Journal of Consulting and Clinical Psychology
1988, Vol. 56, No. 2, 261-266

0022-006X/88/$00.75

Comparison of Operant Behavioral and Cognitive–Behavioral Group Treatment for Chronic Low Back Pain

Judith A. Turner
Department of Psychiatry and Behavioral Sciences,
Department of Rehabilitation Medicine, and Multidisciplinary Pain Center
University of Washington

Steve Clancy
Department of Psychiatry and Behavioral Sciences
University of Washington

To evaluate and compare the efficacy of two widely used behavioral approaches for the treatment of chronic pain, 81 mildly dysfunctional chronic low back pain patients were randomly assigned to operant behavioral (OB) treatment, cognitive–behavioral (CB) treatment, or a waiting-list (WL) control condition. Both treatments, which were conducted in eight-session outpatient groups, resulted in decreased physical and psychosocial disability. The OB patients showed greater pre- to posttreatment improvement as rated by patients and their spouses than did the CB patients. Generally, the OB patients showed a leveling off in improvement at 6- and 12-month follow-ups, whereas the CB patients generally continued to improve over the 12 months following treatment. At 12-month follow-up, patients in both treatments remained significantly improved, with no significant differences between conditions.

Recent studies (Heinrich, Cohen, Naliboff, Collins, & Bonebakker, 1985; Kerns, Turk, Holzman, & Rudy, 1986; Turner, 1982) have demonstrated the usefulness of different behavioral treatments for chronic back pain problems. These treatments generally reflect one of two theoretical approaches. One approach, operant conditioning, aims to decrease pain behaviors and increase well behaviors (e.g., exercise) by modifying associated social and environmental contingencies. The other approach, cognitive–behavioral therapy, aims to modify the patient's subjective experience of pain and cognitions while in pain and emphasizes patient acquisition of cognitive and behavioral skills for coping with pain.

Unfortunately, very little controlled research has examined the effectiveness of either operant-behavioral contingency management or cognitive–behavioral therapy for chronic back pain problems. Cairns and Pasino (1977) and Sanders (1983) have demonstrated the positive effects of staff praise on patient activity level and exercise performance, and Turner (1982) found cognitive–behavioral therapy, including relaxation training, to be somewhat superior to relaxation training alone for chronic low back pain outpatients. Only one study has compared operant behavioral with cognitive–behavioral treatment for chronic pain. Kerns et al. (1986) found significant reductions in health-care use after both behavioral and cognitive–behavioral outpatient treatment for patients with diverse pain problems, although only cognitive–behavioral treatment resulted in improvement on self-reported pain, distress, and activity performance. This study was limited by a small sample size and by reliance on self-report measures only.

The present study examined the relative efficacy of operant behavioral versus cognitive–behavioral therapy for chronic low back pain problems. However, no standard protocol exists for either treatment's application to chronic pain, and both operant and cognitive–behavioral labels have been applied to a wide range of techniques described in clinical and research literature. Thus, the study cannot be viewed as a pure test of two separate theoretical models. In designing the treatments for this study, an attempt was made to follow the major treatment manuals for each approach closely, thus incorporating the most important components, but subjective decisions were made about each protocol. Treatments were conducted via outpatient groups in order to evaluate the effectiveness of this professional resource-efficient, relatively inexpensive mode of treatment.

Method

Subjects

Subjects were chronic low back pain patients referred to the study by community and pain clinic physicians or self-referred following media publicity. Criteria for acceptance into the study required persistent low back pain for at least 6 months, an age of 20–65 years, and current marriage or cohabitation. Exclusion criteria comprised specified medi-

This research project was supported by Grants 1 RO1 NS 19619 and PO1 NS16329 from the National Institute of Neurological and Communicative Disorders and Stroke and by National Institutes of Health Biomedical Research Grant RR 05432. The authors would like to thank the following individuals for their assistance with the study: Stan Bigos, Richard Bulcroft, Claudette Cummings, Mary Jane Davis, Andrew Fry, Julie Heil, Ed Hill, Frank Keefe, Kevin McQuade, Jim Moore, Joan Romano, Karen Syrjala, Peter Vitaliano, and Larry West.

