NEUROPSYCHOLOGICAL STATUS OF ALCOHOL-DEPENDENT PATIENTS: INCREASED PERFORMANCE THROUGH GOAL-SETTING INSTRUCTIONS

A. SCHEURICH¹*, M. J. MÜLLER¹, A. SZEGEDI¹, I. ANGHELESCU¹, C. KLAWE¹, B. LÖRCH¹, B. KAPPIS¹, H.-G. BIALONSKI², S. HAAS² and M. HAUTZINGER³

¹Department of Psychiatry, University of Mainz, Mainz, 2Psychiatric Hospital Eichberg, Eltville and 3Department of Clinical and Physiological Psychology, University of Tübingen, Tübingen, Germany

(Received 27 February 2003; accepted in revised form 5 December 2003)

Abstract — Aims: The effects of goal-setting instructions on neuropsychological performance of alcohol-dependent patients and control subjects were assessed. Methods: 57 alcohol-dependent patients and 59 carefully age- and education-matched healthy control subjects underwent standard neuropsychological investigation. In addition, the goal-setting paradigm was used to systematically manipulate motivation. Participants were requested to calculate simple mathematical problems repeatedly within phases of a 2-min duration receiving normal or goal setting-instructions (to increase performance in the next phase by 20%). Results: The patients demonstrated deficits in standard neuropsychological tests. Patients under goal-setting instructions demonstrated significantly higher improvement (correct responses: P = 0.016) relative to patients with standard instructions. Control subjects with goal-setting instructions demonstrated tendencies for higher improvement relative to control subjects with normal instructions. However, the differences were not significant. Interaction of group (patients vs. control subjects) and instructions (goal setting vs. normal) remained insignificant (P = 0.489) indicating that the increase through goal setting for the patients was not significantly higher than that for the control subjects. Conclusions: Despite of neuropsychological deficits in reasoning and psychomotor functioning, alcohol-dependent patients early in recovery are responsive to goal setting and able to increase neuropsychological performance. Therefore, goal-setting strategies might possibly be used in cognitive rehabilitation and therapy of alcohol-dependent patients. As there was no significant interaction in increase between patients and control subjects, our results do not support the hypothesis that the neuropsychological deficits are affected by or even caused by motivational limitations of the alcohol-dependent patients.

INTRODUCTION

Although not all recently detoxified alcohol-dependent patients demonstrate evidence of cognitive dysfunction, alcohol-induced cognitive impairments range from mild to moderate deficits in neuropsychological testing (about 50% of patients) to the severe disorders of alcohol-induced persisting amnesic disorder (Korsakoff Syndrome) and alcohol-induced dementia (about 10% of patients; Rourke and Loberg, 1996).

As the symptoms of mildly–moderately and severely impaired patients are different and the underlying pathogenetic processes appear also to be different, both groups of patients should be studied separately (Knight and Longmore, 1994; Harding et al., 2000). The present study included alcohol-dependent patients after detoxification treatment without symptoms of persisting amnesic syndrome or dementia. As a group, these alcohol-dependent patients, in comparison to groups of control subjects, typically demonstrate moderate impairments of several cognitive domains, which tend to decline with progressive abstinence: predominantly deficits in executive functioning, deficits in verbal and non-verbal abstraction, in memory and perceptual-motor behaviour (Mann et al., 1999; Sullivan et al., 2000; Ambrose et al., 2001; Noel et al., 2001). The subject of the present study was to investigate the cognitive impairments of recently detoxified alcohol-dependent patients and the impaired motivation hypothesis, that is that the neurological deficits are affected by or even caused by motivational shortcomings of the alcohol dependent patients (Schaeffer and Parsons, 1988).

On the one hand, this hypothesis is founded on empirical evidence about impaired motivational functions in alcohol-dependent patients. DSM-IV criteria for alcohol dependence include the incapability to control substance use and to keep up important social, occupational or recreational activities (American Psychiatric Association, 1994). Behavioural neurobiology found interaction of altered neurochemical rewarding circuits (Padda and Rossetti, 1998) with learned (conditioned) responses like craving to neutral stimuli, for example being in a bar or restaurant (Weiss and Porrino, 2002) to be crucial for the alterations in motivated behaviour. Furthermore, it has been shown that alcohol-dependent patients tend to have immoderate motivational traits like high sensation seeking (Sher et al., 2000) or high harm avoidance (Cloninger, 1987). And finally, impaired executive cognitive functions might reduce the capability to cope with external or internal drug-taking signals (Giancola and Moss, 1998).

