vogler KM. A fidelity scale for the individual placement and support model of supported employment. *Rehabil Couns Bull.* 1997;40:265–284.
102. Bond GR, Salyers MP, Dincin J, et al. A randomized controlled trial comparing two vocational models for persons with severe mental illness. *J Consult Clin Psychol.* 2007;968–982.
103. Becker DR, Drake RE, Bond GR, Xie H, Dain BJ, Harrison K. Job terminations among persons with severe mental illness participating in supported employment. *Commun Ment Health J.* 1998;34:71–82.
104. Mueser KT, Aalto S, Becker DR, et al. A randomized controlled trial of the effectiveness of skills training in improving outcomes in supported employment. *Psychiatr Serv.* 2005;56:1254–1260.
105. Wallace CJ, Tauber R. Supplementing supported employment with workplace skills training. *Psychiatr Serv.* 2004;55:513–515.
106. McGurk SR, Mueser KT, Harvey PD, Marder J, LaPuglia R. Cognitive and clinical predictors of work outcomes in clients with schizophrenia. *Psychiatr Serv.* 2003;54:1129–1135.
107. Mueser KT. Cognitive impairment, symptoms, social functioning, and vocational rehabilitation in schizophrenia. In: Kashima H, Falloon IRH, Mizuno M, Asai M, eds. *Comprehensive Treatment of Schizophrenia: Linking Neurobehavioral Findings to Psychosocial Approaches.* Tokyo, Japan: Springer-Verlag; 2002:344–351.
108. Benedict RHB. The effectiveness of cognitive remediation strategies for victims of traumatic head-injury: a review of the literature. *Clin Psychol Rev.* 1989;9:605–626.
109. Butler RW, Namerow NS. Cognitive retraining in brain-injury rehabilitation: a critical review. *J Neuropsychol Rehabil.* 1988;2:97–101.
110. McGurk SR, Twamley EW, Sitzer DI, McHugo GJ, Mueser KT. A meta-analysis of cognitive remediation in schizophrenia. *Am J Psychiatry.* 2007;164:1791–1802.
111. McGurk SR, Mueser KT, Feldman K, Wolfe R, Pascaris A. Cognitive training for supported employment: 2–3 year outcomes of a randomized controlled trial. *Am J Psychiatry.* 2007;164:437–441.
112. McGurk SR, Mueser KT, Pascaris A. Cognitive training and supported employment for persons with severe mental illness: one year results from a randomized controlled trial. *Schizophr Bull.* 2005;31:898–909.
113. Vauth R, Corrigan PW, Clauss M, et al. Cognitive strategies versus self-management skills as adjunct to vocational rehabilitation. *Schizophr Bull.* 2005;31:55–66.
114. Bell M, Bryson G, Wexler BE. Cognitive remediation of working memory deficits: durability of training effects in severely impaired and less severely impaired schizophrenia. *Acta Psychiatr Scand.* 2003;108:101–109.
115. Bell MD, Bryson GJ, Greig TC, Fiszdon JM, Wexler BE. Neurocognitive enhancement therapy with work therapy: productivity outcomes at 6- and 12-month follow-ups. *J Rehabil Res Dev.* 2005;42:829–838.
116. Bell MD, Fiszdon J, Greig T, Wexler BE, Bryson GJ. Neurocognitive enhancement therapy with work therapy in schizophrenia: 6-month followup of neuropsychological performance. *J Rehabil Res Dev.* 2007;44.
117. Bell MD, Zito W, Greig T, Wexler BE. Neurocognitive enhancement therapy with vocational services: work outcomes at two-year follow-up. *Schizophr Res.* 2008;105:18–29.



118. Fiszdon JM, Bryson GJ, Wexler BE, Bell MD. Durability of cognitive remediation training in schizophrenia: performance on two memory tasks at 6-month and 12-month follow-up. *Psychiatry Res.* 2004;125:1–7.
119. Greig TC, Zito W, Wexler BE, Fiszdon J, Bell MD. Improved cognitive function in schizophrenia after one year of cognitive training and vocational services. *Schizophr Res.* 2007;96:156–161.
120. Lindenmayer JP, McGurk SR, Mueser KT, et al. Cognitive remediation in persistently mentally ill inpatients: a randomized controlled trial. *Psychiatr Serv.* 2008;59:241–247.
121. Cook JA, Leff HS, Blyler CR, et al. Results of a multisite randomized trial of supported employment interventions for individuals with severe mental illness. *Arch Gen Psychiatry.* 2005;62:505–512.
122. Kay SR, Opler LA, Fiszbein A. The Positive and Negative Syndrome Scale (PANSS) for schizophrenia. *Schizophr Bull.* 1987;13:261–276.
123. White L, Harvey PD, Parella M, Knobler H, Powchik P, Davidson M. Empirical assessment of the factorial structure of clinical symptoms in schizophrenic patients: symptom structure in geriatric and nongeriatric samples. *New Trends Exp Clin Psychiatry.* 1994;10:75–83.
124. Wilkinson G. *Wide Range Achievement Test 3 (Manual)*. Wilmington, DE: Wide Range Inc.; 1993.
125. Harvey PD, Moriarty PJ, Friedman JI, et al. Differential preservation of cognitive functions in geriatric patients with lifelong chronic schizophrenia: less impairment in reading compared to other skill areas. *Biol Psychiatry.* 2000;47:962–968.
126. Radford LM, Chaney EF, O’Leary MR. Screening for cognitive impairment among inpatients. *J Clin Psychiatry.* 1978;39:712.
127. Weschler D. *Wechsler Adult Intelligence Scale-Revised*. New York, NY: Harcourt, Brace, Jovanovich; 1981.
128. Delis DC, Kramer JH, Kaplan E, Ober BA. *California Verbal Learning and Memory Test (Manual)*. San Antonio, TX: Psychological Corporation; 1987.
129. Berg EA. A simple objective test for measuring flexibility in thinking. *J Gen Psychol.* 1948;39:15–22.
130. Heaton RK, Gladsjo JA, Palmer BW, Kuck J, Marcotte TD, Jeste DV. Stability and course of neuropsychological deficits in schizophrenia. *Arch Gen Psychiatry.* 2001;58:24–32.
131. Sartory G, Zorn C, Groetzing G, Windgassen K. Computerized cognitive rehabilitation improves verbal learning and processing speed in schizophrenia. *Schizophr Res.* 2005;75:219–223.
132. Bell MD, Bryson G, Greig T, Corcoran C, Wexler RE. Neurocognitive enhancement therapy with work therapy. *Arch Gen Psychiatry.* 2001;58:763–768.
133. Fiszdon JM, Cardenas AS, Bryson GJ, Bell MD. Predictors of remediation success on a trained memory task. *J Nerv Ment Dis.* 2005;193:602–608.
134. Silverstein SM, Hatashita-Wong M, Solak BA, et al. Effectiveness of a two-phase cognitive rehabilitation intervention for severely impaired schizophrenia patients. *Psychol Med.* 2005;35:829–837.
135. Wilson BA. Neuropsychological rehabilitation. *Ann Rev Clin Psychol.* 2008;4:141–162.
136. Carey KB, Carey MP, Maisto SA, Henson JM. Temporal stability of the timeline followback interview for alcohol and drug use with psychiatric outpatients. *J Stud Alcohol.* 2004;65:774–781.
137. McLellan AT, Kushner H, Metzger D, et al. The fifth edition of the Addiction Severity Index: historical critique and normative data. *J Subst Abuse Treat.* 1992;9:199–213.
138. Mueser KT, Drake RE, Clark RE, et al. *Toolkit for Evaluating Substance Abuse in Persons with Severe Mental Illness*. Cambridge, MA: Evaluation Center at HSRI; 1995.
139. Felker B, Yazel J, Short D. Mortality and medical comorbidity among psychiatric patients: a review. *Psychiatr Serv.* 1996;47:1356–1362.
140. Miller BJ, Paschall CBI, Svendsen DP. Mortality and medical comorbidity among patients with serious mental illness. *Psychiatr Serv.* 2006;57:1482–1487.
141. Dixon L, Medoff DR, Wohlheiter K, et al. Correlates of severity of smoking among persons with severe mental illness. *Am J Addict.* 2007;16:101–110.
142. Berkson J. Limitations of the application of four-fold tables to hospital data. *Biol Bull.* 1949;2:47–53.