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OPERANT INTERACTIONS IN OSTEOARTHRITIC PAIN

by

(C) LINDA L. HATT

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF PSYCHOLOGY

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Date September 20, 1983

Dedication

To my parents, Henrietta and Lloyd Hatt for their efforts in shaping my behavior and for their continued support.

Abstract

The present study investigated possible interaction between verbal and nonverbal responses in osteoarthritic pain. Subjects were attending a Ger[illegible]ic Day Hospital and had been diagnosed as having ost[illegible]s confirmed by radiologic examination. Resul[illegible] decrease in motor performance and an increase in blood pressure when pain expressions were increased. A decrease in the number of pain expressions resulted in a decrease in pain ratings.

The second experiment examined the effect of exercise, a nonverbal operant, on verbal expressions of pain. Although a tendency for pain verbalizations to decrease with increased exercise occurred, the results were variable. The variability is attributed to the instructional control of the procedure and the occurrence of intermediate behaviors. In conclusion, the effect of verbal behavior appears to exert more consistent control on nonverbal behavior than vice versa. Theoretical and applied implications of these findings are discussed.

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I. Introduction

Interaction between verbal and nonverbal response classes have important implications in applied settings. The controlling effect of verbal behavior on related nonverbal behavior has demonstrated application in such areas as self-control (Meichenbaum and Goodman, 1971) and teaching prosocial behavior to children (Rogers-Warren and Baer, 1976). The present research extends the analysis of operant interactions to the control of behavior associated with chronic osteoarthritic pain.

Osteoarthritis is a major cause of functional impairment and disability in the elderly (Huskisson, 1979). Surprisingly, only 20% of those showing osteoarthritic changes actually complain of joint pain or other related symptoms (Hart, 1974). Indeed, large amounts of tissue damage may appear in the radiographs with little or no associated symptoms (O'Dell, 1977). Rodnan (1973) notes that as many as 50% of abnormal joints may cause no symptoms whatsoever. Thus the degree of reported pain is apparently independent of the diagnosed pathology. This discrepancy between detected pathology and clinical behavioral symptoms has not been adequately resolved from a medical perspective. However, Fordyce (1976) suggests that any time a discrepancy exists between pathology and pain behavior, an operant analysis may be informative. The operant component of pain involves a class of responses containing both verbal and nonverbal members. Verbal operants consist of reports of pain or requests for assistance while nonverbal responses may involve visible gestures such as grimacing as well as functional limitation or decreased activity. The assumption is that such behavior may contribute to the "pain problem" and, in fact, increase the individual's suffering. Extending this assumption to osteoarthritic pain, implies that the medical problem based on underlying pathology may be significantly amplified by accompanying pain related behavior.

Complaints of pain and decreased locomotor activity are operants which are especially problematic for the geriatric patient with osteoarthritis (Hollander, 1974; Hart and Huskisson, 1972). Excessive dwelling on physical complaints may provoke the intolerance of friends and family as well as increase the difficulty for medical professionals in determining appropriate treatment. For example, reports of pain are often taken by professionals to be an indication of severity and, therefore, partly determines whether the prescription of medication is warranted . For the geriatric patient, however, the use of any prescribed medication must be carefully weighed against factors of drug interactions, compliance, age-related changes in metabolism, overdosing potential and effects of long term use (Brady, 1978; Ward and Blatman, 1979; Baskin, Smith, Hoey, Levy, and Goldfarb, 1981; Bond, 1979). In fact, it has been suggested that reports of mild or intermittent pain may not justify regular pharmacological treatment because of the potential risks involved to the elderly patient (HusKisson, 1979). Hence, patients' verbal reports of pain may significantly influence prescribed treatment. Similarly, decreased activity in the elderly osteoarthritic is also problematic. Bluestone (1980) states that in some cases, patients will refuse to move in order to avoid arthritic discomfort. Unfortunately, this self-imposed immobility may actually increase pain and stiffness as well as cause additional problems of electrolyte imbalance, pressure sores, venous thrombis and decreased joint function (Coni, Davison and Welster, 1980). In conclusion, complaints of pain and inactivity are of particular importance in the diagnosis and treatment of osteoarthritis. Thus an operant analysis of these pain behaviors seems warranted.

Of particular interest to the operant analysis of osteoarthritic pain is the possible interaction of verbal and nonverbal behavior. While operant treatment programs directly manipulate contingencies that control verbal and nonverbal pain behavior (Fordyce, 1976; Roberts, 1981; Cairns and Pasino, 1977), interaction effects have not been typically investigated. Such operant interaction has been demonstrated in previous studies of problem behavior. For example, Lovaas, (1961) differentially reinforced aggressive verbal responses in young children and obtained an increase in nonverbal aggressive behavior. Similar interaction effects were demonstrated in an applied setting by Tracey, Briddel and Wilson (1974). Subjects were psychiatric patients on a token economy ward. Verbal responses relating positive statements about activity were increased by delivering point reinforcers during group therapy. Points could then be exchanged for tokens. Subsequent measures of patient participation in activities indicated that an increase in participation did occur. Thus, the authors concluded that the verbal behavior had generalized to another nonverbal response class.

