Department of Veterans Affairs

JRRD Volume 42, Number 2, Pages 225–234
March/April 2005
Journal of Rehabilitation Research & Development

Rehabilitation during alcohol detoxication in comorbid neuropsychiatric patients

Gerald Goldstein, PhD;* Gretchen L. Haas, PhD; Wendy Jo Shemansky, BA; Belinda Barnett, PhD; Sara Salmon-Cox, MS, OTR/L

Veterans Integrated Service Network 4 Mental Illness Research, Education, and Clinical Center, Department of Veterans Affairs (VA) Pittsburgh Healthcare System, Pittsburgh, PA

Abstract—For this study, we evaluated the effectiveness of a cognitive training program in improving cognitive function in patients with alcoholism comorbid with another neuropsychiatric disorder and going through the subacute phase of detoxication. We employed a randomized clinical trial design in which 20 subjects were assigned to a five-session cognitive rehabilitation program and 20 subjects were assigned to an attention placebo control condition. All subjects received a battery of cognitive tests for reasoning, attention, and visual-spatial abilities. These tests were repeated at the completion of the study. The training consisted of a number of component tasks designed to improve attention, speed of information processing, perceptual analysis, and visual-spatial cognition. We plotted performance on training results across sessions to detect evidence of learning effects. Comparisons of the cognitive tests revealed greater improvement in the training as compared to the attention placebo group on measures of attention and conceptual flexibility. We concluded that the training produced significant improvement over and above natural recovery during detoxication.

Key words: attention control condition, cognitive rehabilitation, comorbid alcohol abuse, detoxication, dual diagnosis, intervention, memory, neuropsychology, rehabilitation, veteran.

INTRODUCTION

For this research, we addressed the assessment and treatment of cognitive deficits for a broadly defined population of neuropsychiatric patients with comorbid alcohol abuse. Alcohol use disorders are common among individuals with schizophrenia and other psychiatric disorders and have negative consequences for treatment outcomes and course of illness [1]. For example, alcohol abuse or dependence associated with noncompliance with medication is thought to be a major contributor to relapse in schizophrenia. While the neuropsychological and neuropsychiatric consequences of individual psychiatric disorders and substance abuse have been widely studied, only a few studies concern the interaction between

---

Abbreviations: ANOVA = analysis of variance, CPT = Continuous Performance Test (Conners), DSM-IV = Diagnostic and Statistical Manual of Mental Disorders-IV, HIPAA = Health Insurance Portability and Accountability Act of 1996, PTSD = posttraumatic stress disorder, SCID = Structured Clinical Interview for DSM-IV, SD = standard deviation, VA = Department of Veterans Affairs, WASI = The Wechsler Abbreviated Scale of Intelligence, WCST = Wisconsin Card Sorting Test.

This material was based on work supported by start-up funds from the Veterans Integrated Service Network 4 Mental Illness Research, Education, and Clinical Center, Department of Veterans Affairs. This project has no grant number.

*Address all correspondence to Gerald Goldstein, PhD; VA Pittsburgh Healthcare System, 7180 Highland Drive (151 R), Pittsburgh, PA 15206; 412-365-5232; fax: 412-365-5231. Email: ggold@nb.net

DOI: 10.1682/JRRD.2004.03.0040

substance abuse and other major psychopathology [2]. We proposed to determine whether a cognitive rehabilitation intervention could improve short-term cognitive outcomes during inpatient treatment and outpatient alcohol rehabilitation of patients with several comorbid neuropsychiatric disorders. We assessed short-term course and outcome in this research in terms of cognitive improvement gained from being in rehabilitation. Because the experimental intervention was added to ongoing rehabilitative treatments, our aim was to evaluate the additive effects of a program of cognitive rehabilitation integrated into an intensive program of inpatient or outpatient treatment combined with domiciliary treatment. Thus, it was anticipated that cognitive function would improve over the course of detoxication and hospitalization as a function of sobriety and adequate nutrition, along with administration of traditional psychiatric, detoxication, and rehabilitation treatments. However, we hypothesized that beyond such improvement, behavioral changes involving maintenance of attention, memory, and adaptive problem-solving may maximize potential by specific training of cognitive abilities. With regard to the present study, the specific aim of cognitive rehabilitation was to help the patient obtain enhanced, immediate benefit from rehabilitation because of improved cognitive capacity, particularly in the areas of attention and memory. Long-term outcome would depend on the success of the total alcoholism rehabilitation program itself.

