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NEUROPSYCHOLOGICAL FUNCTION AND PSYCHOSOCIAL STATUS OF ALCOHOL REHABILITATION PROGRAM RESIDENTS

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Abstract — This investigation examined the relationship between changes in psychosocial status and changes in neuropsychological function of clients undergoing treatment for substance use. A sample of 74 adults enrolled at a rehabilitation program for substance use were randomly assigned to two groups (one serving as a comparison group for practice effects). Participants were tested three times over 60 days on self-esteem, motivation, depression, and neuropsychological function. Consistent with other studies, participants demonstrated impaired baseline neuropsychological function that improved with alcoholic abstinence; however, changes in motivation and depression were associated with positive changes on few tests of neuropsychological function. The more common predictor of improved motor function test scores was low baseline function. Participants who remained in treatment were more likely to be Black, homeless, report less alcohol consumption, and score lower on a motivational scale than those who left treatment.

Chronic alcohol use is widely associated with cognitive and motor impairment (Tamkin & Dolenz, 1990; Sanders, Nixon & Parsons, 1989; Goldman & Goldman, 1988; Grant, 1987; Eckardt & Martin, 1986; Sussman, Rychtarik, Muesser, Glynn & Pruer, 1986; Brandt, Butters, Ryan, & Bayog, 1983). Numerous studies have employed neuropsychological tests to measure impairment associated with chronic alcohol use and recovery with abstinence (Eckardt & Martin, 1986; Kish, Hagen, Moody, & Harvey, 1980; McCrady & Smith, 1986; Sanders et al. 1989; Tarter & Ryan, 1983). Because these studies provide helpful information on the course of recovery in substance abuse treatment, neuropsychological tests continue to be employed to detect impairment associated with alcohol abuse. However, these studies have had limitations.

First, motor and sensory neuropsychological tests are sensitive, but not specific to the effects of a particular neurotoxin (Agnew & Masten, 1994). For example, low scores may indicate the effects of depression or other psychosocial rather than neuropsychological impairment (Castaneda, Lifshutz, & Galanter, 1992; Lezak, 1983; Brown & Schuckit, 1988; Parsons, Sinha, & Williams, 1990; Sinha, Parsons, & Glenn, 1989). Unfortunately, alcohol treatment inpatients frequently manifest psychological and social problems (Weisner, 1993; Timko, Finney, Moos, Moos, & Steinbaum, 1993). Furthermore, studies employing neuropsychological tests are often conducted on chronic alcohol users who are recovering at inpatient or residential programs containing multiple therapies that are designed to promote increased motivation and mitigate feelings of depression (Koroloff & Anderson, 1989; Lapham, Hall, McMurray-

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Avila, & Beaman, 1993). Consequently, it is useful to measure psychological and social status variables along with neuropsychological tests.

A second problem is that neuropsychological tests are effort-dependent and, therefore, most accurate when subjects exert maximal effort (Eisen, Letz, Wegman, Baker, & Pothier, 1988; Lezak, 1983). Thus, the level of motivation and effort of participants may influence scores of neuropsychological tests.

A third difficulty with neuropsychological tests is that the scores of some tests exhibit practice effects after readministration to the same subjects (Goldman, Klisz, & Williams, 1985; Parsons, Schaeffer, & Glenn, 1990). While most researchers agree that significant improvement in neuropsychological function occurs with alcoholic abstinence (Eckardt & Martin, 1986; Kish et al., 1980; McCrady & Smith, 1986; Sanders et al., 1989; Tarter & Ryan, 1983), fewer report that neurological function improves beyond the initial week or so of abstinence (Adams, Grant, & Reed, 1980; Grant, 1987; Long & McLachlan, 1974). Many attribute any improved neuropsychological function after the first few weeks of abstinence to practice or learning effects produced by repeated test administration (Eckardt, Parker, Noble, Paulter, & Gottschalk, 1979; Goldman, 1985; Parsons et al., 1990); and some commonly used neuropsychological tests have demonstrated practice effects after multiple test administrations (Goldman, 1985; Kish et al., 1980; Eckardt et al., 1979). For example, subjects tested on the Purdue Pegboard, a neuropsychological test often used to measure motor speed and dexterity, demonstrated practice effects with repeated administrations (Reddon, Gill, Gauk, & Maerz, 1988). Similar results have been demonstrated on a perceptuomotor test called the Trail Making Test (Dye, 1979). Conversely, subjects tested on other neuropsychological tests such as Simple Visual Reaction Time have not evidenced practice effects (Baker, Maurissen, & Chrzan, 1986).