On the other hand, goal-setting theory describes the positive effect of goals and goal setting on achievement motivation and on performance (Locke and Latham, 1990). The main finding of the goal-setting paradigm is that performance increases under specific and difficult goals relative to performance under vague or easy goals. Goal setting improves achievement by motivating people to exert greater effort and by directing the attention to relevant task characteristics. If goals are self-set, subjects with higher self-efficacy will set higher goals, and this is subsequently correlated with higher performance. If goals are assigned, difficult goals can lead to enhanced performance despite lower self-set goals, and might in turn have stimulating effects on self-efficacy (Locke and Latham, 1990). The motivating effect of goal setting has been


1Department of Psychiatry, University of Mainz, Mainz, 2Psychiatric Hospital Eichberg, Eltville and 3Department of Clinical and Physiological Psychology, University of Tübingen, Tübingen, Germany

(Received 27 February 2003; accepted in revised form 5 December 2003)
consistently demonstrated in several paradigms for healthy volunteers (Kyllo and Landers, 1995; Locke and Latham, 1990) and, for example, for arithmetic performance of patients with brain damage (Gauggel and Billino, 2002).

Therefore, we decided to use the goal-setting paradigm in order to induce enhanced achievement motivation in alcohol-dependent patients under neuropsychological testing.

Regarding previous studies on the impaired motivation hypothesis, Schaeffer and Parsons (1988) found that alcohol-dependent patients and control subjects failed to increase memory performance (using a face–name learning task) in view of financial remuneration. However, in a second study, monetary reward did increase test performance on the Conceptual Level Analogy Test (Schaeffer et al., 1989). Nevertheless, the authors could not demonstrate evidence to support the impaired motivation hypothesis as there was no significant group interaction. Both alcohol-dependent patients and control subjects on the reward condition had significantly increased their test performance.

Sander et al. (1989) investigated whether alcoholics’ low expectancies for successful performance would predict deficient test performance. ‘Although expectancies were significantly correlated with performance, regression analyses indicated they could not account for the obtained performance differences’ to the control subjects (Sander et al., 1989, p. 708). Nixon et al. (1992) used a schedule of two testing phases (with equivalent forms of the same neuropsychological standard tests) to increase test performance either through enhanced personal involvement or through reduced negative affect. After completing the first testing phase under standard instructional sets, one part of the subjects were instructed to find strategies to improve performance relative to their results in phase 1. They were told their exact score on each test in phase 1 and were asked to estimate their expected performance and exact score on that test in phase 2 (personal involvement). Subjects in the condition aiming at reduced negative affect received 15 min relaxation exercise designed to reduce test anxiety. In both testing phases, alcohol-dependent patients were inferior to control subjects in every neuropsychological domain. Yet they reported more effort in task performance than the control subjects. The experimental manipulation failed in both groups to increase test performance but resulted in increased distress-tension and higher effort in phase 2 for the personal involvement group (patients and controls). As well, anxiety was reduced in the relaxation condition both for patients and for control subjects. Therefore, the authors assumed that neither a lack of personal involvement nor differential negative affect could account for the cognitive deficits of alcohol-dependent patients.

Taking the reported studies together, alcohol-dependent patients demonstrated responsiveness to (monetary) incentives; however, no differential effect on performance has been shown. In addition, there was no effect of low expectancies for success, motivating instructions or relaxation on test performance of alcohol-dependent patients. Nevertheless, transferring the goal-setting paradigm to the neuropsychology of alcoholism might represent a new chance to investigate the impaired motivation hypothesis and to experimentally induce higher achievement motivation in alcohol-dependent patients. A significant goal-setting effect in the group of alcohol dependent patients would point at motivational resources regardless of significant differences to increased performance of the control group. These motivational resources could be activated and used in rehabilitation and therapy.