Correspondence concerning this article should be addressed to Judith A. Turner, Department of Psychiatry and Behavioral Sciences RP-10, University of Washington, Seattle, Washington 98195.

cal disorders and diseases selected to exclude subjects in need of medical or surgical treatment as well as those who were unable to participate in an aerobic exercise program.

Of 95 potential subjects who met inclusion criteria, 81 (51 men, 30 women) chose to participate. The average age was 46 years (range = 24–63). The average duration of the current episode of pain was 6.2 years (range = 6 months to 38 years). Average time since onset of first back pain episode was 14.1 years (range = 1–45 years). Ten patients had undergone one or more back surgeries. Seventy-three percent were employed full-time or part-time, 10% were not working due to pain, 7% were unemployed for reasons other than pain, and 10% were homemakers. Six percent were receiving financial compensation for pain, and 7% were involved in litigation related to pain.

Of the 26 patients who started the cognitive–behavioral (CB) treatment, 24 completed treatment and the posttreatment assessment. For the operant behavioral (OB) condition, 30 patients started treatment and 29 completed treatment and the posttreatment assessment. Of the 25 patients assigned to the waiting-list control condition (WL), 21 completed measures at the end of the WL period.

Outcome Measures

A comprehensive set of measures was obtained pre- and posttreatment and at 6 and 12 months following treatment.[1]

Pain severity. The McGill Pain Questionnaire Pain Rating Index (Melzack, 1975) is a widely used measure of the pain experience, and considerable evidence has supported its reliability and validity (Syrjala & Chapman, 1984).

Pain-related physical and psychosocial dysfunction. The Sickness Impact Profile (Bergner, Bobbitt, Carter, & Gilson, 1981) is a 136-item self-report behavioral checklist assessing illness-related physical and psychosocial dysfunction. The Sickness Impact Profile was modified slightly to specify pain- rather than illness-related dysfunction. Spouses completed a version of the Sickness Impact Profile (Sickness Impact Profile–Spouse) that was modified to allow them to rate patient impairment.

Patients also indicated the degree to which they engaged in various pain behaviors on the Pain Behavior Checklist (Turk, Wack, & Kerns, 1985), a 20-item list of common pain behaviors in the categories of distorted ambulation or posture, negative affect, facial/audible expression of distress, and avoidance of activity. Spouses rated patient pain behaviors using a version of the checklist (Pain Behavior Checklist–Spouse) that was modified for this purpose.

Observer ratings of pain behaviors. Patients were videotaped at each assessment while walking, standing, sitting, and reclining in keeping with the protocol described by Keefe and Block (1982) and by Keefe, Crisson, and Trainor (1987). Videotapes were later coded by trained observers who were blind to condition assignment and time of assessment. Videotapes were coded for guarding, bracing, rubbing, grimacing, and sighing behaviors. Keefe and Block (1982) demonstrated that these behaviors can be coded reliably, that they correlate highly with naive observers' ratings of pain, that they decrease following inpatient pain treatment, and that they discriminate chronic low back pain patients from normal subjects and depressed patients. Thirty-four percent of the tapes were coded independently by two trained observers. Interrater reliability for total pain behavior was .78, as calculated by the kappa coefficient (Cohen, 1960).

Cognitive errors. The Cognitive Errors Questionnaire (Lefebvre, 1981) contains 48 short vignettes, and each is followed by a dysphoric cognition about that vignette that reflects a cognitive error. Half of these vignettes are related to low back pain. Patients are asked to rate how similar the cognition is to the thought they would have in that situation.

Patient Ratings of Treatments and Therapists

To determine whether patients in the two treatment conditions differed pretreatment in their attitudes toward treatment, a 5-item Treatment Expectations Questionnaire was administered. Patients rated the likelihood that treatment (for most people and for them personally) would decrease pain and improve the ability to cope with pain and the likelihood that they would be able to use the treatment techniques successfully to manage their pain.

At posttreatment, patients completed a questionnaire on which they rated the helpfulness of the overall program and of specific treatment components. The questionnaire also asked how well they had learned and how often they had used the techniques taught, how often they would use the techniques during the next month, and how supportive they found their spouses and other group members to be. In addition, patients rated their therapists on involvement, warmth/caring, and knowledge of pain.