Interestingly, the effect of nonverbal behavior on subsequent verbal behavior has not been a major concern in behavior analysis. Risley and Hart (1968) noted that, in training correspondence between play activities and the report of play, childrens' verbal reports decreased as a function of their prior play behavior. Thus, nonverbal behavior appeared to control subsequent verbal responding. Recently, Catania, Mathews and Shimoff (1982), report that the verbal behavior of guessing the contingencies in a button pressing task was sometimes controlled by the preceding rate of actual button pressing. This kind of control has been extended to pain behavior in a study by Bandler, Madaras and Bem (1968). In this study, a series of electric shocks were delivered to subjects who were then asked to rate the discomfort level of the shock. Subjects were instructed that, depending on the condition, they could either escape the shock by pushing a lever or endure it. All shock intensities were actually the same, but subjects rated shocks from which they escaped as being greater than those endured. The authors concluded that the level of discomfort reported by the subjects was determined by the prior overt behavior, that is, escaping or enduring. In summary, the above studies suggest that nonverbal responses may influence subsequent verbal behavior of applied importance.

The present study was designed to investigate the interaction of verbal and nonverbal operant responses in osteoarthritic pain. The first experiment examines the effect of altering verbal responses on subsequent nonverbal behavior. Similar to the findings of Tracey et al. (1974), it was expected that an increase in pain verbalizations would result in subsequent increase in nonverbal pain behavior, while a decrease in pain verbalizations would decrease nonverbal pain behavior. The second experiment examines the effect of altering antecedent nonverbal behavior on subsequent verbal behavior. On the basis of the Bandler, et al study (1968), it was predicted that an increase in exercise activity would result in a decrease in pain verbalizations.

II. Experiment 1

Method

A. Participants and Setting

Two male and two female patients between 74 and 86 years old were the participants in this study. Subjects had been diagnosed as osteoarthritic based on radiologic examination. Medical records showed involvement in two or more of the following joints: knee, spine, hip and proximal interphalangeal joints. Subjects were attending a Geriatric Day Hospital which is a special unit of the Youville Memorial Wing, Edmonton General Hospital, Edmonton, Alberta. The facility provides medical assessment and rehabilitative services to geriatric patients who may then continue living in the community. The four subjects agreed to participate in a research project on aging and were informed that no treatment was involved in the research. All subjects participated with the consent of their physician. The two investigators responsible for carrying out the procedures were both trained as paramedical professionals, one as a psychiatric nurse, and the other as a physical therapist. Both were well acquainted with the apparatus and materials used in the study.

B. Measures

To measure the effect of verbal pain behavior on nonverbal behavior, two motor performance tasks were adopted from recommended outcome criteria for assessing the arthritic patient (Greenfield, Solomon, Brook, Davies-Avery, 1978; Hollander, 1974). The first measure, grip strength, was assessed using the standard procedure reported by Agnew and Maas (1982) but employing a sphygmomanometer as described by Harris (1978). In this procedure the subject is asked to hold the inflated cuff of the sphygmomanometer and instructed to grip as hard as he/she can. The task is repeated three times on each hand, alternating from left to right. Grip strength can then be measured as the mean of the three attempts calibrated in millimeters of mercury. The second measure of motor performance was the rate of walking 50 feet. Subjects were asked to walk a predetermined course and timed using a stop watch. Thus, both an upper extremity and a lower extremity task were used in the evaluation.

The effect of verbal pain behavior on subsequent reports of pain was assessed by a 4 point rating scale (0=none, 3=extreme). Clarke, Willis, Stenner and Nichols (1974) employed such a scale to evaluate physiotherapy procedures in the treatment of the osteoarthritic knee. Similar rating scales have been promoted for clinical pain assessment, most recently by Finch and Melzack (1982), and appear on the McGill Pain Questionnaire (Melzack, 1975). To prevent subjects from focusing on pain, a list of ten physical sensations, containing both pleasant and aversive items, were included in the rating scale.

A series of physiological indices consisting of pulse rate, respiratory rate, and blood pressure were manually recorded. The standard procedure of measuring indirect blood pressure using an aneroid sphygmomanometer and a stethoscope is described by Kirkendall, Burton, Epstein and Freis (1967). Pulse rate was measured by manual pressure over the radial artery and counting the number of distentions of the artery wall for 30 seconds. Similarly, respiratory rate was determined by unobtrusive observation of the subjects' chest movement and counting the number of inhalations for 30 seconds. These measures were taken 3 times during each interaction with the subject. An initial resting rate was taken prior to any experimental manipulation, followed by a post manipulation measure, and last, a recovery rate measure which was taken 5 minutes after the experimental manipulation. Although no specific hypothesis was proposed as to the effect of verbal pain responses on physiological responding, these measures were included to provide a safety check on the patients involved.