SUBJECTS AND METHODS

The present study investigates neuropsychological performance of 57 alcohol-dependent patients in contrast to the performance of 59 non-dependent control subjects and the effect of goal setting on neuropsychological performance. Therefore, both groups completed a standard battery of neuropsychological tests in order to assess neuropsychological status. Furthermore, a part of both groups completed simple tests receiving the goal setting instructions to increase test performance by 20%, whereas the other members of both groups completed these simple tests under the unspecific instructions (of most neuropsychological tests) to do their best.

Participants

Fifty-seven male patients diagnosed as alcohol dependent according to DSM-IV after detoxification treatment and 59 carefully age- and education-matched healthy male control subjects were included. All patients and control subjects gave their written informed consent before participating in the study. The study protocol was approved by the local Ethics Committee. Prior to inclusion in the study, all patients underwent clinical detoxification according to routine procedures at the Department of Psychiatry, University of Mainz, Mainz, or at the Psychiatric Hospital Eichberg, Eltville, Germany. In addition to clinical diagnosis, alcohol dependence was assessed by the DIA-X interview (DIA-X, version 1.1, Wittchen and Pfister, 1997). The DIA-X interview is a German-language diagnostic tool (DIA-X stands for: Expert System for Diagnosing Mental Disorders) including a screening questionnaire and a fully standardized structured psychiatric interview for the assessment of mental disorders according to DSM-IV criteria (American Psychiatric Association, 1994). It represents the computerized version of the Composite International Diagnostic Interview (CIDI, Robins et al., 1988). In accordance with the literature (Mann et al., 1999; Noel et al., 2001), neuropsychological testing of the patients was accomplished after cessation of withdrawal symptoms and at least 7–10 days subsequent to termination of detoxification treatment (see the results section). Exclusion criteria for the patients were the presence of relevant neurological disorders, severe internal diseases or a relevant psychiatric axis I disorder such as major depression, bipolar disorder, anxiety disorders (with the exception of social phobia or simple phobia), psychotic disorders, persisting amnesic disorder due to alcohol misuse (Korsakoff Syndrome) or another form of a substance dependence (except for nicotine). In addition to these exclusion criteria, for the control subjects no alcohol misuse nor alcohol dependency were allowed. In order to verify exclusion criteria for the control subjects, the screening questions of the DIA-X interview were used. If a person denies a screening question (e.g. ‘Have you ever had a panic-attack?’) there is a very low probability for this person to have had a psychiatric illness (e.g. 1% for anxiety disorders and 4% for drug dependence) (Wittchen and Pfister, 1997).
Procedure

Patients and control subjects were asked to complete the Michigan Alcoholism Screening Test (MAST, Selzer, 1971), the General Self-Efficacy Scale (GSE, Schwarzer and Jerusalem, 1995) and the Lifetime Drinking History Interview (LDH, Skinner, 1979).

We applied standardized neuropsychological tests, which are commonly used in international and in German studies on the cognitive deficits of alcohol-dependent patients. These neuropsychological tests were used to cover a broad range of cognitive functions and therefore to evaluate systematically the neuropsychological status of the alcohol-dependent patients. The multiple choice vocabulary test, (Mehrfachwahl Wortschatztest-Form B, MWT-B) is a German test designed to measure verbal intelligence (Lehrl, 1989). Results are given in terms of verbal IQ scores with a mean of 100 and a standard deviation of 15. It is thought to be a valid indicator of premorbid intelligence (Lehrl, 1989). The Achievement Measure System (Leistungsprüfsystem, LPS) (Horn, 1962) is a German standardized intelligence test based on a factor-analytic intelligence model to measure general intelligence. It is based on subs tests that are designed to assess Thurstone’s Primary Mental Abilities (Thurstone and Thurstone, 1941). We applied a short version of the LPS (Sturm and Willmes, 1983), which includes seven subs tests: verbal knowledge (LPS subs tests 1 and 2), non-verbal reasoning (LPS subs test 4), verbal fluency (LPS subs test 5), spatial imagination (LPS subs test 9), flexibility of closure (LPS subs test 10) and verbal closure (LPS subs test 12).