A common observation exists that patients going through detoxication and subsequent rehabilitation are far from optimally prepared to benefit from treatment that requires information processing, such as understanding the content of lectures, or the interactions in group counseling. These patients have what Goldman characterized some years ago as "cognitive haze," a mild confusional state with impairments of attention, memory, and comprehension [3]. In 1990, Goldman wrote concerning patients with alcoholism: "Current practice in the United States is for inpatient stays lasting from 21 to 28 days. During that time, didactic information may be taught by an instructor, conveyed in written form and/or through audiovisual aids. The alcoholic is expected to learn about the increasing behavioral effects of alcohol as the dosage increases, the effects of chronic ingestion on the gastrointestinal tract, the liver, and the nervous system, and sometimes on the heart and other organs. Similar material is presented regardless of the particular patient's educational background. Now, recall the approximately 2-week time course of gross neuropsychological deficit in the acute recovery phase, and the longer time course of more specialized deficits (e.g., visual-spatial and problem-solving), particularly in older alcoholics. Clearly, the educational component of early treatment could easily overtax the learning capacity of an individual not yet recovered neuropsychologically and physically." [3]

To address this problem, Goldman and collaborators developed a series of cognitive remediation procedures that have since been shown to be effective in relieving cognitive haze. The remediation program targets areas of learning, attention, problem-solving, and visual-spatial skills. Remediation procedures take two generic approaches: repeated exposure to a task and/or the deconstruction of complex tasks into their simpler component parts. Laboratory and clinical studies involving these tasks have consistently demonstrated improvement in cognitive function [3–4]. Parsons developed a program similar to that of the Goldman group for application in a Department of Veterans Affairs (VA) alcoholism rehabilitation program [5]. The training focused on memory and problem-solving, stressing the use of strategies such as forming images or drawing diagrams. Results of this trial revealed positive outcomes of cognitive rehabilitation procedures on measures of learning and patient self-report measures of outcome.

In this study, we applied a version of the Goldman rehabilitation training procedures in a random-assignment clinical trial with a sample of well-diagnosed neuropsychiatric patients who met Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) criteria for comorbid alcohol dependence and who entered the hospital coincident with a period of heavy drinking. The rehabilitation methods have previously only been applied to alcoholics who have a somewhat different pattern of cognitive dysfunction from patients with comorbid neuropsychiatric disorders, such as schizophrenia. Therefore, some rationale is needed for why these methods might work for such patients.

A concern might be that cognitive haze, in itself, might compromise the ability of patients to benefit from these training programs. However, the evidence is to the contrary. Several studies provide empirical demonstration of improvement from this training in excess of that associated with time-dependent recovery. Forsberg and Goldman showed significant improvement by patients in alcohol rehabilitation on alternate forms of a training task with the Stark verbal and visual-spatial task [6]. Goldman and Goldman showed comparable improvement on a training task involving the Trail Making Test [7]. Goldman [8], via a task based on a Posner-type letter-matching attention task, demonstrated not only improvement on that task but also generalization to other cognitive abilities as measured with such complex procedures as the Ravens Progressive Matrices and the Stroop Test. Training also appears to be associated with not only improvement on the training task itself but also generalization to other complex tasks. In Goldman's studies, time-dependent recovery was separated from experience or training-dependent recovery by studying separate groups starting after varying days of abstinence. Patients with as little as 4 days of abstinence were shown to manifest significant cognitive improvement.

The major hypotheses for our study were that descriptive evidence of incremental learning would be found on all the training procedures and that significant interactions would be found in the before (versus after) training scores between the trained and attention placebo group, with superior improvement obtained by the trained group. No specific predictions were made for any of the before and after testing main effects, although they are reported, since the presence of significant main effect changes would reflect findings for both groups combined, and a clear confounding of training and practice or time-dependent recovery effects would occur.

MATERIALS AND METHODS

Subject Selection and Recruitment

Subjects were recruited from the inpatient services at the Center for Treatment of Addictive Disorders, or the domiciliary of the VA Pittsburgh Healthcare System. Referred subjects were judged by their treating clinicians to be in the stage of subacute detoxication. All subjects were actively alcoholic immediately prior to hospitalization. Clinical staff monitored all subjects to determine that subjects were sufficiently alert to understand the consent forms and to provide fully informed consent before subjects were referred to the staff for introduction of the study. All were neuropsychiatric patients who met the following inclusion criteria:

1. Age between 20 and 55.
2. A minimum of an 8th grade education.
3. The presence of a current DSM-IV Axis I Disorder, determined based on a DSM-IV Diagnosis (SCID [Structured Clinical Interview for DSM-IV]) [9].

Recruitment of hospitalized patients helped reduce the probability of drinking and/or its lack of detection during the course of the study. Patients were excluded if they met diagnostic criteria for dementia or an amnesic disorder because of alcoholism or any other disorder. Initial patient consent to an examination of medical records and the performance of screening interviews was obtained with a Health Insurance Portability and Accountability Act (HIPAA) of 1996 compliant consent form. Subjects included were engaged in a full consent procedure explaining the research itself and containing information regarding risk, the voluntary nature of participation, the right to withdraw, confidentiality, reimbursement, and other related matters. The procedures applied in recruiting and obtaining consent were consistent with HIPAA requirements and were approved by the local independent review board.

We collected data on 40 such subjects, who were randomly assigned to either the experimental cognitive rehabilitation intervention program or an attention control condition. Potential subjects completed a screening assessment documenting the presence of a dual diagnosis of an Alcohol Use Disorder and an additional neuropsychiatric disorder (other than an additional substance use disorder). The sample contained 2 subjects with schizophrenia, 4 with bipolar disorder, 17 with major depressive disorder, 3 with dysthymia, 11 with other mood disorders, and 3 with anxiety disorders. Two patients with major depressive disorders had secondary diagnoses of post-traumatic stress disorder (PTSD). Frequencies of these diagnoses were approximately equally distributed in the two groups. A statistically significant association between diagnostic category and group membership could not be found ($\chi^2_4 = 5.22$, $p > 0.05$).

Potential subjects were monitored until they were sufficiently alert to understand the consent form and to provide fully informed consent. Individuals who did not provide informed consent or who were unable to understand the consent form were not included. Subjects who could not cooperate with study assessment procedures did not continue in the study. All patients were maintained and stabilized on various antipsychotic, antidepressive, or antianxiety medications appropriate for their psychiatric disorders.

Sample Size

Based on power testing using previously obtained neuropsychological test data, with a risk of a Type I error set at $p = 0.05$ and of a Type II error set at $p = 0.20$ (power = 0.80), we calculated that 20 patients assigned to each of the cognitive rehabilitation and attention control groups would provide sufficient power to reject the null hypothesis. The patients were in a narrow age range (20 to 55 years) in which age effects are minimal, so age-stratified randomization was not necessary.

Research Design

Subjects who met study inclusion criteria were randomly assigned, following baseline assessment, to one of two interventions: the experimental cognitive rehabilitation intervention or a "current events" attention control condition. All subjects received five sessions of intervention procedures. The attention control condition was a series of discussions of current events with a counselor in which the subject received equal time and attention during discussion of a recently published news story, but did not perform the cognitive exercises. The neuropsychological assessments were repeated at the end of the intervention sessions.

We compared the two groups for alcohol use and general intelligence. No significant difference was detected in alcohol consumption or general intelligence between them. No administered the Khavari Alcohol Test [10] to provide detailed information about history of alcohol use. The mean annual absolute alcohol intake (AAAI) obtained from the Khavari Test was 3655.61 ounces (standard deviation [SD] = 2185.77) for the rehabilitation group and 2991.94 ounces (SD = 634.0) for the attention control group ($t_{33} = 1.03$, $p \geq 0.05$). We administered the Wechsler Abbreviated Scale of Intelligence (WASI) [11], a short-form intelligence test, as the measure of intellectual ability. The estimated full-scale WASI intelligence quotient was 89.3 (SD = 11.38) for the rehabilitation group and 90.4 (SD = 9.58) for the attention placebo group, a nonsignificant difference ($t_{38} = 0.33$, $p \geq = 0.05$).

Neuropsychological Assessment Battery

The neuropsychological assessment consisted of a selected battery of assessments, including the WASI, as a measure of general intelligence, and a series of cognitive tests shown to be sensitive to cognitive deficits commonly observed in association with alcoholism and other neuropsychiatric disorders. These tests included the Wisconsin Card Sorting Test (WCST) [12] and the Category and Trail Making Tests from the Halstead-Reitan Battery [13]. Because the Block Design subtest, a component of the WASI, is a training program that specifically trains performance on block design tasks, this subtest was repeated and a significant interaction was predicted in its case. Digit Symbol, a subtest of the full Wechsler scales not included in the WASI, was incorporated in the neuropsychological test battery as a measure of speed of information processing. Because of our interest in the general effects of attention on performance, we also integrated a measure of attention, the Conners Continuous Performance Test (CPT) [14].

Cognitive Rehabilitation

Subjects assigned to the cognitive rehabilitation intervention group began attending sessions at the earliest point at which they could cooperate with baseline assessment procedures. They received five 30-minute sessions over a 3-week period, excluding weekends. Training dealt with neuropsychological abilities, such as complex attention and rapid scanning. The individual programs provided repeated practice in a number of cognitive skills, including perceptual analysis, visual scanning, concept formation, psychomotor speed, and spatial abilities. A block design task provided perceptual analysis and conceptual abilities training. We assessed psychomotor speed with a letter-symbol matching procedure. Sometimes we used a component method, in which components of a complex task such as scanning or psychomotor speed were trained separately and then integrated into performance on the complex target task. For the cognitive rehabilitation intervention, we used appropriate media, manuals, and workbooks, as well as specialized protocol and manual developed by the investigators to standardize administration of the intervention procedures.

Attention Control Condition

Just as for subjects assigned to the experimental cognitive rehabilitation intervention group, subjects appointed to the attention control condition began sessions as soon as they could cooperate with and complete the baseline assessment. They met daily with a counselor for a 30-minute discussion of current events, with reference to self-selected recent articles published in newspapers or magazines. Subjects who did not select articles were asked to discuss topics in the news that they had recently either seen on television or read in a newspaper.

Data Analysis

We analyzed training data by both plotting learning curves across sessions and using a repeated measures analysis of variance (ANOVA) where appropriate. Because of the large number of training methods, we integrated both their descriptions and the results in the "Results" section of this paper. We evaluated changes in neuropsychological test performance in the cognitive rehabilitation intervention and attention control condition groups with a two-way (group × time) ANOVA with repeated measures on one factor (time). The finding of greatest importance would be a significant interaction effect, indicating that change over time is not independent of group membership. A significant main effect for the before- versus after-treatment factor would indicate that the sample as a whole improved or worsened over time regardless of the presence or absence of cognitive rehabilitation. Such a finding would reflect time-dependent recovery, as opposed to what Goldman [3] characterizes as experience-dependent (in this case, rehabilitation-dependent) recovery.

RESULTS

Training Data

The **Figure** shows training data in the form of learning curves for the 20 subjects assigned to the rehabilitation training.

Task 1. Cancellation

Description. This task was intended to be a method for improving selective attention. We presented an array of stimuli on a page and asked the patient to draw a line through (cancel) a given target. We used two tasks. In one, the stimuli were opened and unopened folders. The task was to cancel the open folders. The second task used letterboxes as stimuli, and the task was to cancel those letterboxes with their doors closed and the flag in the "up" position.

Results. The results for the two cancellation tasks are presented in **Figure (a)**. We noted a sharp decline in the time needed to complete both tasks. We performed a one-way repeated measures ANOVA for the time scores, yielding a statistically significant difference among scores in the direction of shorter times with training for both the folders task ($F_{4, 56} = 20.45$, $p < 0.001$) and the letterbox task ($F_{4, 56} = 18.78$, $p < 0.001$).

Task 2. Symbol Digit

Description. The patient was shown columns of digits and symbols such as "$" or "*." At the top of the page was a key that paired particular digits with symbols. The task was to match the digits and symbols following the pairing provided in the key, e.g., "* 1," "$ 2." The task was repeated for three-, four-, and six-pair sets. The purpose of the task was to increase speed of information processing during a decision-making task.

Results. Results for all the pair sets are presented graphically in the **Figure (b)**. While little change was seen in the three-pair set, reduced times could be found in the four- and six-pair sets. For the three-pair set, a repeated measures ANOVA yielded a borderline significant change across sessions ($F_{4, 76} = 2.26$; $p = 0.07$). Change for the four-pair set was statistically significant ($F_{4, 76} = 19.88$; $p < 0.001$). Change was also significant for the six-pair set ($F_{4, 76} = 11.96$; $p < 0.001$). We gleaned from these results a significant learning effect for this task.

Task 3. Digit Symbol

Description. Patients performed the Digit Symbol subtest of the WASI two times at each session. The task was to draw geometric symbols under numbers according to a key. The purpose of the training was to improve psychomotor and information processing speed.

Results. Figure (c) Shows Digit Symbol mean time scores (in seconds) across sessions. We detected a roughly linear increase in speed. A repeated measures ANOVA was statistically significant ($F_{4, 76} = 30.53$; $p < 0.001$), indicating significant improvement across sessions.