Treatment

After completing the pretreatment assessment, patients were randomly assigned to one of the two treatments or to a waiting-list control condition. The treatments were highly structured and were conducted in a group format for 2-hour sessions that were held weekly for 8 weeks. Each group contained 5–10 patients, and spouses attended half the sessions in the OB condition. Five groups were conducted for each treatment condition.

Operant behavioral. In this treatment, patients and spouses were educated to the concept of "pain behaviors" and "well behaviors" and to the role of social reinforcers in maintaining pain behaviors as they were described by Fordyce (1976). Spouses were instructed not to reinforce pain behaviors and to reinforce well behaviors positively, and patients and spouses kept daily records of pain behaviors and associated spouse responses. Couples received communication training with the rationale that direct communication was preferable to indirect communication via pain behaviors. In addition, patients set and worked toward behavioral goals in areas affected by pain and engaged in a regular aerobic walking/jogging program based on a "quota" system (cf. Fordyce, 1976), progressing from 10 min to 20 min and from 60% to 70% estimated maximum heart rate five times a week. Patients kept records of distance and heart rate during exercise, and progress and problems were discussed each week.

Cognitive–behavioral. This treatment included weekly training in systematic progressive muscle relaxation (cf. Bernstein & Borkovec, 1973) and imagery (cf. Turk, Meichenbaum, & Genest, 1983) as well as daily home practice with audiotapes. Patients were also taught to identify negative emotions related to pain and stressful events and to identify associated distorted, maladaptive thoughts. They then learned to generate more adaptive alternate thoughts. Patients kept records of negative

[1] Six measures were administered but are not presented in this article. Measures of marital satisfaction and depression are not presented because pretreatment values were in the normal range. Measures of pain and activity from activity diaries were not included because of missing data due to patient failure to complete the diaries. A visual-analogue-scale pain rating was not included because analyses revealed that information obtained from this scale was redundant with that from the McGill Pain Questionnaire. The latter measure has been more extensively studied and is more widely used and, thus, was chosen for inclusion. Finally, a scale assessing the tendency to apply self-control strategies to problems was deleted because of its questionable relevance to back pain problems. Analyses were performed with and without these measures, and conclusions from analyses of all measures did not differ from those reported here.

emotions, antecedent situations, automatic thoughts, and alternate rational responses between sessions and discussed these during sessions. These techniques were drawn from Beck, Rush, Shaw, and Emery (1979).

Therapists

Each group was led by one of six therapists. Four therapists led both a CB and an OB group. All therapists were PhD-level clinical psychologists with previous supervised clinical experience with the operant behavioral and cognitive–behavioral treatment of chronic pain patients. Therapists closely followed a detailed treatment manual and met weekly for supervision with the senior author to ensure compliance with the manual.

To determine whether therapist attitudes differed toward the two treatments (thus potentially affecting outcome), prior to treatment, therapists rated their beliefs that they would successfully implement the treatment techniques and their confidence that the treatment techniques were efficacious for chronic low back pain patients. Average ratings of CB and OB therapists were identical on both questions and indicated a high degree of confidence on both dimensions. At posttreatment, there were no significant therapist main effects or Therapist × Treatment interaction effects on the dependent measures, as assessed by analyses of covariance with pretreatment scores on the dependent measures used as covariates.

Results

Data Analysis

To meet assumptions of normality, log transformations of Sickness Impact Profile scores were used in statistical analyses because the positive skewness of this measure significantly ($p < .01$) differed from zero. Because five cohorts of patients participated in each condition, two multivariate analyses of variance (MANOVAs) were performed to test for significant differences between cohorts on demographic characteristics and dependent measures. The results indicated that the cohorts were equivalent in these classes of variables. Therefore, cohorts were combined within conditions for all subsequent analyses.

Analysis of Pretreatment Differences Between Groups

Patients in the three conditions did not differ significantly at pretreatment on age, sex, employment, education, compensation/litigation status, number of back surgeries, or duration of pain, as tested by univariate analyses of variance (ANOVAs) and chi-square analyses. There were also no significant differences pretreatment between the three conditions on four classes of dependent measures, as tested by MANOVAs. These classes were the patient-rated measures of pain (McGill Pain Questionnaire) and pain behavior (Sickness Impact Profile and Pain Behavior Checklist), the spouse-rated measures of dysfunction (Sickness Impact Profile and Pain Behavior Checklist), and observed pain behaviors.