Results for the subs tests are given as T-scores with a mean of 50 and a standard deviation of 10. The results for the total intelligence test (LPS-IQ) are displayed as full-scale IQ scores with a mean of 100 and a standard deviation of 15. We applied the German version of the Auditory Verbal Learning Test (AVLT, Heubrock, 1992) in order to assess verbal memory. A list of 15 words is administered repeatedly and recall is tested immediately after each trial. The Trial Making Test was administered to assess psychomotor functioning (TMT, Reitan, 1992). Results are given in terms of time in seconds to complete parts A and B. The Testbattery for Attentional Performance (Testbatterie zur Aufmerksamkeitsprüfung, TAP, Zimmermann and Fimm, 1993) was developed for the assessment of attention deficits. It covers several different subs tests. We applied the subs test ‘Alertness’ which represents a simple reaction time task. Test output is given in terms of median of reaction times in milliseconds.

Goal setting effects were investigated using a computer based test (Gauggel and Billino, 2002). Participants had to solve simple mathematical problems (adding single-digit numbers from 1 to 9, shown on the computer screen) continuously during phases of 2-min duration. The arithmetic tasks (e.g. $2 + 3$) were displayed one by one on the computer screen and the correct solution had to be entered by keyboard (e.g. pressing the key 5).

Directly after the solution was entered the task disappeared and a new task was displayed. After each phase or block of mathematical tasks, the participants were given feedback (via computer screen), on how many tasks they had solved. Participants were told to solve as many problems as possible. Three baseline phases (2 min each) were used to eliminate training effects. Subsequently, during four phases of 2-min duration for a part of both samples, the goal setting instructions (i.e. to increase the performance by 20%) were given. This was done by feedback on the achieved results and by assigning a specific high goal for the next block: ‘During the last three blocks you correctly solved on average . . . problems per block. Now, we want you to improve your performance by 20%. This means that you should calculate . . . additional problems receiving an average number of . . . correct solutions per block.’ (Gauggel and Billino, 2002). The remaining patients and control subjects completed the four phases of 2-min duration with the request to do their best.

We investigated another hypothesis and applied a second experiment with the same samples of alcohol-dependent patients and control subjects subsequent to the goal-setting experiment at the end of the same testing session. Three of the four experimental conditions of these second experiments, which will be described in another manuscript, included experimental instructions. Only under one condition standard neuropsychological instructions have been used. As these experimental instructions could have been influenced by the goal-setting instructions earlier in the testing session, we decided to apply the goal-setting instructions only to those patients and control subjects that were scheduled to be under standard instructions in the second experiment. Consequently, we had to divide both samples into four different groups with 15 persons in each. Therefore, regarding the goal-setting experiment, 15 patients and 15 control subjects were instructed to solve a specific number of tasks (20% in addition to the last test performance), whereas the remaining 45 patients and 45 control subjects were instructed as in standard neuropsychological testing to do their best. Unfortunately, due to computer malfunction and failure in data management, we lost the data of two patients. One patient under goal setting instructions and one control subject under ‘do your best’ instructions refused to complete all four experimental blocks because of the repetitiveness of the tasks. Therefore, our final dataset comprised 13 patients and 14 control subjects within the goal setting condition and 44 patients and 45 control subjects within the ‘do your best’ condition. In order to provide internal validity of the experiment, alcohol dependent patients and control subjects under the different experimental conditions were matched for age, education and number of previous detoxifications (patients). We were able to use statistical information about the total group of alcohol-dependent patients of the Department of Psychiatry in Mainz. The median of the variables age, education and number of previous detoxifications were used to dichotomise these variables and to create eight different strata (e.g. young and low socio-economic status and high number of detoxifications). The study participants have been randomly assigned to the experimental conditions, while the number of participants within the different strata have been kept balanced. That is, the next free place in a strata defined the experimental condition for that participant. Therefore, we could randomly assign alcohol dependent patients and control subjects matched for age, education and (concerning only the patients) number of previous detoxifications to the different experimental conditions.

Data analysis

Reducing the number of comparisons, average scores for number of correct responses, total number of tasks and reaction
time during the three baseline phases were calculated. To test the statistical significance of the goal-setting effect, the differences between the experimental trials (phases 4–7) and the baseline results were calculated for each participant. This procedure established four different subtraction results for the increase in correct responses, total amount of calculations and the decrease in reaction time relative to the baseline (see Figs 1 and 2).