However, studies using neuropsychological function tests often fail to measure motivation or depression (Sinha et al., 1989; Malloy, Noel, Rogers, Longabaugh, & Beattie, 1989; Lafferty & Kahn, 1986; Eckardt, Ryback, & Pautler, 1980) or practice effects (Goldman, 1985; Kish et al., 1980; Eckardt et al., 1979). Thus, the purpose of this investigation was to examine the neuropsychological function of recovering, chronic alcohol abusers over 60 days of abstinence to (a) test whether the neuropsychological function of chronic alcohol users improved with abstinence; (b) measure whether improved neuropsychological function is positively associated with increased motivation and decreased depression; and (c) assess the influence of practice effects.

METHODS

Sampling site

The recruitment site was a 100-bed, residential, adult rehabilitation program (ARP) operated by the Salvation Army in Baltimore, Maryland. All prospective clients, referred from area hospitals and detoxification centers, were required to meet several intake criteria including that they have no medical or psychiatric diagnosis, be able to work 40 hours per week, and have a Social Security number. ARP intake workers accepted referrals by telephone, but only determined eligibility for program admission after a thorough face-to-face interview.

Clients who were admitted lived on the premises. The ARP required a minimum on-site stay of 90 days and a maximum stay of 365 days. In addition to the work requirement, clients were required to attend self-help group (e.g., Alcoholics Anonymous, Narcotics Anonymous), religious activities, and other group exercises.

Alcohol use during rehabilitation was monitored at least daily through routine ARP procedures of administering breathalyzer tests when residents left and reentered the facility. In addition, the ARP conducted drug and breathalyzer screening weekly on randomly selected residents. Participants who tested positive on either breathalyzer or drug screening were immediately discharged from the ARP.

Study sample

The ARP clients were male, 25 years of age or older. All ARP residents who were admitted between February 1990 and March 1991 with primary alcohol abuse histories (as determined by intake histories) were invited to participate in the study. Because interviews and testing sessions were administered on the Salvation Army premises, study participants who tested positive on random breathalyzer or drug tests were dropped from the study because of discharge from the program.

Design and instrumentation

Study participants were followed prospectively over an approximately 60-day period. During the 60-day period, study participants were interviewed and tested three times.

We used a study design in which the impact of an extra testing session could be measured on final session scores. Participants were randomly assigned to one of two groups. The only difference between groups was that Group A received the total battery of neuropsychological tests at first (baseline) and third sessions, while Group B received the entire battery of tests at all three sessions. During the second session, two substitute motor tests (described below) were administered to Group A to allay suspicions about the absence of motor tests during that session. The first (baseline) session was scheduled between the subject's fourth and ninth day of rehabilitation admission. The delay in testing was incorporated to allow subjects to acclimate to their new environment and to overcome the most severe symptoms of alcohol withdrawal.

The nature of the study was explained to all prospective participants, and consent, including the National Institute of Alcoholism and Alcohol Abuse (NIAAA) Certificate of Confidentiality, was obtained on all individuals who agreed to participate. The session consisted of a pretest, a questionnaire, and a battery of motor performance tests. The pretest was the Mini-Mental State Exam (MMSE), a measure used to detect dementia (Folstein, Folstein, & McHugh, 1975). Data collection did not continue with participants who scored below 27. All other participants were interviewed using a questionnaire that last approximately 90 minutes and included demographic questions, psychosocial measures, alcohol and drug scales, and a vocabulary test. All measures incorporated in the questionnaire were administered and coded using standardized protocols to avoid inconsistencies that can result from use of isolated questions or anecdotal reports (Bronisch & Hecht, 1987; Fagan & Mauss, 1986). The instrument was read by the interviewer to eliminate differences in understanding based on reading levels. The following components were included.

