

Neurocognitive enhancement therapy with vocational services: Work outcomes at two-year follow-up

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Abstract

Neurocognitive enhancement therapy (NET) is a remediation program for the persistent and function-limiting cognitive impairments of schizophrenia. In a previous study in veterans, NET improved work therapy outcomes as well as executive function and working memory. The present study aimed to determine whether NET could enhance functional outcomes among schizophrenia and schizoaffective patients in a community mental health center receiving community-based vocational services. *Method:* Patients ($N=72$) participated in a hybrid transitional and supported employment program (VOC) and were randomized to either NET+VOC or VOC only. NET+VOC included computer-based cognitive training, work feedback and a social information information-processing group. VOC only also included two weekly support groups. Active intervention was 12 months with 12 month follow-up. Follow-up rate was 100%. *Results:* NET+VOC patients worked significantly more hours during the 12 month follow-up period, reached a significantly higher cumulative rate of competitive employment by the sixth quarter, and maintained significantly higher rates of employment. *Conclusion:* NET training improved vocational outcomes, suggesting the value of combining cognitive remediation with other rehabilitation methods to enhance functional outcomes.

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1. Introduction

Cognitive remediation treatments utilizing combinations of computer-based cognitive exercises, individual instruction and group techniques can lead to improvement in cognitive performance for patients with schizophrenia (Kurtz et al., 2001; Twamley et al., 2003; McGurk et al.,

2007a). In one study as many as 75% of patients were able to obtain performance comparable to healthy controls on tasks used in training (Wexler et al., 1997). In another, many people were able to reach normal levels of performance on neuropsychological tests separate from the training exercises (i.e., within 1 SD below the mean value of normal subjects, Bell et al., 2001). While some studies suggest that the gains from cognitive remediation do not generalize to functional outcomes in the community (Pilling et al., 2002; Twamley et al., 2003), others present encouraging results (Wykes et al., 2007a,b). One randomized study of 44 clients with severe mental illness

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and a history of job failure found that competitive employment rates, work hours and wages were significantly better for subjects randomized to the “Thinking Skills for Work Program,” compared to those who received standard supported employment services alone. These findings remained robust at two to three year follow-up (McGurk et al., 2007a,b; McGurk et al., 2005). Bell et al. (2005) examined work performance and work productivity in a randomized clinical trial comprising 145 patients who participated in work therapy (WT) alone, or work therapy+neurocognitive enhancement therapy (NET+WT). NET intervention was very similar to the intervention used in the current study except that it was for 6 months rather than for 12 months. Outpatients were placed in transitional employment positions in a Department of Veterans Affairs (VA) medical center for six months, and followed for an additional 6 months. Participants receiving NET+WT worked significantly more hours in the 6 months following training than did those receiving only WT. Moreover, responders to the cognitive intervention demonstrated the best work outcomes. In the present study, we hypothesized that the benefit found for NET with work therapy in the VA for people with schizophrenia would also be true if NET were added to vocational services at a community mental health center (CMHC) with job placements in the community. The vocational program at this CMHC was a hybrid, combining elements of transitional and supported employment programs. Participants received services (e.g., job development, job coaching) for 12 months and were followed for an additional 12 months. Specifically, we hypothesized that clients randomized to NET+ vocational program (NET+VOC) would work more total hours (transitional and competitive), work more competitive hours, and have better employment rates at follow-up than participants randomized to VOC only.

2. Methods

2.1. Participants

Seventy-seven stable outpatients with diagnoses of schizophrenia or schizoaffective disorder were recruited at a large urban community mental health center. Participants met diagnostic criteria based on the Structured Clinical Interview for DSM-IV (First et al., 1996) from the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association & Task Force on DSM-IV, 1994), conducted by research psychologists, and were eligible if they were clinically stable (i.e., GAF > 30, no housing changes, psychiatric medication alterations, or psychiatric hospitalizations in

the 30 days prior to intake). Exclusion criteria included history of traumatic brain injury, known neurological diseases, developmental disability, and active substance abuse within the past 30 days. Three randomized subjects were subsequently excluded for failing to meet exclusion criteria, and one withdrew voluntarily before receiving services. An additional participant classified as a missing person by the police was excluded from analyses. Thus, 72 participants were regarded as our intent-to-treat sample (See Fig. 1). They completed intake, were randomized and reached the two-year follow-up between 2000 and 2005. Thanks to the high degree of engagement engendered by the vocational program, our follow-up rate for employment data was 100%.

3. Design

This was an unblinded randomized clinical trial with an experimental arm (neurocognitive enhancement therapy (NET) plus vocational rehabilitation (VOC)) and active control arm (VOC only). Randomization was stratified based on degree of cognitive impairment and vocational experience. Participants were classified as cognitively impaired if they scored 1 SD below the mean (for a previously established schizophrenia sample) on 2 or more of 6 neuropsychological indicators (Bell et al., 2001). Participants were classified as work experienced if they had ever held a continuous full time job for at least one year. Vocational outcomes were tracked over 24 months. This trial is registered as NCT00339170.