Multivariate analysis of variance was used with the repeated measures as dependent variables. We performed $4 \times 2$ MANOVA (phases $\times$ goal-setting instructions) for the patients and the control subjects to evaluate the effect of goal setting on the amount of correct responses, the total amount of additions and on reaction time. Additionally, a $4 \times 2 \times 2$ MANOVA (phases $\times$ group $\times$ goal-setting instructions) evaluated the effect of the group factor (alcohol patients vs. control subjects). We decided to use the multivariate test because, if the assumption of uniform variances and covariances is not met, the univariate test is associated with a higher Type I error rate (Davidson, 1972). All analyses were carried out using SPSS release 10.0. Statistical significance was set at $P = 0.05$ for all analyses.

RESULTS

Patients and control subjects were of comparable age and had reached the same educational level (Table 1). The alcohol-dependent patients had been abstinent prior to the experiment for an average 16.8 (standard deviation: 6.9, range 7–44) days. Concerning drinking behaviour, the patients demonstrated considerable problems related to alcohol misuse. As expected, their MAST scores (mean: $32.7 \pm 10.9$) were significantly higher than the MAST scores of the control subjects (mean: $1.8 \pm 2.7$). Despite comparable duration of lifetime alcohol consumption (means: 28.8 years for the patients vs. 25.4 years for the control subjects) the patients had consumed 5.7-times the amount of absolute ethanol (mean: $677.5 \text{ kg/1558 lbs}$) than had the control subjects (mean: $118.2 \text{ kg/272 lbs}$). The General Self-Efficacy Scale (GSE) demonstrated significantly lower self-efficacy in the patients (mean $28.5 \pm 5.4$ vs. $30.6 \pm 4.4$).

Standard tests demonstrated deficits in neuropsychological status for the alcohol-dependent patients. Intelligence (LPS-IQ) of the patients was on average (mean: 107.7, range: 85–129) lower than intelligence of the control subjects (mean: 112.4, range 87–133). Concerning the LPS subtests, non-verbal reasoning, verbal fluency, spatial imagination and flexibility of closure was lower for the alcohol-dependent patients. The largest difference between both groups was found for complex psychomotor functioning. Trail Making Test-B resulted in, on average, 95.2 s for the patients and 74.2 s for the control subjects. In contrast, no significant differences were found in verbal reasoning (MWT-B, LPS 1, 2 and LPS 12), reaction time (TAP Alertness) and verbal memory (AVLT).

Both for patients and control subjects (due to the matching procedure described in the methods section) the subjects receiving the goal-setting instructions and the subjects requested to do their best in within-group comparison did not differ in age, educational background or number of detoxifications (patients). In addition, they did not differ in MAST score, LPS-IQ, Trail Making Test results, reaction time (TAP) and amount of lifetime alcohol consumption.

Concerning baseline performance of the goal-setting experiment, the control subjects reached significantly more correct tasks (mean of correctly solved calculations in the three baseline phases) than the alcohol-dependent patients ($T = 3.597$, d.f. = 114, $P < 0.001$; see Table 1). As well, the total amount of processed tasks was higher and reaction time was shorter for the control subjects.

![Fig. 1](https://example.com/fig1.png)

**Fig. 1.** Goal-setting experiment with control subjects. Test performance of 14 control subjects under goal-setting instructions (to increase performance in the next experimental phase by 20%) versus 45 control subjects under standard instructions (to ‘do their best’). Ordinate shows increase in number of correct tasks relative to baseline performance. Values are means. Brackets indicate 2 standard errors of the mean.

![Fig. 2](https://example.com/fig2.png)

**Fig. 2.** Goal-setting experiment with alcohol-dependent patients. Test performance of 13 alcohol-dependent patients under goal-setting instructions (to increase performance in the next experimental phase by 20%) versus 44 patients under standard instructions (to ‘do their best’). Ordinate shows increase in number of correct tasks relative to baseline performance. Values are means. Brackets indicate 2 standard errors of the mean.
## Table 1. Demographic variables, alcohol-related variables, neuropsychological status and baseline performance during goal-setting experiment of alcohol-dependent patients and control subjects