1. Demographic questions were selected from the Epidemiologic Catchment Area (ECA) Survey Questionnaire (Eaton et al., 1984) and The Service Needs of Homeless Interview (Breakey et al., 1989).
2. Levels of Social Support from Family and Friends was measured (Procidano & Heller, 1983). Two scales of Achievement Motivation were used to measure the desire to do well at a job and desire to succeed in life (Costello, 1967). Center for Ep-

idemiological Studies-Depression Scale (Weissman, Sholomskas, Pottenger, Prusoff, & Locke, 1977) and Rosenberg's Self-Esteem Scale (Rosenberg, 1965) were also used. These latter two scales have been used on subjects with histories of chronic alcohol abuse (Charalampous, Ford, & Skinner, 1976; Nocks & Bradley, 1969; Weissman et al., 1977) and homelessness (Padgett & Struening, 1992; Padgett, Struening, & Andrews, 1990; Susser, Conover, & Struening, 1989).
3. Both alcohol and illicit drug use were assessed using questions extracted from the Addiction Research Foundation Interview (Addiction Research Foundation, 1982).
4. The vocabulary test from the Weschler Adult Intelligence Scale Revised (WAIS-R) was used as a measure of premorbid intelligence (Wechsler, 1981).

Following the interview, a battery of several neuropsychological motor performance tests were administered.

1. Neuropsychological motor tests included: the three Purdue Pegboard tests (Lafayette Instrument Company, n.d.; and Tiffin, 1968); Trail Making Test, Part A and B (Army Individual Test Battery, 1944); left- and right-handed Finger Tapping Test (Reitan & Davidson, 1974); and Simple Visual Reaction Time (SVRT) (Baker et al., 1986; Wilkinson & Houghton, 1982).
2. Additional substitute motor performance tests were: Digit Symbol (Wechsler, 1981) and a motor test, called Bolts, in which participants attached 10 nuts and bolts. Bolts was created exclusively for this population, which consisted mainly of semi- and unskilled laborers.

After 30 days, all study participants who had not left the ARP were reinterviewed using the same set of psychosocial scales. The only difference between groups was the set of motor performance tests. Group B participants received the same battery of motor performance tests administered at baseline, while Group A participants received only the two additional substitute motor performance tests. After 30 days (or total of 60 days), the third and final interview and testing session took place, and both groups received the same interview and motor tests administered at baseline.

Analyses

The SAS® was used to conduct all analyses. The Chi-Square Test of Independence and Fischer's Exact Test were used to compare groups on discrete variables. Continuous variables with skewed distributions were transformed to better approximate normality, and then independent group *t*-tests were used to compare groups on continuous variables. Paired *t*-tests were used to examine change in participant's motor performance and psychosocial status between the first and third sessions after 60 days of abstinence. Effects from repeated administration on motor function tests were evaluated by comparing the magnitude of change in scores between first and third testing sessions. Multiple linear regression was used to assess the association between test scores indicating improved motor function (the dependent variable) and demographic characteristics, alcohol history, history of head trauma, or changes in psychosocial variables. Dependent variables consisted only of motor function scores that improved between the first and the third session of test administration.

Variables entered into the regression model were selected based on findings from previous studies on motor performance and included baseline motor performance, age, amount of alcohol consumed in the year prior to admission (in cc's), and total

days of abstinence (Macciocchi, Ranseen, & Schmitt, 1989; Malloy et al., 1989; Goldstein, Shelly, Mascia, & Tarter, 1985; Hasselbrock, Weidenman, & Reed, 1985; Lezak, 1983; Walker, Donovan, Kivlahan, & O'Leary, 1983). In addition, demographic variables (i.e., age and race), history of head trauma, and change in psychosocial status (i.e., depression, motivation, and social support) were entered using backward stepwise regression. Because of sample size limitations, no more than five variables were entered into any regression model (Glantz & Slinker, 1990; Kleinbaum, Kupper, & Muller, 1988). Determination of the best regression model to explain changes in neuropsychological test performance was based on two criteria: (1) the highest *F*-statistic and (2) the largest Adjusted R-square.

RESULTS

Seventy-nine potential candidates were asked to participate in the study. Two refused. Three others were excused because (1) a score below 27 was obtained on the MMSE, (2) one participant became so emotionally distraught over the psychosocial questions that he was unable to continue, and (3) one participant was foreign-born and not fluent in English.