4. Instruments

A neuropsychological test battery administered at intake consisted of the Wechsler Adult Intelligence Scale — III (WAIS-III; Wechsler, 1997a), Wechsler Memory Scale — III (WMS-III; Wechsler, 1997b), Hopkins Verbal Learning Test (HVLT; Brandt and Benedict, 2001), Verbal Fluency (Benton et al., 1994), Wisconsin Card Sorting Test (WCST; Bell et al., 1997b; Heaton, 1981) Gorham’s Proverbs (Gorham, 1950; Marengo et al., 1980), Bell Lysaker Emotion Recognition Test (BLERT; Bell et al., 1997a) Trail Making Test (Reitan and Wolfson, 1985), Tower of London (Davis, 1999) and Continuous Performance Test (CPT; Loong, 1991). The 6 variables for determining severity of cognitive impairment classification were: CPT total score wrong, HVLT Trial 1, WMS-R Visual Reproduction, WCST categories correct, Gorham’s Proverbs Bizarreness, and BLERT total score. These were selected as representative of the major domains of cognitive processes commonly impaired in schizophrenia

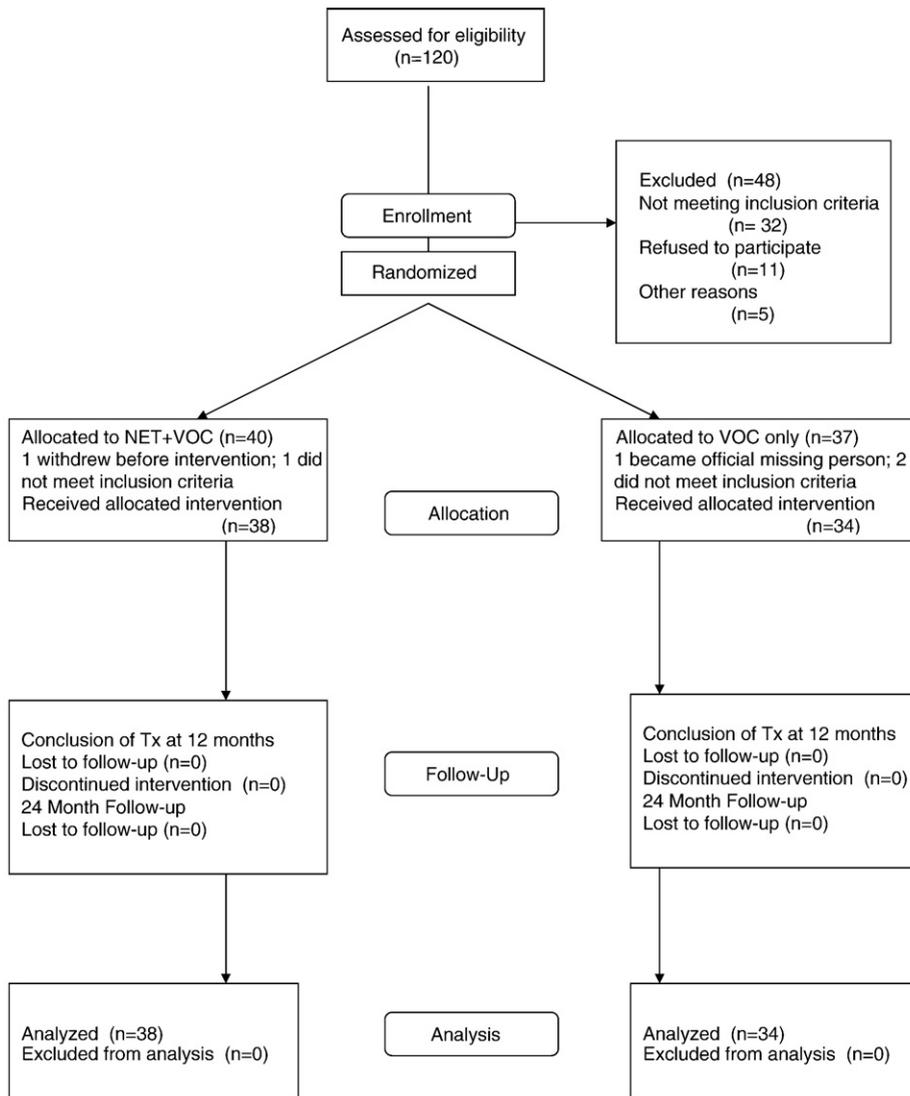


Fig. 1. Participant flow chart.