Immediate Treatment Effects

Table 1 shows means and standard deviations for dependent measures by condition and assessment. To assess the immediate treatment effects (pretreatment to posttreatment), a doubly multivariate repeated-measures ANOVA was performed. The group variable was treatment (OB, CB, and WL), the repeated-measures variable was time (pretreatment and posttreatment), and all seven dependent measures were considered simultaneously.

A significant overall Treatment × Time interaction was found for the seven dependent variables, Wilks's lambda = .63, $F(14, 13) = 2.24$, $p < .01$. Univariate analyses revealed that the variables contributing to the overall significance of the Treatment × Time interaction were the Sickness Impact Profile, $F(2, 70) = 4.12$, $p < .05$; the Sickness Impact Profile–Spouse, $F(2, 70) = 3.97$, $p < .05$; the Pain Behavior Checklist–Spouse, $F(2, 70) = 4.89$, $p < .01$; and the Cognitive Errors Questionnaire, $F(2, 70) = 3.72$, $p < .05$. A closer inspection of the average pre–post change for each group on each dependent measure revealed that, for every measure, the OB group improved more than did the other two groups. This superiority was statistically significant ($p < .05$) in comparisons with the WL group on the patient and spouse reports of both pain behavior and overall physical and psychosocial dysfunction. The CB group did not improve significantly more than did the WL group on any measure and improved significantly ($p < .05$) less than did the WL group on the patient- and spouse-rated Sickness Impact Profiles.

A pre–post analysis similar to that performed for the three groups was also performed for the two treatment groups only. The multivariate test for the Treatment × Time interaction was not significant. However, the time effect was significant, $F(7.39) = 13.78$, $p < .0001$.

Follow-Ups

Of the 53 (24 CB and 29 OB) patients who completed an active treatment condition, 81% (20 CB and 23 OB) were available for follow-up at 6 months, and 92% (22 CB and 27 OB) were available for follow-up at 12 months. To determine the long-term effects of the two treatments, separate multivariate repeated-measures analyses were performed to examine change on the dependent variables from pretreatment to 6-month follow-up and from pretreatment to 12-month follow-up. In both analyses, a significant effect was found for time: From pretreatment to 6 months, Wilks's lambda = 0.30, $F(7.35) = 11.88$, $p < .001$; from pretreatment to 12 months, Wilks's lambda = .29, $F(7.39) = 13.78$, $p < .001$, but there were no significant Treatment × Time interactions.

Patterns of Improvement in Treatment Groups

Although the analyses provided evidence that the two treatment groups experienced significant change from pretreatment to posttreatment and 6- and 12-month follow-ups, they did not address the pattern of the change. To examine this, we conducted repeated-measures ANOVAs with three times (pre, post, 6 months) and with four times (pre, post, 6 months, 12 months) for each dependent variable separately. (Because of insufficient degrees of freedom, multivariate repeated-measures analyses with three times were not possible.) Significant ($p < .05$) Treatment × Time interactions were found for the curvilinear component of both the patient- and spouse-rated Sickness Impact Profiles in the analyses conducted with three times. On both measures, the OB group showed greater immediate improve-