The 74 subjects who completed the first session are described in Table 1. More than 50% were over the age of 35 years. Half were Black and half were White. Approximately half had never married and approximately half had not attained a 12th-grade education. More than two-third were classified as homeless based on having spent at least one night in a mission, shelter, or on the streets in the year prior to ARP admission (Robertson, Zlotnick, & Westerfelt, 1993). Head trauma was reported by more than a third of the sample. The mean number of days abstinent for clients prior to ARP admission was approximately 22 (*SD* of 27 days).

Because of recruitment criteria, alcohol was the primary substance used by participants, with the overwhelming majority of participants reporting more than 10 drinks per day. Almost one-fifth of the sample reported concurrent drug use. Cocaine was the most commonly used substance followed by marijuana, narcotics (mostly heroin), and hallucinogens.

Table 1. Comparison of factors between groups (in percent)

	Total sample (N = 74)	Group A (n = 36)	Group B (n = 38)
Age			
25–35	41.9%	47.2%	36.8%
36+	58.1	52.8	63.2
Race			
Black	51.4	52.8	44.7
White	48.6	47.2	55.3
Education <12th grade	52.7	55.6	50.0
Never Married	60.8	52.8	68.4
Homeless in Past Year	70.3	63.9	76.3
Ever Had Head Trauma	35.6	36.1	35.1
Any Drug Use	18.9	19.4	18.4
Cocaine	13.5	13.2	13.9
Marijuana	4.1	8.3	0.0
Narcotics (including heroin)	2.7	2.8	2.6
Hallucinogens	1.4	0.0	2.6

Of the 74 participants, 36 and 38 were randomly selected in Groups A and B, respectively. No differences were found between groups in demographic characteristics, drug and alcohol use, history of head trauma, or baseline psychosocial measures (Table 2). The only significant difference noted between groups was that Group A participants scored significantly better on left-hand Finger Tapping ($p < .05$) (not shown in Table 2).

From the 74 participants at baseline, 50 were still ARP residents after 30 days (23 from Group A and 27 from Group B), and only 35 remained 60 days after admission (16 from Group A and 19 from Group B). There was no difference in attrition rates between groups.

No differences were found between the two groups. The number of days between the last alcoholic drink and the first testing session did not differ between Groups A and B (Mean = 17.2, SD = 13.5 compared to Mean = 16.2, SD = 14.0, respectively). Furthermore, we found no difference in neuropsychological function between participants of Groups A and B who were tested at the third session. In addition, no differences in change of motor performance (from first to third session) were found between Groups A and B, suggesting the added testing session administered to Group B had no impact on third-session motor test scores (Table 3). Based on this lack of evidence of practice effects from the added testing session, data from both groups were combined for all remaining analyses.

After Groups A and B were combined, paired t-tests were used to detect differences in motor performance scores and in the psychosocial tests from session one and session three. Only scores on Achievement Motivation Scale–I (to do a job well) and CES-Depression Scale demonstrated significant improvement (see Table 4). Higher test scores from session one to session three were noted on six scales, all three Purdue Pegboard tests, Digit Symbol and Trail Making–Parts A and B, but not on the Finger-Tapping Test or Simple Visual Reaction Time (Table 4).

Multiple linear regression was used to examine the association between changes in psychosocial status and motor performance test scores that improved from baseline to third session (the dependent variables). Four independent variables were entered into all equations (regardless of significance levels): the interval of abstinence, the volume of ingested alcohol (in cc's) reported the year prior to admission, age, and baseline

Table 2. Comparison of groups remaining 60 days of study duration (in percent)

	Total sample (N = 35)	Group A (n = 16)	Group B (n = 19)
Age			
≤35	34.2%	50.0%	21.0%
>35	65.7	50.0	79.0
Race			
Black	47.4	50.0	47.4
White	52.6	50.0	52.6
Education <12th grade	48.6	50.0	47.4
Never Married	65.7	62.5	68.4
Homeless in Past Year	80.0	75.0	84.2
History of Head Trauma	34.3	37.5	31.6
Any Drug Use	11.4	5.7	5.7
Cocaine	8.6	6.3	10.5
Marijuana	2.9	6.3	0.0
Narcotics (including heroin)	0.0	0.0	0.0
Hallucinogens	0.0	0.0	0.0