C. Experimental Design

This experiment utilized a reversal design counterbalanced for order effects. The interventions were alternated in an A A′B A′C A′ or A A′C A′B A′ sequence. Each phase of the experiment lasted a minimum of 3 days with one

20 to 30 minute session per day. The experimental manipulations consisted of two procedures to increase and decrease the frequency of verbal responses related to arthritic pain and associated problems. The first procedure attempted to establish stimulus control whereby thematic prompts cued the appropriate verbal response. Target responses were then followed by social reinforcement in the form of attention and continued conversation. MacDonald and Butler (1974) produced walking behavior in nursing home wheelchair patients using verbal prompts and contingent social reinforcement. Thus, it was assumed that a similar procedure would be effective in producing the desired verbal behavior.

Phase A

During Phase A, a baseline condition, there was no attempt to systematically control the patients' verbal behavior but operant levels were established for each dependent measure. Each session involved measurement of the physiological indices, motor performance (i.e. grip strength, walking rate) and self-ratings.

Phase A'

The A' phase was an attention control procedure for the effects of the interview and consisted of a 10 minute recorded interview session immediately following the initial physiological measures. During this session, any verbal behavior on the part of the subject was followed by social reinforcement (i.e. response independent reinforcement). Subjects were asked to discuss the problems and rewards of aging. Prompts such as, "Can you think of anything else" or re-statements of what the subject was saying were used to provide cues for continued verbal responding. Immediately following the interview session, the dependent measures were taken as in baseline.

Phase B

During this phase, any responses mentioning pain, weakness, stiffness or arthritic discomfort were differentially reinforced by contingent attention and social interaction. In addition, thematic prompting of pain responses (i.e. "How is your back today?") were also provided. In other words, the B phase procedure attempted to increase the rate of pain talk. At the end of the interview, subjects provided pain ratings, motor indices and physiological measures as in the baseline phase.

Phase C

The objective of phase C was to decrease the frequency of pain verbalizations during the interview session. The decrease was accomplished by a DRO contingency which required the interviewer to provide social reinforcement for any verbalizations other than expressions of pain. Furthermore, prompts for non-pain verbalizations (i.e. the topic was changed to current events or other non-health related issues) were also provided. Again dependent measures were completed following the interview period.

III. RESULTS

A. Manipulation of the Independent Variable

In order to determine the effectiveness of the experimental manipulation, verbatim transcripts were made of all interview sessions. One rater, blind to the hypotheses and the conditions, scored the transcripts for the occurrence of arthritic pain expressions. Arthritic pain expressions were defined as any word, phrase, clause or sentence fragment referring to:

1. arthritis or any synonym (e.g. rheumatism, joint pain).
2. symptoms of arthritis (e.g. pain, stiffness, muscular weakness).
3. functional limitation due to pain, stiffness, muscular weakness (e.g. I can't get dressed by myself because I'm so stiff in the morning).

Expressions could be in first or second person, and past, present or future tense. These instructions parallel those used by Fordyce, McMahon, Rainwater, Jackins, Questad, Murphy and DeLateur (1981) for observational recording of pain behavior. The specific reference to arthritic pain was added for the purposes of this study. Each exchange between the subject and the interviewer was numbered consecutively. An exchange was defined as an interviewer verbal response followed by the subject's verbal response. Each exchange was then rated as to the presence of an expression of arthritic pain verbalized by the subject. The percentage of the total number of exchanges containing pain expressions could then be calculated. Reliability was determined by having a second rater, also blind to the hypotheses and conditions, rate a randomly selected sample of transcripts. The number of agreements was divided by total agreements plus disagreements and multiplied by 100. An agreement occurred when both raters scored the same exchange as expressing arthritic pain. If one rater indicated an exchange contained an expression of arthritic pain and the other rater did not, a disagreement was counted. The overall percentage of agreement was 87%.

Group data for the mean number of pain verbalizations is presented in Figure 1a. As expected, the number of expressions of arthritic discomfort increase in the B phase and decrease in the C phase. Individual subject and group means for total number of exchanges and the percentage containing expressions of arthritic discomfort are presented in Table 1. Although the highest percentage of pain expressions occur in the B phase and the lowest in the C phase there are some interesting anomalies. The operant level of total exchanges is low in the initial A' phase for all subjects. This coincides with the introduction of the interview session and likely reflects subjects' response to the recorded interview situation. Note also that Subject 4 has a rather low operant level for pain expressions in the initial baseline (5%) while Subject 3 has a high operant level (61%). In fact, during the B phase the percentage of

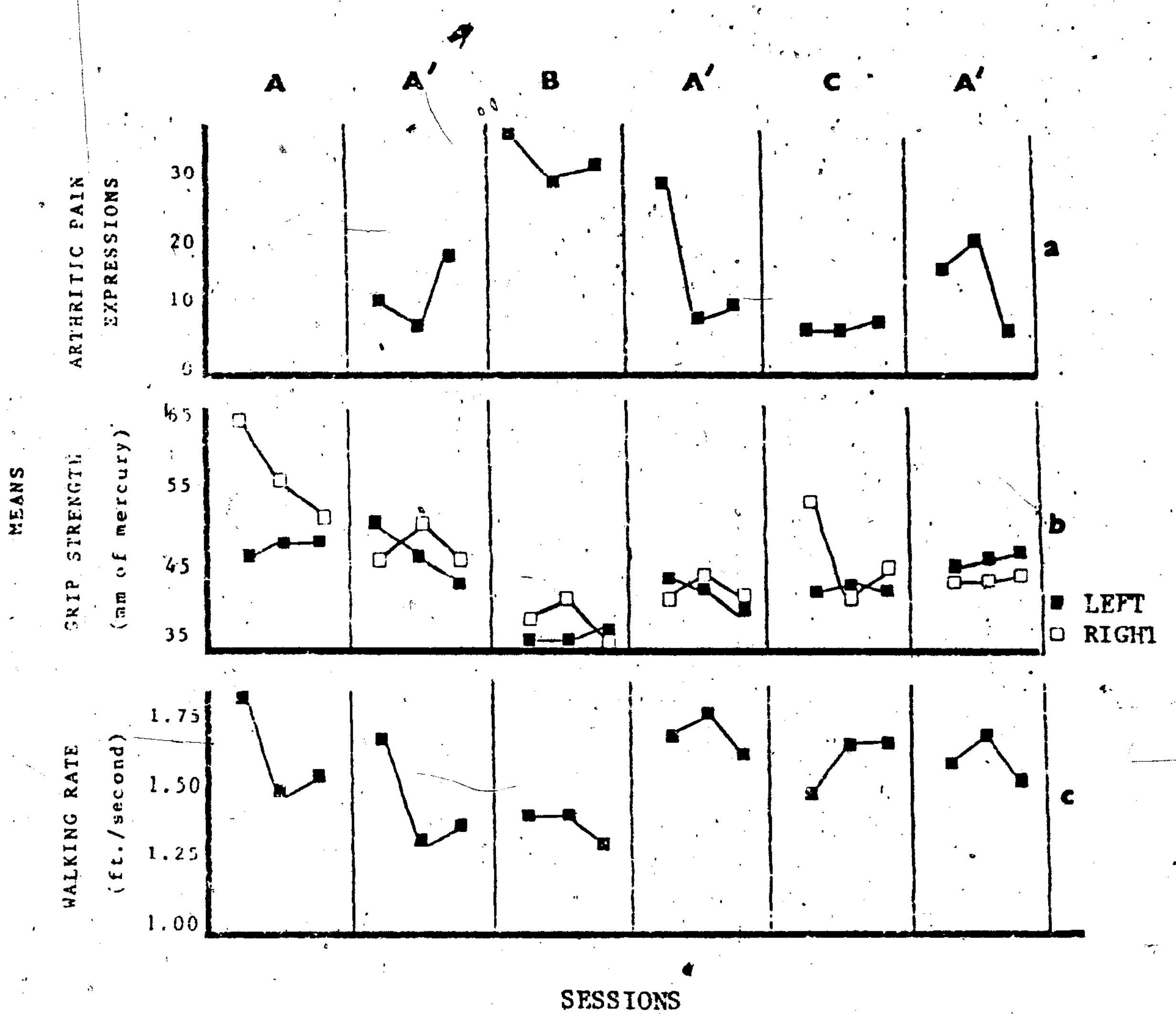

FIGURE 1: GROUP MEANS FOR PERFORMANCE MEASURES AND PAIN EXPRESSIONS

TABLE 1

Total Conversational Exchanges and Percentage of Arthritic Pain Expressions

		PHASE				
		A'	B	A'	C	A'
Group Mean	Total	75.3	122.5	115.8	137.8	125.0
	% Pain	33.4	55.3	37.5	11.8	26.5
Subject						
1	Total	90	149	159	177	156
	% Pain	31	62	44	11	35
2	Total	73	114	125	137	134
	% Pain	36	59	37	12	16
3	Total	83	139	128	144	133
	% Pain	61	50	27	16	32
4	Total	55	88	51	93	77
	% Pain	5	50	42	8	23

exchanges containing expressions of pain actually decreased for Subject 3, although remaining high at 50%. