Benefits of Cognitive Remediation and Supported Employment for Schizophrenia Patients With Poor Community Functioning

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Objective: **This study was conducted to determine whether augmenting supported employment with cognitive remediation can improve vocational outcomes and whether augmentation is more important for participants with lower community functioning.** ***Methods:*** **In this secondary analysis of data from two related, single-blind, randomized controlled trials, 175 participants with schizophrenia or schizoaffective disorder received supported employment or supported employment plus cognitive remediation and were classified into higher or lower community functioning according to a median split of their quality-of-life scores at baseline. Participants received one year of active intervention and follow-up a year later. Primary outcome measures were competitive employment rates and total hours of work.** ***Results:*** **Employment rates over two years for participants with lower community functioning were significantly different for the two conditions (supported employment=20%, plus cognitive remediation=49%, p<.005), whereas participants with higher functioning showed equivalent rates of employment (62% versus 54%, ns). Among lower-functioning participants, those who received cognitive remediation also worked significantly more hours over two years than those who received supported employment only, but higher-functioning participants worked similar amounts of hours in both conditions. Improvements in cognitive functioning and intrinsic motivation were related to employment outcomes but only for the lower-functioning group in the supported employment plus cognitive remediation condition, suggesting possible mechanisms for the observed effects.** ***Conclusions:*** **Augmenting supported employment with cognitive remediation may boost vocational outcomes for participants with lower community functioning but may not be necessary for those functioning better in their communities. (*Psychiatric Services* 65:469–475, 2014; doi: 10.1176/appi.ps.201200505)**

Individual placement and support (IPS) is an evidence-based approach to supported employment that has been found effective in improving competitive employment outcomes for people with serious and prolonged mental illness (1). Although rates of competitive employment for people with serious mental illness are much better with IPS than with conventional vocational rehabilitation services, more than half of participants do not find jobs. Cognitive impairments are common in schizophrenia and related disorders and have been associated with poorer community functioning and work performance. Therefore, in several previous studies it has been hypothesized that improving cognitive functioning through cognitive remediation might lead to better vocational outcomes, and we (2,3) and others (4–6) have demonstrated that combining various methods of it with vocational services can produce significantly better vocational outcomes, including rates of competitive employment.

Some have argued that high-fidelity IPS can help clients compensate for their cognitive impairments either through teaching compensatory strategies on the job or finding accommodating work settings that reduce cognitive demand. In an unpublished analysis we found some support for this claim because severity of cognitive impairment at baseline did not prove to be in itself a direct predictor of competitive employment outcomes with IPS. However, in a preliminary report, we found that community functioning at baseline was related to these outcomes (7).

Because cognitive remediation is a resource-intensive activity and may not be necessary for all patients seeking competitive employment, it is worthwhile to determine whether there is a subset of patients for whom cognitive

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Table 1

Design elements for original and continuation studies[a]

Design element	Original study	Continuation study
Cognitive remediation	Scientific Learning; Cogrehab	PositScience Brainfitness and Insight
Supported employment	IPS with transitional funds	IPS
Groups for cognitive remediation	Social information–processing group, work support group	Work support group
Groups for supported employment only	Lifestyle group; work support group	Work support group
Cognitive testing	Comprehensive battery of individual tests	MCCB and additional measures
Symptoms and quality of life	PANSS, Quality of Life Scale	PANSS, Quality of Life Scale
Follow-up	12 months and 24 months	12 months and 24 months
Vocational outcomes	Competitive employment rates, hours of competitive employment, transitional hours worked (not included in this report)	Competitive employment rates, hours of competitive employment

[a] IPS, individual placement and support; MCCB, MATRICS Consensus Cognitive Battery; PANSS, Positive and Negative Syndrome Scale

remediation is needed to increase rates of employment despite the best efforts of IPS services. Several investigators (6,8) have argued that the effects of cognitive remediation on functional outcomes may occur through mechanisms other than improving cognition, at least as measured by neurocognitive tests. These might include increasing motivation through experiences of personal efficacy or decreasing negative symptoms through the activating and rewarding nature of the intervention.

In this study, we explored baseline community functioning as a moderator of cognitive remediation's effect on vocational outcomes, and we examined whether improved cognition, increased intrinsic motivation, or decreased negative symptoms might be associated with these outcomes. Specifically, we hypothesized that participants with lower community functioning will differentially benefit from cognitive remediation in rates of competitive employment and hours worked and that these outcomes may be related to improvements in cognition, motivation, and negative symptoms.

Methods

Participants

Unemployed outpatients with diagnoses of schizophrenia or schizoaffective disorder (N=175) were recruited at a large urban community mental health center between 2001 and 2010. Participants met diagnostic criteria on the Structured Clinical Interview for DSM-IV (9), which was conducted by research psychologists, and participants were eligible if they were determined to be clinically stable (Global Assessment of Functioning score >30 and if they had made no changes to housing or psychiatric medication and had no psychiatric hospitalizations in the 30 days before intake). Exclusion criteria included history of traumatic brain injury (TBI), known neurological disease, developmental disability, or active substance abuse within the past 30 days. Between 2000 and 2012, a total of 174 participants completed the study; this was our intent-to-treat sample. [A CONSORT flow chart and additional details about procedures are available online in a data supplement to this article.]

Thanks to the high degree of engagement engendered by the vocational program, our follow-up rate for determining employment outcome was 100%. However, we could not always verify the exact number of hours each person worked over the two years; therefore, analyses for hours worked include 87% (N=86) of the sample for the supported employment plus cognitive remediation (SE+CR) condition and 86% (N=65) for just the supported employment (SE) condition. Rate of completion for individual evaluations at one-year follow-up was 78% (N=77) for SE+CR and 80% (N=60) for SE.

Design

Data for this analysis were from an original study and a continuation study (3) (Table 1). The studies had the same inclusion and exclusion criteria, the same length of active treatment (approximately 12 months), and the same follow-up observations (baseline, conclusion of active treatment, and approximately two years from baseline). They were both single-blind randomized controlled trials (RCTs) with an experimental arm (SE+CR) and an active control arm (SE). Vocational outcomes were tracked over 24 months.

Instruments

In the original study, a comprehensive neuropsychological test battery was administered at baseline and repeated at one- and two-year follow-ups. In the continuation study, the MATRICS Consensus Cognitive Battery (MCCB) replaced many of the original tasks. For the purposes of this analysis, we selected the measures that were administered throughout, ensuring that the major domains of neurocognition were represented. Composite z scores for total score were calculated from ten neurocognition measures. Executive function was tested with the Wisconsin Card Sorting Test (10,11) for conceptual-level and perseverative response. Verbal and visual memory tests included the revised Hopkins Verbal Learning Test (12) total score, the Brief Visuospatial Memory Test–Revised (13), or the Wechsler Memory Scale–III (WMS-III) (14) visual reproduction I subscale and WMS-III logical memory 1 subscale. Working memory batteries included the Wechsler Adult Intelligence Scale–III (WAIS-III) (15) digit span subscale and the WAIS-III letter number sequence subscale. Processing speed was tested with the

WAIS-III digit symbol subscale and the Trail Making A test (16).

Community functioning was measured with the Quality of Life Scale (QLS) (17), which has excellent reliability (intraclass correlation coefficient [ICC]=.91). The QLS is a 21-item scale based on a semistructured interview. We used the QLS total score to determine participants' ability to function within the community. A measure of intrinsic motivation was derived from the purpose, motivation, and curiosity items of the intrapsychic foundations subscale of the QLS, following methods described by Nakagami and colleagues (18). This measure has been used in at least four prior studies with schizophrenia samples (19–21).

Symptoms were assessed with the Positive and Negative Syndrome Scale (PANSS) (22), which has excellent reliability (ICC=.88–.98). A five-component model based on factor analysis of the PANSS (23) was used as an alternative to the rationally derived categories of positive, negative, and general symptoms. The five components were positive, negative, cognitive, hostility, and emotional discomfort.

Vocational outcome measures

Work hours were based on payroll records and verified weekly. Total hours worked refers to payment for competitive employment only over the two-year follow-up period. Hours spent in groups or in cognitive remediation were not included as work hours. Employment rates reported here are the cumulative rates of employment calculated over the two-year follow-up period within each intervention condition.

Procedure

After procedures were fully explained to participants, their written informed consent was obtained in accordance with the standards of the local institutional review board. Research psychologists performed diagnostic assessments, neuropsychological testing, and clinical ratings. Demographic and illness characteristics were obtained at intake from participant interviews, clinician interviews, and medical chart reviews.