Table 1
Mean Scores by Assessment and Treatment Condition

Measure and condition	Pretreatment[a]		Posttreatment[a]		6 Month[b]		12 Month[c]	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
McGill Pain Questionnaire								
CB	18.30	10.43	15.91	11.63	12.70	12.75	10.80	6.38
OB	23.07	12.37	18.50	12.43	19.57	15.31	15.07	11.62
WL	22.57	13.67	22.14	12.35				
Sickness Impact Profile								
CB	7.70	6.15	5.39	3.91	3.57	3.90	2.91	2.87
OB	8.70	7.09	3.96	4.70	3.27	3.70	3.07	4.49
WL	9.25	9.12	5.74	6.90				
Sickness Impact Profile–Spouse								
CB	6.29	6.39	5.97	4.78	4.40	4.73	3.76	5.02
OB	6.50	5.98	4.40	5.90	3.38	4.75	3.20	4.73
WL	5.12	5.52	4.86	6.61				
Observed Pain Behavior								
CB	6.45	4.63	5.96	4.88	7.63	7.06	5.70	5.05
OB	6.89	5.88	4.82	4.45	4.09	4.18	4.61	5.17
WL	9.19	6.33	8.62	9.80				
Pain Behavior Checklist								
CB	43.46	10.35	37.73	11.44	34.95	9.12	33.65	7.09
OB	40.37	7.12	31.26	9.17	35.77	10.18	32.92	8.37
WL	43.21	9.52	40.63	10.06				
Pain Behavior Checklist–Spouse								
CB	38.73	11.52	33.30	8.20	33.47	8.03	33.56	9.95
OB	40.04	10.31	30.11	8.55	31.18	10.76	30.55	8.81
WL	38.55	12.08	37.35	12.91				
Cognitive Errors Questionnaire								
CB	25.96	15.98	18.17	14.12	30.90	20.71	28.00	20.01
OB	25.03	16.56	16.52	13.89	31.04	22.00	23.82	19.55
WL	23.50	18.66	23.25	21.77				

Note. CB = cognitive–behavioral; OB = operant behavioral; WL = waiting list.
[a] For the CB condition, $n = 24$ patients (23 spouses); for the OB condition, $n = 29$ patients (27 spouses); for the WL condition, $n = 21$ patients (20 spouses). [b] For the CB condition, $n = 20$ patients (15 spouses); for the OB condition, $n = 23$ patients (17 spouses). [c] For the CB condition, $n = 20$ patients (18 spouses); for the OB condition, $n = 27$ patients (22 spouses).

ment followed by a gradual leveling off at 6 and 12 months. The CB group continued to improve at 6 and 12 months so that, by 12 months, there was little difference between the two groups.

The patients' scores on the Pain Behavior Checklist showed a similar pattern, although self-reported pain behaviors temporarily increased in the OB group at the 6-month follow-up before decreasing again at 12 months. The repeated-measures analysis conducted with three times for this variable also revealed a significant ($p < .05$) Treatment × Time effect for the curvilinear component.

The only other variable showing a significant Treatment × Time interaction in the analyses conducted with either three or four times was observer-rated pain behaviors. On this measure, the OB group showed greater pre- to posttreatment improvement that subsequently leveled off. In contrast, the CB group did not improve much from pretreatment levels and demonstrated a temporary increase at 6 months.

The remaining three dependent measures showed no differences in pattern of improvement between the OB and CB groups. On the spouse-rated Pain Behavior Checklist, both groups experienced an immediate improvement followed by a leveling off at 6 and 12 months. The curvilinear component for the time effect for this variable was significant ($p < .001$) in both the analyses conducted with three times and those conducted with four times. On the McGill Pain Questionnaire, the repeated-measures analysis with four times showed a significant ($p < .001$) linear effect for time, indicating a continuous improvement in both treatment groups. The analysis with three times showed only a trend toward a significant time effect ($p < .10$), although the linear component for time was significant at $p < .05$. The Cognitive Errors Questionnaire followed a more erratic pattern over time in both groups, with initial gains followed by an increase in errors at 6 months and a return to near-pretreatment levels at 12 months.

Patient Ratings of Therapists and Treatments

At pretreatment, patients in the two treatment groups did not differ in their expectations of treatment helpfulness, as assessed by total scores on the Treatment Expectations Questionnaire. On the posttreatment evaluation questionnaires, patients in the CB condition indicated significantly greater satisfaction with the treatment, $t(50) = 2.04$, $p \leq .05$, and rated treatment as more helpful, $t(51) = 2.88$, $p \leq .01$. On a scale of 1 (*extremely dissatisfied*) to 7 (*extremely satisfied*), satisfaction with the program was rated, on the average, at 5.45 by the OB patients and at 6.08 by the CB patients. On a scale ranging from 1 (*very*

harmful) to 7 (*extremely helpful*), the average rating in the OB group was 5.69 and in the CB group was 6.29.

There were no significant differences between the two groups in their perceived mastery of the techniques taught, in the frequency with which they had used the techniques in the week following the final treatment session, or in the projected frequency of use of techniques during the next month. Both groups rated spouse and group support during the treatment as high, with no significant differences between conditions.