<table>
<thead>
<tr>
<th></th>
<th>Alcohol-dependent patients (n = 57)</th>
<th>Control subjects (n = 59)</th>
<th>t-test (n = 57) vs. (n = 59)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
</tr>
<tr>
<td>Age (years)</td>
<td>45.5</td>
<td>9.5</td>
<td>27–67</td>
</tr>
<tr>
<td>Education (years)</td>
<td>10.6</td>
<td>2.8</td>
<td>9–18</td>
</tr>
<tr>
<td>MAST score</td>
<td>32.7</td>
<td>10.9</td>
<td>8–51</td>
</tr>
<tr>
<td>Lifetime alcohol consumption (years)</td>
<td>28.8</td>
<td>9.1</td>
<td>13–49</td>
</tr>
<tr>
<td>Lifetime alcohol consumption (drinks in kg)</td>
<td>677.5</td>
<td>379.7</td>
<td>16.9–1486.1</td>
</tr>
<tr>
<td>Self-efficacy (GSE)</td>
<td>28.5</td>
<td>4.9</td>
<td>18–40</td>
</tr>
<tr>
<td>MWT-B (verbal IQ)</td>
<td>110.3</td>
<td>14.0</td>
<td>85–143</td>
</tr>
<tr>
<td>LPS (full scale IQ)</td>
<td>107.7</td>
<td>9.9</td>
<td>85–129</td>
</tr>
<tr>
<td>LPS-1/2 (verbal reasoning; T scores)</td>
<td>56.8</td>
<td>3.6</td>
<td>51–69</td>
</tr>
<tr>
<td>LPS-4 (non-verbal reasoning; T scores)</td>
<td>53.6</td>
<td>6.1</td>
<td>38–68</td>
</tr>
<tr>
<td>LPS-5 (verbal fluency; T scores)</td>
<td>54.2</td>
<td>7.4</td>
<td>38–66</td>
</tr>
<tr>
<td>LPS-9 (spatial imagination; T scores)</td>
<td>56.2</td>
<td>7.8</td>
<td>35–70</td>
</tr>
<tr>
<td>LPS-10 (flexibility of closure; T scores)</td>
<td>56.9</td>
<td>6.7</td>
<td>41–70</td>
</tr>
<tr>
<td>LPS-12 (verbal closure; T scores)</td>
<td>53.1</td>
<td>7.9</td>
<td>38–66</td>
</tr>
<tr>
<td>AVLT (correct words trial 1)</td>
<td>6.5</td>
<td>1.9</td>
<td>3–12</td>
</tr>
<tr>
<td>AVLT (total correct for trials 1–5)</td>
<td>48.3</td>
<td>8.8</td>
<td>29–68</td>
</tr>
<tr>
<td>TMT-A (s)</td>
<td>38.5</td>
<td>18.1</td>
<td>16–120</td>
</tr>
<tr>
<td>TMT-B (s)</td>
<td>95.2</td>
<td>41.4</td>
<td>50–288</td>
</tr>
<tr>
<td>TAP Alertness (median of reaction times in ms)</td>
<td>224</td>
<td>34</td>
<td>172–318</td>
</tr>
<tr>
<td>Goal setting baseline: Average of correctly solved additions</td>
<td>66.5</td>
<td>15.8</td>
<td>34.3–100.3</td>
</tr>
<tr>
<td>Goal setting baseline: Average of total amount of additions</td>
<td>68.2</td>
<td>15.7</td>
<td>37.3–102.0</td>
</tr>
<tr>
<td>Goal setting baseline: Average of reaction time (s)</td>
<td>1.9</td>
<td>0.5</td>
<td>1.18–3.26</td>
</tr>
</tbody>
</table>

*Due to missing values, n = 39; †n = 58; ‡n = 47; §n = 50; ‖n = 56. AVLT, (Auditory Verbal learning Test Heubrock, 1992); GSE, General Self-Efficacy Scale (Schwarzer and Jerusalem, 1995); LPS, Achievement Measure System (Leistungspruefsystem Horn, 1962); M, mean; MAST, Michigan Alcoholism Screening Test (Selzer, 1971); MWT-B, multiple choice vocabulary test (Mehrfachwahl Wortschatztest Lehrl, 1989); SD, standard deviation; TAP (Testbattery for Attentional Performance Zimmermann and Fimm, 1993); TMT (Trail Making Test Reitan, 1992).*

Starting from baseline performance of 66.5 correctly solved tasks (mean of the three baseline phases) the alcohol-dependent patients increased performance to 71.8 correctly solved tasks (out of 73.9 processed tasks) in the last of the four experimental phases with ‘do your best’ instructions and to 81.5 correctly solved tasks (out of 84.0 processed tasks) with goal-setting instructions.