(attention, verbal and visual memory, executive function, cognitive disorganization, and affect recognition).

Symptoms were assessed using the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987). A five component model based on factor analysis of the PANSS (Bell et al., 1994) is used as an alternative to the rationally derived categories of positive, negative, and general symptoms. The five components are Positive, Negative, Cognitive, Hostility, and Emotional Discomfort (Table 1). Demographic variables were obtained at intake from participant interviews, clinician interviews, and medical chart reviews.

Work performance and cognitive functioning on the job was assessed bi-weekly using the Work Behavior Inventory (WBI; Bryson et al., 1997, 1999) and the

Vocational Cognitive Rating Scale (VCRS; Greig et al., 2004). Ratings were performed by the vocational specialists, who were trained to good reliability by the instrument developers. Evaluations were based upon direct observation of the participant at work and upon brief interviews with the supervisor. Almost all participants had obtained their job with the assistance of the vocational specialist so that the employer was aware that the participant was involved in a vocational rehabilitation program. Three participants obtained work on their own and did not want the vocational specialist to interview their supervisor. They did agree to being observed discretely while at work, and their ratings were based on these observations. WBI and VCRS raters were not blind to condition. However, these scores were used

Table 1
Participant characteristics^a

	VOC ^b (N=34)		NET ^c +VOC (N=38)	
	n	%	n	%
<i>Gender</i>				
Male	16	47	23	61
Female	18	53	15	39
<i>Ethnicity</i>				
African American	15	44	19	50
Asian	0	0	1	2.5
Caucasian	17	50	17	45
Hispanic	2	6	1	2.5
<i>Schizophrenia diagnosis</i>				
Paranoid	15	44	21	55
Undifferentiated	2	6	4	11
Disorganized	3	9	2	5
Residual	2	6	1	3
Schizoaffective	12	35	10	26
<i>Medications</i>				
Atypical	19	56	24	63
Conventional	10	30	5	13
Both	5	15	9	24
	Mean	SD	Mean	SD
Age	37.18	8.99	41.97	9.85
Education	12.50	1.74	13.01	2.56
WAIS IQ	85.35	18.07	90.08	15.47
Age at 1st hospitalization	21.26	6.67	24.95	9.66
Lifetime # hospitalization	8.79	8.11	8.42	8.95
<i>PANSS</i>				
Total	79.91	11.86	75.29	16.82
Positive	17.74	4.64	17.13	4.87
Negative	20.85	6.62	19.32	6.98
Cognitive	19.76	4.37	18.47	5.40
Hostility	8.91	3.02	7.68	2.70
Emotional discomfort	11.24	3.38	11.24	3.16

^a No significant differences by condition.

^b Vocational services.

^c Neurocognitive enhancement therapy.

only for giving work feedback and were not an outcome measure for comparison by condition.

5. Outcome measures

5.1. Work hours

Work hours were based on payroll records and verified weekly. Work hours compensated by transitional funds were differentiated from competitive employment hours, which were compensated by the employer. Total hours worked refers to all work hours

regardless of transitional or competitive payment source. Hours spent in groups or in cognitive remediation were not included as work hours, even though participation in those activities was compensated.

5.2. Employment rates

Cumulative rates of employment were calculated by condition. Employment rates were also calculated for each 13-week period, representing quarterly intervals over two years.

Work hours and employment rates are objective measures that are particularly resistant to experimenter bias. Blinding was not relevant since these outcomes were not dependent on ratings.

6. Procedure

After obtaining written informed consent, which conformed to the standards of the local institutional review board, research psychologists performed diagnostic assessments, neuropsychological testing, clinical ratings, and collected demographic information. Following stratification, participants were randomly assigned to the vocational rehabilitation only (VOC), or neurocognitive enhancement+vocational rehabilitation conditions (NET+VOC). Randomization was in blocks of 8 generated from a randomization website by a statistical assistant not associated with the study, who worked at a different facility. The assistant kept the randomization tables and would be called by the project director when assignment was to occur.

7. Interventions

7.1. Vocational rehabilitation (VOC)

The vocational rehabilitation condition was comprised of the work services provided by the CMHC with the addition of weekly groups (described below) led by the research staff. The CMHC vocational program is a hybrid transitional and supported employment program that derives its essential features from the Individual Placement and Support model (IPS) plus transitional funds to facilitate rapid job placement in community-based sites. Job specialists determined when transitional funds, provided by the State of Connecticut, were necessary to quickly place a participant in community-based employment. These decisions were made independently and without input from the research team. Transitional funds were used

when employers were willing to hire a participant if the client could perform the job adequately. Usually transitional funds were used at the beginning of a participant's involvement, but sometimes they were used later on, in a second job attempt. These jobs were in community-based competitive settings where participants performed the same jobs as their non-mentally ill co-workers, the only difference being the payment source during the transitional period. In all other respects, these jobs are consistent with competitive employment defined by the US Department of Labor and the supported employment literature in that these jobs 1) paid minimum wage or higher; 2) were in a mainstream, socially integrated setting; 3) were not set aside for mental health consumers; and 4) were not set aside or contracted with a social service agency (Razzano et al., 2005).