Interestingly, CB therapists were rated as significantly warmer, $t(47) = 3.14$, $p < .01$, and better informed about pain, $t(46) = 2.21$, $p < .05$, than were OB therapists, although therapists were rated highly in both conditions. On a scale of 1 (*warm/caring*) to 7 (*cold/disinterested*), the average rating was 1.72 for the OB therapists and 1.17 for the CB therapists. On a scale of 1 (*very well-informed*) to 7 (*lacking knowledge*), the average rating was 1.96 for the OB therapists and 1.48 for the CB therapists. No differences were found on ratings of therapist's active involvement.

Discussion

Both the operant behavioral and the cognitive–behavioral therapies resulted in long-term improvement in multiple aspects of chronic pain problems. The operant behavioral condition appeared to be more effective than the waiting list and the cognitive–behavioral conditions at posttreatment; however, the two treatments were equivalent at the 12-month follow-up. This equivalence reflected steady improvement over time in the CB group rather than an increase in dysfunction in the OB group. It may be speculated that this continued improvement in the CB group reflected continued practice of the coping skills taught, but further research is needed to examine the processes by which change occurs following treatment.

It is interesting that CB patients were more satisfied than OB patients with the treatment program and rated it more helpful, despite the greater improvement of the OB patients as measured by the Sickness Impact Profile. It is possible that the dependent measures did not assess those problems for which CB patients found the treatment helpful. For example, patients may have found the CB techniques helpful in managing stress but not in decreasing disability. It is also possible that satisfaction was related to perceptions of therapists as warm, caring, and knowledgeable. That the CB patients rated their therapists as warmer was most likely due to the nature of cognitive–behavioral therapy, which involves much discussion of the patient's thoughts and feelings, because for the most part, therapists for the two treatments were the same people.

Both treatments resulted in the decreased endorsement of cognitive errors. It might be hypothesized that changes in cognitions followed improved physical and psychosocial functioning. However, WL patients showed significant improvement in physical and psychosocial functioning but no decrease in cognitive errors, and OB patients showed greater improvement than CB patients in physical and psychosocial functioning but no significantly greater decreases in cognitive errors. Similarly, it might be argued that the changes in cognitive errors were not due to decreased pain because the CB and OB patients did not report significantly less pain than did the WL patients at posttreatment. Therefore, it seems plausible that both treatments produced similar changes in ways of thinking, even though only the cognitive–behavioral treatment explicitly attempted to do this. These findings suggest the need for further study of how various treatments for pain affect the patient's way of thinking about and responding to the pain and how these processes, in turn, affect future pain, suffering, and disability.

The patient sample was representative of the majority of chronic back pain sufferers and not of patients seen in pain clinics. There is a considerable need to examine the relative efficacy of various outpatient treatments for individuals mildly limited by chronic back pain in light of the prevalence and cost of this syndrome. However, the relatively low pretreatment mean scores on many of the measures used in this study precluded the possibility of dramatic improvement.

That WL subjects showed significant improvement in pain-related dysfunction was surprising because previous treatment-outcome studies of chronic low back pain patients have found no improvement in WL subjects over time (Linton & Gotestam, 1984; Turner, 1982). The population from which this sample was drawn might have been more capable of spontaneous short-term improvement than patients seen in pain clinics or orthopedic clinics. Given the chronicity of pain reported by patients in the present study, one could speculate that if they had not received treatment after being in the waiting-list condition, they would have returned to pretreatment levels of pain and dysfunction at 6 and 12 months. Unfortunately, no control group was possible for follow-up comparisons.

As noted previously, no standard protocols exist for either cognitive–behavioral or operant behavioral interventions. Studies with different treatment components and/or more sessions might yield different results. Such variations, as well as differences in measures and patient samples, may explain the discrepancies between the findings of the present study and those of Kerns et al. (1986). Important questions to be addressed in future studies include whether specific techniques are differentially effective for various aspects of chronic pain problems and, if so, by what mechanism of action as well as whether certain pretreatment patient characteristics predict responses to different treatments.

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Received January 21, 1987
Revision received June 23, 1987
Accepted July 8, 1987 ■

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Department of Psychology
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