The control subjects started from 77.1 correctly solved tasks at baseline (mean) and increased performance to 83.0 correctly solved tasks (out of 85.0 processed tasks) in experimental phase four with normal instructions and to 88.7 correctly solved tasks (out of 93.2 processed tasks) with goal-setting instructions.

MANOVA (4 × 2 × 2) of number of correctly solved tasks during the four experimental phases showed a significant time effect (phases) for both groups (Wilks’s λ = 0.395; F(4,109) = 41.719; P < 0.001) indicating an increase in test performance over time. There were two main effects. The control subjects accomplished more correctly solved tasks than the alcohol dependent patients (Wilks’s λ = 0.915; F(4,109) = 2.541; P = 0.044). Moreover, all subjects (patients and control subjects) on the goal setting condition reached more correct tasks than the subjects requested to do their best (Wilks’s λ = 0.884; F(4,109) = 3.565; P = 0.009). Interaction of group (patients vs. control subjects) and instructions (goal setting vs. normal) remained insignificant (Wilks’s λ = 0.969; F(4,109) = 0.969; P = 0.489). The significant main effects and the insignificant interaction could be shown for total amount of processed tasks and for reaction time as well.

A significant difference in improvement was established between those patients receiving goal setting instructions and those receiving normal instructions (4 × 2 MANOVA). The patients with the goal setting instructions demonstrated a significant higher increase in the amount of correct responses (Wilks’s λ = 0.794; F(4,52) = 3.373; P = 0.016; see Fig. 2), the total amount of tasks (Wilks’s λ = 0.691; F(4,52) = 5.821; P = 0.001) and in reaction time (Wilks’s λ = 0.821; F(4,52) = 2.828; P = 0.034). In contrast, for the control subjects (4 × 2 MANOVA), the additional increase in achievement through goal setting was not significant in the amount of correct responses (Wilks’s λ = 0.946; F(4,54) = 0.771; P = 0.549; see Fig. 1), the total amount of calculations (Wilks’s λ = 0.851; F(4,54) = 2.359; P = 0.065) and reaction time (Wilks’s λ = 0.847; F(4,54) = 2.442; P = 0.058). As there was no significant interaction of group and instructions, the increase in test performance through goal setting for the patients was not significantly larger than that for the control subjects.

**DISCUSSION**

In standard neuropsychological testing, our samples of alcohol-dependent patients and control subjects demonstrated...
typical neuropsychological deficits of alcohol-dependent patients after detoxification treatment: deficits in non-verbal reasoning, verbal fluency, spatial imagination, flexibility of closure and complex psychomotor coordination. These functions include aspects of executive functioning, which is known to be the leading cognitive deficit (Sullivan et al., 2000; Noel et al., 2001) in alcohol-dependent patients. Furthermore, the alcohol-dependent patients showed preserved functions in verbal intelligence, verbal memory and normal reaction times. Functions that are typically intact or already recovered after detoxification treatment (Knight and Longmore, 1994).

Therefore, we were able to investigate the effects of experimental variation of motivation in a sample of alcohol-dependent patients with typical neuropsychological deficits.

Transferring goal-setting theory to neuropsychological assessment of alcohol-dependent patients resulted in the finding, that alcohol-dependent patients early in recovery are responsive to motivational instructions. The patients under goal-setting instructions demonstrated significantly greater improvement in arithmetical performance than did patients with standard instructions to ‘do their best’. That is, despite deficits in reasoning (LPS) and complex psychomotor functioning (TMT-B), they were able to increase, for example, the number of correctly solved tasks while trying to reach the assigned difficult goal of 20% improvement. The effect was significant despite the small sample size of only 13 patients under the experimental goal-setting instructions. Thus, the patients were able to increase efforts and performance according to the goal-setting paradigm. Hypothetically, they were able to use feedback and to execute such complex cognitive operations as allocating attention to relevant task characteristics (Locke and Latham, 1990) and to increase visuo-motor coordination.