Participants in VOC also attended two research staff-led groups: a work support group and a lifestyles group. The work support group consisted of general discussion of work-related issues. The lifestyles group focused on social concerns (including how to handle their newly earned income), but without structured exercises or planned activities in order to preserve the distinction of the VOC condition as a non-cognitive intervention. Participants were paid minimum wage for each hour-long group attended. Groups were offered weekly for the first 12 months of their participation.

7.1.1. Treatment integrity of the VOC condition (Perepletchikova et al., 2007):

Apart from the deliberate deviation of transitional funds, the vocational program was committed to adhering to the principles of the IPS model. This modified IPS program received a score of 62 out of 75 (83%; "Fair" rating) on the IPS fidelity scale when rated by three independent raters including Gary Bond Ph.D. (personal communication), who interviewed the program staff and vocational specialists. The rating was lowered primarily by the use of transitional funds and by the fact that job specialists were not members of the primary treatment teams. Following the guidelines of supported employment, job specialists and participants developed a work plan collaboratively, with participants' interests, preferences and experience taken into consideration. On-site coaching and all other conventional services were provided throughout the 24 months of participation. Typical jobs were entry-level service positions such as washing dishes at a restaurant, serving meals in a retirement home, and processing clothes in a department store. Vocational specialists were supervised weekly by their own program directors, and the research staff met with

them at least once a week to review their activity. Their job coaching hours were recorded and compared between the two conditions (reported in results).

The PI met weekly with research staff members, who were doctoral level clinical psychologists, to review group activities, and the PI occasionally attended the groups. Careful attention was paid to preserving the distinction between these groups and the cognitively based groups in the other condition by frequent reviews of the guiding principles and format. Attendance was carefully monitored. Those in the VOC condition had a mean of 26.6 (15.6) work support groups and a mean of 21.9 (14.7) life-style groups for a combined mean of 48.6 (28.8) groups for the year and these rates were compared with those of the NET+VOC condition (see below).

7.2. Neurocognitive enhancement therapy (NET) + VOC

Participants in the NET+VOC condition received identical employment services to participants in the VOC condition. Participants in the NET+VOC condition received up to 10 h per week of computerized cognitive exercises and attended two cognitively focused, research staff-led groups per week focused on work feedback and social information-processing. Job specialists attended the work feedback group and provided participants with specific feedback from WBI and VCRS evaluations which was then used to formulate individual weekly work goals.

Cognitive remediation exercises (Table 2) were drawn from two sources: CogRehab, (Bracy, 1995) originally developed for people with compromised brain function and modified according to our specifications for people with schizophrenia, and Sci-Learn, developed by the Scientific Learning Corporation in conjunction with one of the authors (BEW) (Scientific Learning, 2003). The exercises required cognitive abilities often compromised in schizophrenia (e.g., attention, language, memory, executive function), were deliberately made very easy at the start of treatment and followed a standard sequence and progression of difficulty. Participants graduated to new tasks after achieving a prescribed performance level, or when their performance remained unchanged over 8 half-hour training sessions. In this way, tasks were neither too boring nor too challenging, and the intervention was adjusted to each participant's pattern of cognitive strengths and weaknesses. Patients were paid minimum wage for each hour of cognitive remediation.

The social information-processing group was based on group exercises designed by Ben-Yishay et al. (1985) for

Table 2
Cognitive training tasks

Training tasks	Component cognitive processes						
	SA	CA	RI	M	L	CF	PS
Simple attention							
Letters	Xx		x		x		
Words	Xx		x		xx		
Color–shape	Xx		x				
Simple auditory	Xx						
Simple visual random small	Xx						
Complex attention and response inhibition							
Simple choice	Xx		x				
Auditory							
Random small	Xx		x				
Simultaneous multiple attention	Xxx	xxx	xx				xxx
PAT-alternate by signal	Xx		xxxx				
Memory							
Sequential recall	X			xxx	xx		
Digits auditory							
Digits visual	X			xxx			
Reverse digits auditory	X			xxx	xx		
Reverse digits visual	X			xxx			
Words visual	X			xxx	xx		
Graphics visual	X			xxx	x		
Language mediated							
Synonyms	Xx				xxx		
Antonyms	Xx				xxx		
Text–picture	Xx				xxx		
Phonetics	Xx				xx		
Rhymes	Xx				xx		
Category formation							
Verbal memory categorizing	X			xx		xxx	
Exemplars	Xx		x		xx	xxx	
Planning and strategy							
Knights challenge	X		x				xxxx

patients with traumatic brain injury. Each week, one participant was responsible for preparing an oral presentation on a work-related topic (e.g., “The people I work with”) while non-presenting 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. As in the VOC condition, participants received minimum wage for each group attended, and the groups were available for the first 12 months of participation.