Task 4. Block Design Training

Description. This task involved the Goldstein-Scheerer version of the Kohs Block Test [15]. In this version, cues were provided in the cards as models from which the design was to be reproduced with colored blocks. In the strongest cue, the models contained the blocks drawn in their actual size with lines drawn to indicate the correct placement of the blocks. The next strongest cue consisted of models in which the size was the same, but there were no lines. Next, the size of the model was reduced to one-fourth the size of the blocks, but the lines were present. In the uncued condition, the size was reduced and there were no lines. Subjects were to repeat the task, beginning with the strongest cue, until they could

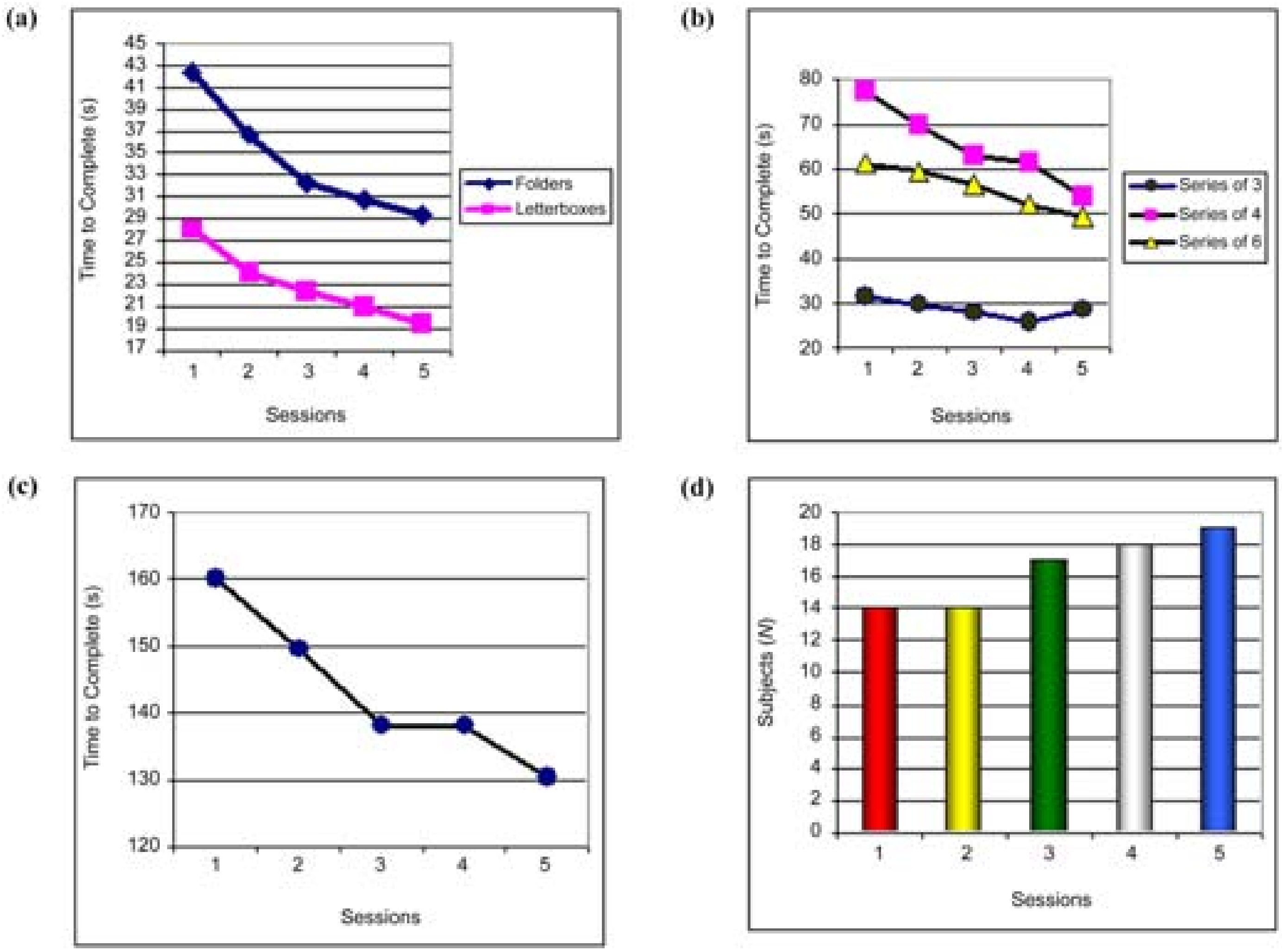

Figure.
Training data for each of four tasks across five training sessions: **(a)** Cancellation, **(b)** Symbol Digit, **(c)** Digit Symbol, and **(d)** Block Design. Note that in **(d)** Block Design, Task *N* represents number of subjects who achieved a criterion of performance of task in uncued condition.

do it successfully in the uncued condition. The purpose of the training was to improve spatial-constructional ability and its underlying analytical reasoning basis.

Results. Figure (d) shows the number of subjects who could perform the Block Design task in the uncued condition. At the first session, 14 of the 20 subjects could perform the task in the uncued condition. At the fifth session, 19 subjects achieved that goal. We noted a decrease in time needed to perform the uncued task, beginning with a mean of 26.6 s at the first session to a low of 15.6 s, with a fifth session mean score of 16.8 s. Thus, the training appeared to be associated with an increase in the ability to do a complex spatial-constructional task in the absence of cues and a decrease in the time required to perform that task.

Summary of Training Data

The training data generally showed improvement in performance across sessions, often at statistically significant levels. Clear evidence exists of learning across sessions in such areas as speed of information processing, rapid decision-making, and spatial-constructional ability. In that sense, the training worked because it improved performance. Next, we addressed whether the training generalized to other cognitive abilities.

Baseline and Postintervention Training Assessments

To determine whether the randomization procedure was effective in equating the cognitive rehabilitation intervention and attention control condition groups for level of performance on the neuropsychological tests, we made *t*-test comparisons for each test at baseline. The means and SDs for these tests are given in the pretraining columns of **Table 1**. No differences were statistically significant ($p < 0.05$), indicating the equivalence of the two groups prior to training. Two-way ANOVA results of the comparison between the first and second administrations of the neuropsychological tests are presented in **Tables 1** and **2**. Three kinds of findings are possible: no significant differences at all, significant main effects for testing session, and significant treatment *x* time interactions with (by hypothesis) greater improvement in the training group than in the attention control condition group. A significant main effect for testing session may be interpreted as a practice effect or as a function of time-dependent recovery from the consequences of alcohol intoxication. The research design we used cannot make that distinction. A completely nonsignificant result would

Table 1.
Means ± standard deviations (SDs) comparing the cognitive rehabilitation intervention and attention control condition groups before and after training.

Test	Pretraining		Posttraining	
	Training	Control	Training	Control
Neuropsychological Test Data				
CPT–Omission Errors	2.35 ± 2.35	1.85 ± 1.04	1.70 ± 0.86	2.80 ± 2.26
CPT–Commission Errors	10.85 ± 7.71	8.80 ± 5.64	8.45 ± 8.43	6.70 ± 5.32
CPT–Sensitivity	3.22 ± 0.82	3.42 ± 0.72	3.87 ± 1.36	3.59 ± 0.91
Category Test Errors	57.50 ± 20.60	67.75 ± 29.32	37.90 ± 21.64	47.70 ± 27.74
Trail Making B–Seconds	92.05 ± 53.58	75.00 ± 27.07	75.85 ± 38.26	65.65 ± 19.43
WCST–Categories	4.65 ± 2.13	5.11 ± 1.45	5.20 ± 1.61	4.84 ± 1.54
WCST–Perseverative Errors	15.80 ± 10.74	14.37 ± 8.04	10.15 ± 7.03	15.00 ± 11.64
Digit Symbol Boxes Filled	69.74 ± 14.60	63.65 ± 13.51	97.79 ± 21.55	71.60 ±17.55
WASI Block Design	7.80 ± 2.59	7.60 ± 2.19	9.40 ± 2.52	8.85 ± 2.30
IQ Data				
Verbal	88.40 ± 9.88	91.10 ± 12.73	—	—
Performance	92.00 ± 11.23	91.80 ± 10.10	—	—
Full Scale	89.30 ± 11.38	90.40 ± 9.58	—	—

CPT = Continuous Performance Test (Conners), IQ = intelligence quotient, WCST = Wisconsin Card Sorting Test, WASI = Wechsler Abbreviated Scale of Intelligence.

Table 2.
Two-way analyses of variance for cognitive tests comparing training and control groups before and after training.

Neuropsychological Test Data	F_{group}		F_{time}		F_{gxt}	
	F	*p*-Value	*F*	*p*-Value	*F*	*p*-Value
CPT Omissions	0.50	NS	0.17	NS	4.83	<0.05
CPT Commissions	0.81	NS	16.08	0.001	0.07	NS
CPT Sensitivity	0.02	NS	9.23	<0.01	3.15	NS
Category Test Errors	1.77	NS	62.24	<0.001	0.01	NS
Trail Making B–Seconds	1.62	NS	7.57	<0.01	0.54	NS
WCST Categories	0.01	NS	0.47	NS	3.51	NS
WCST Perseverative Errors	0.36	NS	5.19	<0.05	8.12	<0.01
Digit Symbol Boxes Filled	10.05	0.01	82.88	<0.001	25.84	0.001
WASI Block Design	0.26	NS	45.03	<0.001	0.68	NS

F_{group} = main effect for group, F_{time} = main effect before or after training, F_{gxt} = group × time interaction, CPT = Continuous Performance Test (Conners), NS = nonsignificant ($p < 0.05$), WASI = Wechsler Abbreviated Scale of Intelligence, and WCST = Wisconsin Card Sorting Test.

mean that practice, recovery, or training did not alter performance level. A significant interaction showing enhanced outcomes for the experimental treatment group would support the effectiveness of the cognitive training.

We found no nonsignificant differences when we combined the results for the testing session main effect and the interaction. Nevertheless, we detected strong evidence for improvement in performance over time. Examination of the interactions should help account for the proportion of the improvement attributable to training. We found significant differences ($p < 0.05$) for testing session without significant interactions for commission errors from the CPT, Category Test, Trail Making Test, and Block Design. We noted significant interactions for omission errors from the CPT, for perseverance errors from the WCST and Digit Symbol. The significant interaction for CPT omission errors might be interpreted with caution, since three CPT comparisons were made and the interaction was only significant at the 0.05 level. Furthermore, power for this effect was equal to 0.57 with an effect size of 0.34, raising the possibility of a Type I error. In contrast, the findings for the WCST, where the results were at the <0.01 level, were more robust. Power for the test of the interaction on the WCST was 0.79 with an effect size of 0.42. Similarly, power for Digit Symbol was 0.99 with an effect size of 0.64, suggesting substantially less likelihood of Type I errors in these cases.

DISCUSSION

We found clear evidence of incremental learning, often statistically significant across trials, and thereby supportive of the first hypothesis. The repeated cognitive testing results would appear to partially confirm the second hypothesis, demonstrating that dual diagnosis patients in the subacute phase of detoxication can improve their information processing skills through systematic training. This improvement is seen in not only the training itself, but also improvement on standard tests of cognitive function. The data provide a distinction between cognitive changes that occur as a result of exposure to the test material or natural, time-dependent recovery and changes associated with cognitive training. We noted improvement on some of the test procedures regardless of whether training was received, and we most conservatively interpreted it as practice effects. However, it is interesting to note that these patients, who were in the subacute stages of detoxication, developed such effects to the extent of statistically significant differences. Such changes might suggest that recovery may have been a factor in addition to the influence of previous testing.

Further investigation with regression methods is needed to determine whether the significant changes noted in both the cognitive rehabilitation intervention and attention control groups are associated with recovery or practice effects [16–17]. However, a more comprehensive analysis requires the existence of a database of expected practice effects associated with the tests used in the general population. Regardless of the results of such analyses, in all cases we found time-dependent or training-dependent improvement, and the training data indicate to us that the patients in the study were fully capable of incremental learning as demonstrated by significant improvements in performance over sessions. In the cases of some abilities, we could not detect significant interactions, but possible evidence of time-dependent recovery of these abilities could exist.

We discovered significant interactions indicating the effectiveness of training on tests of attention, speed of information processing, and conceptual flexibility. Attention and speed of information processing were specifically trained, but conceptual flexibility was not. The significant interaction for the omission errors from the CPT indicate that trained subjects became less distractible and more capable of making accurate judgments. The significant interaction on the WCST suggests an increase in conceptual reasoning ability, probably reflecting increased cognitive flexibility.

Earlier we noted a possible concern that cognitive haze, in itself, might compromise the ability of patients to benefit from these training programs. Evidence from our research is consistent with the Goldman group findings demonstrating improvement from this training in excess of that associated with time-dependent recovery even during the period of cognitive haze [6–8], as well as generalization to other complex cognitive tasks. It might be argued that such improvements may be viewed simply as "practice effects" [16–17], since it is generally appreciated that patients who are retested for assessment purposes may perform better on repeated testing than they did originally, simply on the basis of previous experience with the test. However, in a rehabilitation application, practice effects may be viewed as desirable, particularly when one or two outcomes occur. The first outcome suggests evidence of a positive outcome if greater improvement occurs with systematic training than with no training or an attention placebo in research studies. Recorded training data further demonstrate the presence and progress of incremental learning and its effect on outcome for those tasks that yielded significant time effects with training. The second outcome, even more indicative of substantive improvement, is the presence of generalization or improvement with training on cognitive tasks not specifically trained. In this study, both outcomes were obtained.

CONCLUSION

For this study, we demonstrated that the successful results of Goldman's group [3] and Parsons [5] can be repeated in a group of patients who had not only alcoholism but also another major neuropsychiatric disorder. Of particular interest was that significant interactions were found on tests that assess abilities that were not specifically trained. No specific training of abstract reasoning was measured by the WCST, nevertheless the cognitive rehabilitation intervention group demonstrated a significantly improved level of conceptual flexibility than did the attention control condition group. The CPT results tentatively suggested that the training was associated with reduced distractibility. Reduced omission errors on the CPT were typically interpreted as reflecting increased sustained alertness while subjects were making judgments. Future research might address that matter.