For the group of control subjects, the goal setting effect resulted in trends for higher performance in the total amount of processed tasks ($P = 0.065$) and for shorter reaction time ($P = 0.058$). No effect was found for the number of correct tasks ($P = 0.549$). The inability of the control subjects to demonstrate a significant goal-setting-effect might be due to both the small sample size of only 14 subjects under goal-setting instructions and hypothetically to a ‘ceiling effect’. The control group had repeatedly reached more than 70 correct tasks during the baseline phases on average in 1.6 s per task.

Taking both groups together into consideration, the time effect for the entire group indicates improved performance in subsequent phases through training effects. The main effect of the factor ‘group’ indicates better performance of the control group relative to the alcohol-dependent patients throughout the four experimental phases. The main effect of ‘instructions’ indicates better performance for persons with goal-setting instructions relative to persons with standard instructions. Therefore, the used tasks are sensitive to training effects, control subjects were superior in adding single-digit numbers during phases of 2-min duration and the used tasks are sensitive to goal-setting effects.

As there was no substantial difference (no significant interaction) in increase of test performance between the patients receiving goal-setting instructions and the control subjects with the goal-setting instructions our results do not support the hypothesis of systematic influence of motivation on the neuropsychological testing results of alcohol-dependent patients. But parallel to Schaeffer et al. (1989), who used monetary reward, we demonstrated that alcohol-dependent patients early in recovery are responsive to motivational manipulations and capable to increased neuropsychological performance. Moreover, concerning alcohol-dependent patients, our study is, to our best knowledge, the first to demonstrate an increase in test performance through motivating instructions alone. Compared to the results of Nixon et al. (1992), goal setting with assigned goals appears to be superior relative to stimulating the participants to reflect on their performance and to produce self-set goals for a second trial with the same test. As self-set goals depend on self-efficacy the lower self-efficacy of alcohol-dependent patients (as in our sample) might possibly reduce the effect of this motivating strategy, whereas assigned goals are successful despite low self-efficacy. Certainly, the fact that Nixon et al. (1992) applied standard neuropsychological tests, whereas in the present study simple arithmetical tasks have been used, reduces the implications of our findings. However, the increase in test performance of alcohol-dependent patients due to monetary reward was demonstrated by Schaeffer et al. (1988) with standard tests of executive functioning. Furthermore, we found no difference in simple reaction time (TAP) between patients and control subjects in standard neuropsychological testing. Therefore, the increase in arithmetical performance in alcohol-dependent patients through goal-setting instructions is possibly due to higher cognitive processes. Nevertheless, future research should examine goal-setting effects in alcohol-dependent patients with standard neuropsychological tests. Also, as the alcohol-dependent patients are responsive to the motivating effect of assigned difficult goals, research should investigate the effect of goal-setting strategies in (cognitive) rehabilitation and therapy. Taking therapeutic aspects directly into account, on the one hand it might be possible to improve cognitive performance of alcohol-dependent patients, for example through training of executive functioning under specific and difficult goals. Improvement in cognitive functioning might help the patients in various ways. Following Giancola and Moss (1998) improved cognitive functions might increase the capability to cope with external or internal drug-taking signals. It might be helpful in participating and learning from, for example cognitive–behavioural treatment. It might help in organizing daily life and to solve individual problems. On the other hand, there are the reciprocal effects of goal setting and self-efficacy. Goal setting and the subsequently enhanced performance will possibly have stimulating and direct therapeutic effects on perceived self-efficacy (Locke and Latham, 1990). Furthermore, goal-setting effects possibly might be helpful in order to build up alternative behaviour to substance consumption. According to the responsiveness of alcohol-dependent patients to goal-setting instructions, therapeutic strategies in behavioural activation could possibly include specific and difficult behavioural goals in order to increase performance in activities of daily functioning and subsequently again enhance self-efficacy of the patients.
REFERENCES


NEUROPSYCHOLOGICAL STATUS OF ALCOHOL-DEPENDENT PATIENTS 125