Table 3. Comparison of mean neurobehavioral test differences between groups[a]

	Group A (N = 16)	Group B (N = 19)
	Mean change (SD)	Mean change (SD)
Finger Tapping		
Right	1.25 (5.91)	1.78 (7.55)
Left	0.13 (5.99)	0.11 (4.55)
Purdue Pegboard		
Right	1.94 (3.21)	2.44 (2.83)
Left	1.06 (2.41)	1.76 (2.54)
Assembly	3.94 (5.79)	3.29 (8.22)
Simple Visual Reaction Time	−6.69 (39.08)	−10.84 (35.46)
Digit Symbol	7.87 (3.48)	9.88 (6.32)
Trail Making		
Part A	−7.00 (13.96)	−5.22 (14.46)
Part B	−17.47 (38.39)	−11.50 (26.98)

[a]No significant differences were found between groups.

motor test scores. Other demographic, drug history, and psychosocial variables were introduced using the Backward Stepwise technique so only variables with unique contributions would be entered into the model.

In three of the six scales (i.e., Purdue Pegboard–Left Hand, Trail Making Part A and Trail Making Part B) in which improved motor performance scores were found, a low baseline motor score was the only variable that consistently explained improved motor function. In addition to a low baseline motor score, change in level of depres-

Table 4. Mean change in psychosocial and motor function over 60 days (n = 35)[a]

	Mean Change	(SD)
Social Support		
Family	+0.62	(4.65)
Friends	−1.23	(4.19)
Motivation		
To do a job well	+0.40	(1.14)*
To succeed in life	−0.51	(1.46)
CES-Depression	+6.88	(12.46)**
Rosenberg's Self-Esteem	−0.20	(0.93)
Finger Tapping		
Right	+1.47	(6.73)
Left	−0.12	(5.19)
Purdue Pegboard		
Right	+2.21	(2.98)***
Left	+1.42	(2.46)**
Assembly	+3.61	(7.04)**
Simple Visual Reaction Time	+8.94	(36.66)
Digit Symbol	+8.94	(5.21)***
Trail Making		
Part A	+6.06	(14.04)*
Part B	+14.39	(32.57)*

[a]Plus and negative signs (+, −) show improvement and deterioration, respectively.
*$p < .05$.
**$p < .01$.
***$p < .001$.

sion and not being homeless were the best predictors to explain better scores on Trail Making, Part A (Adjusted R-Square = 47%, $p < .001$). Lower baseline motor scores on Trail Making, Part B explained approximately 43% of the variance ($p < .001$). Improved scores on the Purdue Pegboard–Left Hand were negatively associated with baseline scores and reported volume of alcohol in the past year (Adjusted R-Square = 56%, $p < .001$). Increased self-esteem was the sole significant contributor to the model explaining Purdue Pegboard–Assembly (Adjusted R-square = 21%, $p < .05$). No significant variables were found to explain improved scores on the Purdue Pegboard–Right Hand or Digit Symbol tests.

Because of the high attrition rate in the sample, baseline measurements of individuals who were lost to follow-up were compared to those who remained in the study. Using logistic regression (Backward, Stepwise selection), we found participants who remained in treatment, compared to participants who left treatment, reported less alcohol consumption the year prior to admission (Odds Ratio 0.43 $p < .01$), were more than seven times more likely to report being homeless in the past year (Odds Ratio 7.67, $p < .05$), were four times more likely to be Black (Odds Ratio 4.37, $p < .05$), and obtained lower scores on the achievement test measuring desire to succeed in life (Odds Ratio 0.55, $p < .05$) (Model Chi-Square $p < .003$).

DISCUSSION

The first goal of this study was to examine whether chronic alcohol abusers demonstrated improved motor function with continued abstinence; the second goal was to assess whether improved motor performance was related to change in psychosocial variables after adjusting for days of sustained abstinence. Consistent with other studies (Eckardt & Martin, 1986; Kish et al., 1980; McCrady & Smith, 1986; Sanders et al., 1989; Tarter & Ryan, 1983), our findings indicated that after 60 days of abstinence, ARP residents demonstrated improved motor function on the more complex motor tests including all three Purdue Pegboard tests, Digit Symbol, and both Trail-Making tests, but showed no changes in either the Finger-Tapping test or Simple Visual Reaction Time. Simultaneously, ARP participants demonstrated decreased depression based on the CES-Depression scale and increased desire to do a job well as indicated on the Achievement Motivation Scale–I.

However, changes in these variables were rarely correlated with changes in motor performance. The two exceptions were that improved CES-Depression significantly predicted improved scores in Trail Making, Part A and that improved scores on Rosenberg's Self-Esteem Scale were significantly associated with improved Purdue Pegboard Assembly scores. Nonetheless, these results were not consistent among neuropsychological motor performance tests and consequently would not provide support for the conclusion that change in social support, depression, or motivation was associated with improved motor performance.

Possible explanations for these indeterminate results might be due to the instruments chosen to measure the psychosocial variables or the sample size. Tests for self-esteem, depression, social support, and motivation were selected based on previous use with the population, availability of standardized protocols, and ease of administration. Nevertheless, these instruments may have lacked the sensitivity to detect change in status over a 60-day period. Also, as with other analyses in this investigation, the power to detect statistically significant differences might have been affected by the small sample size that resulted owing to attrition.

In response to the third goal of the study, no practice effects were found on any motor performance tests; however, this study only tested the influence of the addition of one testing session within the 60-day period. The length of the interval between test repetitions and the number of repetitions are both factors linked to practice effects (Reddon et al., 1988). It is also important to note that *any* repeat administration might introduce practice effects. Accordingly, administration of baseline tests may produce practice effects in subsequent test administrations. Based on this study, we can only conclude that the addition of one extra motor performance testing session within a 60-day period evidenced no practice effects on final motor performance test scores for this sample.

Unrelated to the hypotheses, but an interesting finding that arose in the course of the study, was that participants who remained in treatment for the entire 60-day period were more likely to be Black with histories of homelessness, to have reported lower alcohol consumption in the past year, and to score lower on the achievement motivation test to succeed in life compared to those who left treatment. In contrast, researchers of another study discovered that clients who dropped out of inpatient rehabilitation settings were those who reported longer, more severe histories of alcohol abuse and who were residentially unstable (MacKenzie, Funderburk, Allen, & Stefan, 1987).

The Salvation Army residential rehabilitation programs are well-established, long-term programs that target homeless individuals who are chronic alcohol users, alone, less educated, unskilled, and unemployed (Katz, 1966; Moos, Mehren, & Moos, 1978; Stoil, 1987). In addition, Salvation Army clients with histories of homelessness demonstrate poorer perceptuomotor function compared to their nonhomeless counterparts (Zlotnick, Fischer, & Agnew, 1995). At first glance, this type of environment would seem disagreeable to homeless men with histories of chronic alcohol abuse who are reputed to shun traditional institutions and who are more likely to live on the streets rather than live in shelters (Grigsby, Baumann, Gregorich, & Roberts-Gray, 1990). Perhaps mandatory religious activities, group meetings, and 40-hour work weeks are acceptable payments in exchange for guaranteed shelter, food, and clothing for formerly homeless clients, but not for nonhomeless clients who can obtain the same essentials elsewhere.

An important limitation of this study is the restricted sample. Only men aged 18 years or older, without mental or physical illness, who had been referred from hospital or detoxification centers and admitted with a primary alcohol problem, were eligible for admission into the ARP. Because of the ARP admission restrictions, it is evident that there was a selection bias limiting the generalizability of the results. Similarly, a high rate of attrition limited the ultimate sample size and power of the study. Findings regarding characteristics of those remaining in treatment, however, are worthy of future examination.

Another problem of this study is its limited ability to detect practice effects. Only the effect of receiving three test administrations compared to over a 60-day period was tested. Other investigations measuring practice effects have examined the results of more frequent testing sessions (Reddon et al., 1988) administered with shorter time periods (Dye, 1979). To obtain practice effects, clients must recall the test and apply past experience to taking the test. If chronic alcohol users have learning problems, they may be unable to learn tasks well enough to manifest practice effects on certain neuropsychological tests (Goldman et al., 1985; Parsons et al., 1990). If this is the case, chronic alcohol users undergoing rehabilitation may need longer periods to understand treatment modalities that require learning.

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