This research was clearly preliminary in the sense that it did not measure long-term outcomes. Another possible limitation of the study was that patients were medicated. However, the results of the study cannot be attributed to medication because both the cognitive rehabilitation intervention and attention control condition groups were receiving medication. While a study with medication-free patients might be of interest, the point of the rehabilitation method described here was more that of supporting ongoing treatment than functioning as an independent modality. Another limitation of the study was our inability to unequivocally discriminate between practice and natural recovery effects. However, the Goldman group stipulated that there was natural or time-dependent recovery in cognitive ability with sustained sobriety and adequate nutrition [3], and the point of our training was improving both assessment-related practice effects and natural recovery. The results of this study would support the conclusions that clear evidence of learning the tasks in the training program exists, a substantial time-dependent recovery can be attributed in part to a practice effect, and a modest benefit of training can occur over and above what can be attributed to natural recovery and anticipated practice effects.

ACKNOWLEDGMENTS

We would like to express indebtedness to the Veterans Integrated Service Network (VISN) 4 Mental Illness Research, Education, and Clinical Center (MIRECC) and the VA Medical Research Service for support of this research.

REFERENCES

1. Bennett ME, Barnett B. Dual diagnosis. In: Hersen M, Turner SM, editors. Adult psychopathology and diagnosis. 4th ed. Hoboken (NJ): Wiley; 2003. p. 36–71.
2. Allen DN, Goldstein G, Aldorando, F. Neurocognitive dysfunction in patients diagnosed with schizophrenia and alcoholism. Neuropsychology. 1999;13(1):62–68.
3. Goldman MS. Experience-dependent neuropsychological recovery and the treatment of chronic alcoholism. Neuropsychol Rev. 1990;1(1):75–101.
4. Allen DN, Goldstein G, Seaton BE. Cognitive rehabilitation of chronic alcohol abusers. Neuropsychol Rev. 1997; 7(1):21–39.
5. Parsons OA. Neuropsychological consequences of alcohol abuse: Many questions, some answers. In: Parsons OA, Butters N, Nathan PE, editors. Neuropsychology of alcoholism: Implications for diagnosis and treatment. New York: Guilford; 1987. p. 153–75.
6. Forsberg LK, Goldman MS. Experience-dependent recovery of visuo-spatial functioning in older alcoholic persons. J Abnorm Psychol. 1985;94(4):519–29.
7. Goldman MS, Goldman RS. Remediation of visuo-spatial and information processing abilities in chronic alcoholics. Paper presented at the American Psychological Association Convention; August 1986; Washington (DC).
8. Goldman MS. Neuropsychological recovery in alcoholics: Endogenous and exogenous processes. Alcohol Clin Exp Res. 1986;10(2):136–44.
9. Spitzer RL, Williams JBW, Gibbon M, First MB. User's guide for the structured clinical interview for DSM-III-R. Washington (DC): American Psychiatric Press; 1990.
10. Khavari KA, Farber PD. A profile instrument for the quantification and assessment of alcohol consumption. The Khavari Alcohol Test. J Stud Alcohol. 1978;39:1525–39.

11. Wechsler D. WASI: Wechsler Abbreviated Scale of Intelligence. San Antonio (TX): The Psychological Corporation; 1999.
12. Heaton RK, Chelune GJ, Talley JL, Kay GG, Curtiss G. Wisconsin Card Sorting Test Manual. Odessa (FL): Psychological Assessment Resources; 1993.
13. Reitan RM, Wolfson D. The Halstead-Reitan Neuropsychological Test Battery: Theory and clinical interpretation. 2nd ed. Tucson (AZ): Neuropsychology Press; 1993.
14. Conners CK, Multi-Health Systems Staff. Conners' Continuous Performance Test computer program. Toronto: MHS; 1994.
15. Goldstein K, Scheerer M. Abstract and concrete behavior: An experimental study with special tests. Psychol Monogr. 1941;53(2):1–151.
16. Dikmen SS, Heaton RK, Grant I, Temkin NR. Test-retest reliability and practice effects of expanded Halstead-Reitan Neuropsychological Test Battery. J Int Neuropsychol Soc. 1999;5(4):346–56.
17. Temkin NR, Heaton RK, Grant I, Dikmen SS. Detecting significant change in neuropsychological test performance: a comparison of four models. J Int Neuropsychol Soc. 1999; 5(4):357–69.

Submitted for publication March 30, 2004. Accepted in revised form August 31, 2004.