Participants were randomly assigned to the SE or SE+CR conditions. Randomization was in blocks of eight in the first study and ten in the continuation study, and assignments were generated from a randomization Web site by a statistical assistant not associated with the study who worked at a different facility. In the original study, randomization was equal between conditions. In the continuation study, randomization was set at 40% for the SE condition and 60% for SE+CR to allow sufficient power for future analyses of process variables within the SE+CR condition.

Interventions

Supported employment. Supported employment included IPS provided by the community mental health center (CMHC) and weekly groups (described below) led by the research staff. In the original study, the CMHC vocational program included a hybrid program of transitional work as well as IPS (24). Vocational specialists determined when transitional funds, provided by the State of Connecticut, were necessary to quickly place a participant in community-based employment. The worker could get up to six months of transitional funding at up to ten hours per week, although decisions about how much transitional funding was used and when it was needed were made independently by vocational specialists and without input from the research team. In the continuation study, transitional funds were no longer available from the state, so IPS alone was used.

In the original study, participants in supported employment attended two groups led by research staff: a work support group and a lifestyle group. The work support group consisted of general discussion of work-related issues. The lifestyle group focused on social concerns (including how to handle newly earned income) but was designed without structured exercises or planned activities in order to preserve the distinction of supported employment as a noncognitive intervention. The continuation study offered the work support group but not the lifestyle group. The work support group was attended by IPS vocational specialists working with our participants.

In the original study, participants were paid minimum wage for each hour-long group attended. In the continuation study they were paid $5 per hour for group attendance. Groups were offered weekly throughout the active phase of participation.

Supported employment plus cognitive remediation. Participants in the augmented condition received identical employment services to participants in the SE condition in the original study and in the continuation. Participants in the SE+CR condition received up to ten hours per week of computerized cognitive exercises.

Cognitive remediation exercises in the original study were drawn from two sources: Cogrehab software (25), originally developed for people with compromised brain function and modified according to our specifications for people with schizophrenia, and Sci-Learn (www.scilearn.com), developed by Michael Merzenich, Ph.D., in conjunction with one of the authors (BEW). In the continuation study, we used new software (PositScience's Brainfitness and Insight), also developed by Dr. Merzenich. Additional training tasks, called Aristotle, focused on executive functions developed by PositScience in collaboration with BEW. Exercises in the original or continuation study required cognitive abilities often compromised in schizophrenia (such as attention, language, memory, and executive function). Tasks were deliberately made very easy at the start of treatment and followed a standard sequence and progression of difficulty. Patients were paid minimum wage for each hour of cognitive remediation in the original study and $5 per hour in the continuation study.

In the original study participants in the SE+CR condition attended a social information–processing group based on group exercises designed by Ben-Yishay and colleagues (26) for patients with TBI. Each week, one participant was responsible for making an oral presentation on a work-related topic (for example, "The people I work with") while nonpresenting members asked questions and provided feedback and constructive criticism. The social information–processing group demanded attention,

memory, and problem solving, as well as affect recognition, empathy, and verbal communication skills. Participants also attended a second group that focused on work support and provided work feedback from job coaches to those in the group who were employed. In the continuation study, no social information–processing group was offered, and participants attended the same work support group as those in the SE condition. The work support group was attended by an IPS vocational specialist who was working with our participants. Groups were offered weekly throughout the active phase of participation.

Statistical analysis

Data were analyzed with an intent-to-treat analysis (N=174). To be consistent with the a priori determination to use a median split as done in our previously published study (7), we recalculated the QLS median score (the result was a cutoff of <41 for the lower half) and created higher- and lower-community-functioning groups. To test the acceptability of our randomization, we compared baseline characteristics between groups on all measures, using F tests for continuous variables and chi square tests for categorical variables. For competitive employment rates, logistic regressions and chi square tests were conducted for community functioning (high versus low) × intervention condition (SE versus SE+CR). For total hours of work, nonparametric procedures were employed, including categorization of hours into three groupings and use of the Mann-Whitney U test. This was done because many participants had no competitive work hours.

To test our exploratory hypotheses regarding mechanisms of cognitive remediation's effects on vocational outcome, we first determined whether there were baseline effects for our hypothesized variables (community functioning, cognitive functioning, negative symptoms, and intrinsic motivation) on vocational outcomes. We next examined changes in neurocognition, negative symptoms, and intrinsic motivation using paired t tests for the sample as a whole and for each subgroup from intake to 12-month follow-up. Effect sizes were calculated by dividing change scores by baseline standard deviations. We then examined the relationship between changes in neurocognition, negative symptoms, or intrinsic motivation and vocational outcomes by using binary logistic regressions and partial correlations. Nagelkerke R^2 was used as our effect size measure in these analyses. Significance was set at $p<.05$ for all analyses. The exploratory analyses, which had a clear directional hypothesis (improvement positively related to vocational outcomes), used one-tailed testing. All other analyses used two-tailed tests.

Results

Baseline differences by community functioning and intervention

Demographic characteristics did not differ between groups by level of functioning within the community (Table 2). The lower-functioning group was significantly more symptomatic on the PANSS total score and on PANSS negative, cognitive, and hostility domains, whereas the two groups did not differ significantly on positive or emotional discomfort domains. Within lower- and higher-functioning groups, there were no differences between participants in the SE+CR or the SE conditions on any of these variables.

Baseline effects of hypothesized mechanisms of CR on work outcomes

Community functioning at baseline—a continuous variable—was significantly correlated with employment ($r=.21$, $p<.01$, N=174) and with categorized hours worked ($r=.15$, $p<.05$, N=150) at two-year follow-up. Neurocognition at baseline was not significantly related to vocational outcomes, nor were negative symptoms or intrinsic motivation.

Cognitive remediation and work outcomes, by functioning

A logistic regression model to predict employment rates at two years that included intervention condition (SE +CR versus SE only), community functioning (low versus high community functioning), and the interaction term showed a highly significant relationship for the interaction of condition and community functioning ($\chi^2= 6.55$, df=1, p=.01, Exp[B]=.24) driven by the effect of intervention condition in lower community functioning ($\chi^2=7.56$, df=1, p=.006, Exp [B]=3.94).

For all participants (N=174), the SE+CR condition showed a trend toward greater employment rates at two years compared with the SE condition (52% employed versus 40%; $\chi^2= 2.51$, df=1, p=.11). However, the difference between conditions was entirely due to differences found for participants with lower rather than higher community functioning. Those in the lower-functioning group in the SE+CR condition showed a significantly greater rate of employment than those in the SE condition (49% employed versus 20%; $\chi^2=7.98$, df=1, $p<.005$). Those in the higher-functioning group showed no significant difference in employment rates on the basis of intervention condition (54% versus 62%; $\chi^2=.58$, df=1, p=.45).

The variable for hours worked was divided into three categories—0 hours, 1–300 hours, and >300 hours—and showed a similar pattern for the interaction of condition and community functioning. For all participants for whom hours-worked data were available (N=151), no significant difference was found by condition, but a significant difference was found for condition within the group with lower community functioning who received the SE+CR intervention ($\chi^2=8.60$, df=2, p=.02). Mann-Whitney U analysis produced a similar result for the lower- versus higher-functioning participants but not for the higher-community-functioning participants (low-functioning group with SE+CR, 230.43±395.69 hours; low-functioning group with SE, 145.33±441.13 hours; U=432.50, p=.006; high-functioning group with SE+CR, 316.26±567.32 hours; high-functioning group with SE, 388.78±504.53 hours; U=60.1, p=.24).

Neurocognition, negative symptoms, and intrinsic motivation

The sample showed significant pre-post improvement at 12-month follow-up in neurocognition ($t=4.97$, df=134, $p<.001$), negative symptoms ($t=3.64$, df=134, $p<.001$), and intrinsic motivation ($t=6.60$, df=132, $p<.001$). To

Table 2

Characteristics of participants with schizophrenia and lower or higher functioning in their community and who received supported employment only or augmented by cognitive remediation

	Supported employment (N=75)				Supported employment + cognitive remediation (N=99)				
	Low		High		Low		High		
Characteristic	N	%	N	%	N	%	N	%	p
Gender									
Male	24	55	15	48	33	72	28	53	
Female	20	46	16	52	13	28	25	47	
Race-ethnicity									
African American	24	55	20	65	27	59	23	43	
Asian	1	2	0	—	1	2	—	—	
Caucasian	17	39	10	32	16	35	30	57	
Hispanic	1	2	1	3	1	2	—	—	
Schizophrenia subtype									
Paranoid	22	50	11	36	23	50	25	47	
Undifferentiated	4	9	2	7	6	13	4	8	
Disorganized	1	2	2	7	1	2	2	4	
Residual	3	7	3	10	6	13	4	8	
Schizoaffective	13	30	12	39	10	22	18	34	
Antipsychotic medication									
2nd generation	29	66	20	65	25	54	38	72	
1st generation	9	21	6	19	7	15	9	17	
Both	4	9	3	10	9	20	3	6	
Age (mean±SD)	40.07±8.96		40.35±10.48		41.28±10.28		42.51±10.69		ns
Education (mean±SD years)	12.20±2.04		12.26±1.57		12.57±2.44		13.57±2.68		ns
Wechsler Adult Intelligence Scale IQ (mean±SD)	86.77±15.88		87.90±12.85		90.83±15.06		95.42±17.05		ns
Age at first hospitalization (mean±SD)	21.75±9.46		22.65±5.72		23.20±11.25		23.11±8.36		ns
Lifetime hospitalizations (mean±SD)	9.28±11.83		9.65±6.89		7.61±8.78		7.42±7.82		ns
PANSS score (mean±SD)[a]									
Total	76.55±15.85		64.77±13.70		72.83±16.48		65.45±15.99		<.001
Positive	17.00±5.44		16.23±5.54		16.39±5.31		15.94±5.93		ns
Negative	19.64±8.06		15.39±5.12		18.52±6.84		16.62±6.44		<.005
Cognitive	19.02±4.66		16.19±4.21		18.22±4.57		15.38±4.7		<.001
Hostility	8.25±3.03		6.68±3.10		8.20±3.25		6.49±2.81		<.001
Emotional discomfort	11.00±3.86		9.10±3.35		9.93±3.92		9.83±3.73		ns

[a] Positive and Negative Syndrome Scale; higher scores indicate greater symptom severity. Possible total scores range from 30 to 210. Possible scores for each domain are as follows: positive, 6–42; negative, 8–56; cognitive, 7–49; hostility, 4–28; emotional discomfort, 4–28.

clarify whether these changes could occur with or without cognitive remediation in the low- and high-community-functioning groups, we conducted repeated-measures analyses of variance with negative symptoms, neurocognition, or intrinsic motivation as a dependent variable; time as a within-person variable; and intervention condition (SE+CR versus SE only) and community functioning (low versus high community functioning) as between-person variables. The results indicated that neurocognition scores had a significant interaction between time and community functioning ($F=2.94$, df=2 and 186, $p=.05$), indicating that participants with lower community functioning in both SE+CR and SE conditions showed greater improvement in neurocognition, compared with participants functioning better in their communities. Results from post hoc analyses indicated that those receiving SE showed small improvement in neurocognition (effect size=.20, $p<.05$), whereas those receiving SE+CR showed somewhat greater improvement (effect size=.27, $p<.001$). Lower-community-functioning participants in the SE+CR condition showed the greatest improvement in neurocognition (effect size=.43, $p<.001$).

In addition, intrinsic motivation had a significant interaction between time and community functioning ($F=8.76$, df=2 and 260, $p<.001$) and a trend interaction toward significance between time and intervention group on ($F=2.73$, df=2 and 260, $p=.067$), indicating that participants with lower community functioning showed greater improvement in intrinsic motivation compared with participants with higher community functioning. Also, participants receiving the SE+CR intervention showed somewhat greater improvement in intrinsic motivation than those receiving SE only. Results from post hoc analyses indicated that those receiving SE showed small improvement in intrinsic motivation (effect size=.27, $p<.001$), whereas those

receiving SE+CR showed somewhat greater improvement (effect size=.33, $p<.001$). Participants with lower community functioning who received the SE+CR intervention showed the greatest improvement in intrinsic motivation (effect size=.38, $p<.001$).

No significant interactions were found for negative symptoms in analyses of time, level of community functioning, and intervention condition. This indicates that participants improved on negative symptoms regardless of study condition.

We calculated point-biserial correlations of 12-month follow-up scores with competitive employment, controlling for intake scores. Only the participants in the SE+CR condition with lower community functioning showed a significant relationship between improvement in the proposed mechanisms and competitive employment rates. Neurocognition scores were significant ($p<.05$), explaining 13% of the variance; intrinsic motivation also was significant ($p<.04$), explaining 18% of the variance; and negative symptoms were significant at the trend level ($p<.09$), explaining 10% of the variance. None of the other groups showed these relationships between the proposed mechanisms and competitive employment rates. No significant relationships were found for these mechanisms in predicting hours worked for any of the groups.

Relationship of study cohort to vocational outcomes

Membership in the original study cohort or the continuation cohort did not appear to influence vocational outcomes. There were no significant differences in baseline characteristics between the two samples. Within the group with lower community functioning, there were no significant differences in employment rates between study cohorts (36% for the original study and 38% for the continuation) or hours worked. Study cohort also appeared to have no effect on employment rates among participants with lower community functioning in the SE+CR condition (56% for original study and 43% for the continuation study) or hours worked.

Discussion

A median split in QLS scores was used to group persons with schizophrenia by level of functioning within their communities. This split produced groups with similar demographic characteristics, although participants with lower community functioning were more symptomatic on negative, cognitive, and hostility domains. The finding of more negative, cognitive, and hostility symptoms in the lower-functioning group is consistent with the well-recognized role that such symptoms play in impairing community participation and social functioning.

As had been the case in our preliminary analysis, community functioning at baseline was significantly related to employment and hours worked at follow-up. Neurocognition, negative symptoms, and intrinsic motivation were not significantly related to employment and hours worked at follow-up. It is possible that the impact of these impairments on vocational outcomes may be mitigated by IPS, which seeks accommodations and provides coaching that may address the behavioral consequences of these features of illness. On the other hand, it appears that overall community functioning remains an important moderator of vocational outcome even when supported employment is the intervention.

As hypothesized, augmenting supported employment with cognitive remediation had a significant impact on vocational outcomes, but only for the participants functioning less well in their communities. Those functioning less well in the community were 2.5 times more likely to find employment if they received cognitive remediation with supported employment versus only supported employment, and they worked >1.5 times more hours than those who received only supported employment. Thus it appears that cognitive remediation was advantageous to participants with lower community functioning but not to their higher-functioning counterparts.

This finding has important clinical implications for service providers. It may be that cognitive remediation is not necessary to boost vocational outcomes for all participants in supported employment, but it is a service that may help those who are most impaired in their overall community functioning. To have additional services that improve functional outcomes for those who need it most is a powerful reason to continue to investigate the benefits of cognitive remediation programs for persons with serious mental illness.

To understand the effects found for participants with lower community functioning who received supported employment plus cognitive remediation, we had selected, a priori, three possible mechanisms: improvement in neurocognition, decreased negative symptoms, or increased intrinsic motivation. Although improvements were noted in all groups and cognitive remediation augmentation did not show a significant effect, the largest effects were observed specifically for participants with lower community functioning who received the augmented intervention (SE+CR). Moreover, these improvements were significantly correlated with their employment rates.

Thus the study indicated a clear moderator effect and some possible mechanisms to explain the effects of cognitive remediation for the participants with lower community functioning. Improvement in neurocognition and intrinsic motivation had significant effects, and decreased negative symptoms may have played some role.

The study had several limitations. There were some important differences in the type of cognitive remediation offered in the original study and the continuation study, although no differences between cohorts were found on vocational outcomes. Still, subtle differences in study methods could have influenced results. Differences in neurocognitive assessments between the two studies meant that only overlapping measures could be used, thus limiting somewhat the range of assessments. Also, to reduce type I error, we examined neurocognition as a global score and did not examine the possible mediating effects of specific neurocognitive domains (such as executive function). Moreover, these findings are not necessarily generalizable to patients experiencing a first episode of psychosis, who may be more responsive to supported employment interventions.

Conclusions

Supported employment, particularly when modeled on evidence-based practices of IPS, has been found to be superior to traditional vocational services for patients with serious mental illness, but as shown in this study, those with poor community functioning are less likely to benefit from supported employment without additional services. Cognitive remediation appeared to improve vocational outcomes for this important subgroup of patients. Cognitive remediation is commercially available in a variety of formats, and there is no consensus yet on best practices. Its potential benefit is being studied for a number of psychiatric populations, including patients with serious mental illness, substance use disorders, attention-deficit hyperactivity disorder, and posttraumatic stress disorder, as well as patients with prolonged postconcussive syndrome, mild cognitive impairment, and TBI. Moreover, RCTs are using cognitive remediation with putative cognition-enhancing medications for schizophrenia and other disorders. This vigorous environment of clinical practice and research on cognitive remediation is leading to new developments in training methods and deeper understandings of the potential for producing experience-based neuroplastic changes in cognitive systems affected by psychiatric illness. Our findings suggest that these developments in cognitive remediation may provide clinicians with an effective approach to augmenting rehabilitation services to improve the lives of those who need it most—people with serious mental illness and poor community functioning.

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The authors report no competing interests.

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