7.2.1. Treatment integrity of the NET+VOC condition

The cognitive training curriculum was standardized and because it was computer based, the exercises themselves were the same for all participants. However, a guiding principle was to optimize the balance between challenge and frustration. For that reason, occasional alterations in the curriculum (such as changing tasks before completion) would be made in order to preserve that optimal balance.

Staff was vigilant to participant’s engagement in the activity. If a participant began to fall asleep or appeared to be responding randomly, staff would intervene. In that way, quality of the training was preserved. We deliberately encouraged a high level of training intensity and duration, even though we were concerned that it might conflict with work hours. We did so because NET is based upon models of neuroplasticity that call for intense and repetitive practice in order to remediate impaired neurocognitive functioning. Participants averaged 113.75 h (sd SD=94.0) of cognitive training, over an average of 28 weeks (sd SD=17.0), for an average weekly training of 3.6 h (sd SD=1.9). As with any treatment trial, there was a wide range of participation, but most received a substantial dose (more than 70 h) of the intervention. Six participants (15.8%) trained for 10 h or fewer; 6 (15.8%) trained for 11 to 64 h; 19 (50%) trained for 71 to 165.75 h; 7 (18.4%) trained for 212 to 359.5 h.

The PI met weekly with research staff to review group activities and occasionally observed the groups.

The group principles and procedures had been developed and manualized by the PI in an earlier study (Bell et al., 2005), and staff from the earlier study were among those in the current study. Adherence to these procedures was reinforced weekly, and written material from the meetings (such as WBI feedback graphs and participant presentation outlines) were checked for conformity to the principles and completeness. The social information-processing group included ratings on each participant's performance in the group (data not included in this report) which served as another check on the quality of the groups. Attendance was also recorded. Participants had a mean of 28.1 (14.8) work feedback sessions and a mean of 20.9 (14.8) social information information-processing sessions for a combined mean of 49.0 (26.5) for the year. Conditions did not differ significantly on number of groups attended ($df=70$, $t=.07$, $p=n.s.$).

8. Data analyses

Except when specified, statistical analyses were performed using SPSS 12.0 for Windows. Chi-square analyses were employed for categorical data and t -tests for continuous data. Prior to analyses, data were screened for violations of normality and homogeneity of variance. Transformations were performed where necessary using Blom normalization procedures in SPSS. Because job specialists were not blind to condition, intensity of job coaching over the one-year period was compared by condition to test for the possibility that one condition received more intensive services than the other. Hours coached by a job specialist were calculated as both the total hours of job coaching and as the ratio of coached work hours to total work hours.

Work outcome measures were analyzed by a statistical consultant using SAS version 9 for Windows. Employment rates were compared by condition over eight quarters using repeated measures, mixed model analyses with a binary dependent variable indicating the presence or absence of work activity (work activity — yes/no). Analyses were performed separately for rates of total community-based work activity (transitional and competitive payment combined), and rates of community-based work activity paid exclusively by the employer (competitive payment). Rates of employment (total and competitive payment) were also examined cumulatively for the two-year period.

The statistical consultant compared hours worked by condition across quarters over the course of the two-year study using mixed models, repeated measures ANOVAs. Analyses were performed separately for total hours

of community-based work activity (transitional and competitive payment combined), and hours of community-based work activity paid exclusively by the employer (competitive payment). Because of significant skew introduced by non-working participants in each quarter, analyses were repeated using ranked data as a nonparametric check of the results. Except where corrected for multiple comparisons, alpha was set at .05 and all tests were two-tailed.

9. Results

There were no significant differences between conditions in demographic characteristics (Table 1) or previous work experience (Table 3).

Cumulative transitional and competitive employment rates reveal that 95% of participants in NET+VOC and 100% in VOC went to work within the first 13 weeks (Fig. 2a). Cumulatively, conditions did not differ on rates of total employment, but the NET+VOC group achieved significantly higher cumulative competitive

Table 3
Participant work experience at intake^a

	VOC (<i>n</i> =34)		NET+ VOC (<i>n</i> =38)		Total (<i>n</i> =72)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
<i>Work experienced</i>						
Yes	14	41	20	53	34	47
No	20	59	18	47	38	53
<i># Full time jobs held for one or more years</i>						
No full time employment	20	59	18	47	38	53
One job	8	23	12	32	20	28
Two jobs	3	9	3	8	6	8
Three or more jobs	3	9	5	13	8	11
<i>Longest full time job (years)</i>						
No full time employment	20	59	18	47	38	53
One year	4	12	6	16	10	14
Two to four years	3	9	9	24	12	17
Five to ten years	4	12	3	8	7	10
> Ten years	2	6	2	5	4	6
<i># Years since last full time employment</i>						
No full time employment	20	59	18	47	38	53
One year	1	3	0	0	1	1
Two years	2	6	2	5	4	6
Three years	2	6	1	3	3	4
Six to ten years	2	6	2	5	4	6
Eleven to fifteen years	4	12	6	16	10	14
Sixteen to twenty years	2	6	4	11	6	8
> Twenty years	1	3	5	13	6	8

^a No significant differences by condition.

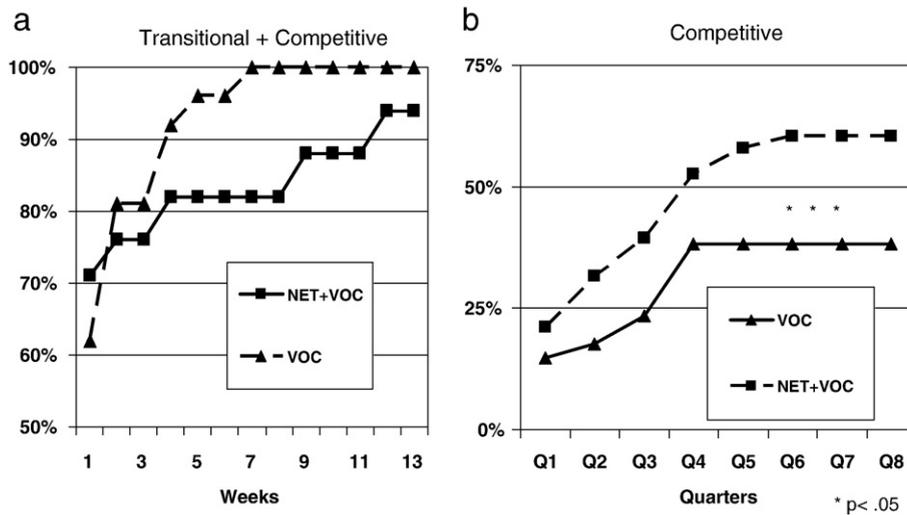


Fig. 2. Cumulative rates of employment.

employment rates (Fig. 2b) by the sixth quarter ($\chi^2=3.57, df=1 p<.05$). The absolute difference in risk of never being competitively employed between the two conditions was 22.3% (95%CI — .26% to 44.84%) and the Number Needed to Treat to see an effect is 5.

During the active intervention in year-one, the NET+VOC and VOC conditions did not differ significantly in total hours worked (NET+VOC Mean (SD)=245.5 (250.7); VOC=346.4 (299.3)), total competitive hours worked (NET+VOC Mean (SD)=89.1 (196.6); VOC=101.9 (216.7)), number of jobs held (NET+VOC Mean (SD)=1.35 (.75); VOC=1.54 (.56)) and

duration of jobs held in weeks (NET+VOC Mean (SD)=20.3 (16.0); VOC=22.05 (15.6)). Hours of job coaching did not differ by condition (NET+VOC Mean (SD)=46.2 (43.8); VOC=52.8 (41.9)) nor did the intensity of job coaching as a percentage of number of hours worked in which there was on-site job coaching (NET+VOC=25%; VOC=22%).

Mixed model repeated measures ANOVA results for total hours worked at quarterly intervals over two years (Table 4), however, showed a significant time by condition interaction ($F(1,572)=10.00, p<.001$). The finding for the time by condition interaction remained

Table 4
Hours and rates of employment by condition over 8 quarters

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
<i>Total hours (transitional and competitive)^a</i>								
VOC	86.89 (68.13)	89.26 (80.78)	84.1 (88.26)	76.48 (87.22)	68.82 (96.92)	61.52 (97.65)	48.82 (94.78)	42.43 (88.12)
NET+VOC	59.38 (64.67)	66.06 (67.48)	57.59 (72.49)	73.06 (99.51)	73.01 (96.15)	75.31 (101.5)	81.56 (116.1)	78.63 (112.4)
<i>Competitive hours^b</i>								
VOC	11.31 (37.70)	18.62 (52.79)	28.00 (67.38)	40.86 (81.94)	54.41 (95.19)	50.48 (96.02)	41.32 (88.06)	35.37 (81.14)
NET+VOC	11.92 (28.59)	24.67 (58.69)	18.89 (52.58)	42.88 (95.49)	48.96 (91.98)	51.09 (91.72)	61.15 (116.7)	59.2 (111.1)
<i>Quarterly rates in percent (combined)^c</i>								
VOC	97.1	91.2	73.5	64.7	50.0	44.1	29.4	23.5
NET+VOC	78.9	78.9	68.4	60.5	55.3	50.0	47.4	44.7
<i>Quarterly rates in percent (competitive)^d</i>								
VOC	14.7	11.8	17.6	32.4	29.4	26.5	23.5	20.6
NET+VOC	21.1	23.7	26.3	34.2	34.2	28.9	28.9	28.9

^a Total hours time×condition interaction, $p<.001$.

^b Competitive hours show significant linear trend by condition for Q5 to Q8, $p<.05$.

^c Quarterly rates show a significant time×condition interaction for Q5 to Q8, $p<.005$.

^d Quarterly rates of competitive employment do not differ significantly by condition.

significant when data were converted to ranks ($F(1,572)=7.74, p<.005$), indicating that skew from non-working participants did not influence the results. Post-hoc comparison of hours in the 12 months of follow-up show a significant difference ($p<.05$) favoring NET+VOC. However, the standardized effect size for this difference is small (.22 (95%CI from .69 to -.24)). Mixed model repeated measures analyses for competitive (employer-funded) work hours over two years were not significant. Competitive work hours did show a significant linear trend by condition for year two in isolation, ($F(1,70)=3.72, p<.05$) with results favoring NET+VOC.

Mixed models analyses of quarterly employment rates over two years showed a significant interaction by condition for year two ($t(71)=2.91, p<.005$) when transitional and competitive community-based work activity were combined. In the final quarter, 44.7% in the NET+VOC condition were working compared with 23.5% of VOC. By the 8th quarter (Table 4), the absolute difference in risk of unemployment was 21.2% (95%CI — .08 to 42.5%) and the Number Needed to Treat to see an effect is 5. Strictly competitive (employer-funded) employment rates did not show a significant interaction by condition over two years.

10. Discussion

Results support the hypothesis that NET enhanced vocational outcomes. Participants in NET+VOC achieved more total hours worked during the 12 month follow-up period, had higher quarterly employment rates during the follow-up period, and achieved higher cumulative rates of competitive employment in the last three quarters. Patients in the VOC only condition showed a steady decline in employment during year two. It is particularly encouraging that patients who had received NET were significantly better able to sustain employment throughout the second year.

The vocational program at the CMHC was a combination of transitional funds and IPS services. It was the same for both conditions and was not an independent variable. The NET training was the independent variable, but with its groups and computer computer-based training, it was multifaceted. Thus, any discussion of individual effects of the various components and their interactions must be complex and speculative. However, we offer some comments about the treatment elements and their possible influence on results based upon our observation of our participants' experience.

Cumulative employment rates (transitional and competitive) for both conditions reveal that almost all participants

in this study tried to work and that they did so within the first 13 weeks. Thanks to the availability of transitional funds, even the most impaired had the opportunity to be employed in the community in a job of their choosing with appropriate supports. Given the opportunity, most took advantage of it. These participants were not screened for "work readiness". Following the IPS model, all that was required of them was an initial willingness to work. We believe that this high response to appropriate opportunity supports the survey literature that many people with severe mental illness would like to have a job of some kind. Those in the NET+VOC condition were somewhat slower to go to work initially, probably because they were engaged in cognitive training. Any non-specific effects of additional staff attention during computer training in the first few months of the intervention would have been offset for the VOC only condition by the non-specific benefits of more work activity.

Patients in both conditions received approximately 1 h of on-site job coaching for every 4 h worked as well as a weekly group discussion focused on work experiences. This ratio may be more intensive than is generally the case in IPS programs (personal communication with Gary Bond). It may be a consequence of the availability of transitional funds that allowed everyone to work; including the most impaired who needed continual coaching.

Patients in the NET+VOC condition had a potential advantage in that their weekly group included their job coach. They received regular and consistent feedback about their work performance and their cognitive functioning on the job with specific goal-setting based upon that feedback. Because of rapid job engagement, this feedback (as well as feedback from on-the-job coaching received by all subjects) could begin early in the rehabilitation program, thus maximizing the time period in which the participant could benefit from these interventions.

Those in the NET+VOC condition received an intense dose of cognitive remediation. To our knowledge, this is the highest dose thus far reported in the published literature. We deliberately sought to achieve a high intensity and duration of training because our approach is based upon animal and human experimental literature on experienced-based neuroplastic brain changes, which require intensive, repetitive training for results (Wexler and Bell, 2005). We also were concerned that negative results not be attributable to insufficient training dose. Naturally, a few participants did not take advantage of the training, but most did. Elsewhere, (Bell et al., 2001, 2007, 2005; Greig et al., 2007) we have reported that this training led to greater cognitive

improvements compared with those who received only work services on pre-post neuropsychological measures of executive function and working memory.

Participants were paid for their time in cognitive training, and it is unknown how much payment influenced cognitive training adherence or delayed rapidity of job attainment. We noticed that a number of participants began to think of the cognitive training as an agreeable part-time job, and we were sometimes concerned that cognitive training might be substituting for competitive employment. Quarterly rates of employment rose more slowly for NET+VOC participants, reaching equivalence with VOC only toward the end of their training year. Rates then continued to rise over the next 4 quarters, while VOC only participants' rates declined. While lower rates in the first three quarters for NET+VOC may be attributable to competition from NET training, the subsequent rise seems to indicate that participants gained something from their year of training that allowed them to sustain employment and to achieve and maintain competitive employment even after cognitive remediation and weekly support groups ended. By contrast, the decline for VOC only participants in the second year would seem to suggest some lack of resilience (whether to problems on the job or some other stressor) that led to job discontinuation and no further job attainment, despite on-going assistance from vocational specialists.

NET+VOC included a social information information-processing group that may have served therapeutic as well as cognitive training purposes. In this group, participants prepared and delivered presentations on topics related to their work life. In addition to the cognitive aspects of the exercise, we observed that this process helped many participants organize and give voice to their on-going experience of struggle and recovery. Lysaker et al. (2002, 2006) have described how patients' narrative about their illness and recovery can change through rehabilitation and that interventions that address this narrative process may improve functional outcomes. Thus, this group may have had therapeutic effects beyond the intended training targets.

The results of this study support the hypothesis that cognitive interventions when combined with comprehensive rehabilitation may enhance functional outcomes, a similar finding to that of Hogarty et al. (2004, 2006) who used cognitive training and other rehabilitation methods to enhance cognitive function, "gistful learning" and social competence. Although time by condition interaction shows a powerful effect for NET+VOC, the effect sizes for total hours and rates of employment are modest. Cognitive training has more powerful effects on proximal end-points such as

neuropsychological test performance (McGurk et al., 2007a), but more distal outcomes such as employment likely have many other moderating or mediating factors that reduce its direct impact. In another report (Bell et al., *in press*), we found that the greatest benefits from training occurred for those with the poorest community functioning prior to entering the study. This suggests that NET may only be needed for those whose impairments make it unlikely that they would attain functional goals with support services alone. Future studies might include a cost utility analysis regarding its effects on such a subgroup within the schizophrenia spectrum.

The strengths of this study are the 100% follow-up at two years and the objectivity of its outcome measures (hours and rates of employment). Its limitations include the complexity of the intervention and the fact that staff was not blind to condition. Despite our efforts to equalize attention by having two support groups for the VOC only condition to match the two groups in the NET+VOC condition, we cannot know what other biasing processes might have been at work. Regarding the vocational specialists, they were from a separate agency and were evaluated by their supervisor according to their clients' achievements without regard to condition. They made their own decisions about transitional funds, job coaching and job seeking strategies. Our check on intensity of job support indicates that NET+VOC and VOC only participants received similar intensity of services. We do not believe that the vocational specialists were aware of, or particularly invested in, our cognitive training hypotheses. Nevertheless, we cannot know for certain that bias was not present.

This study is now the third, along with the VA study (Bell et al., 2005) and that of McGurk et al. (2005) to demonstrate that cognitive training combined with work services may yield better vocational outcomes. Moreover, the current study addresses a number of methodological concerns raised by previous studies in regard to study size, length, intensity and integrity of cognitive training, type of vocational services, and integrity of the active control condition. The mechanisms for this effect are as yet undetermined, and dismantling studies that unpack the intervention may be needed to understand essential therapeutic elements and their interaction. The social information information-processing group and the work feedback and goal-setting group were cognitively based activities, but they were not traditional cognitive remediation. It could be that these group experiences caused the main effects alone or that they were necessary but insufficient without the computer-based exercises to cause the main effects. Hogarty et al.

(2004, 2006) found that improvements in processing speed and neurocognition from cognitive training in the first six months of their two two-year intervention persisted for the next two and a half years and mediated subsequent social cognition and social adjustment outcomes. Wykes et al. (2007b) found a similar mediating effect of cognitive training on functional outcome in a study of young, early onset patients with schizophrenia. More studies of this kind may help shape future interventions by indicating how cognitive remediation should be related to other rehabilitation interventions that may translate cognitive gains into meaningful functional outcomes.

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Contributors

Morris Bell and Bruce Wexler made substantial contributions to the conception, design, analysis, interpretation, drafting and final approval of this article. Wayne Zito and Tamasine Greig contributed to the collection, analysis and interpretation of data as well as contributing important intellectual content to the article and giving final approval of this version.

Conflict of interest

Authors have no relevant financial interest in this manuscript and no conflict of interest.

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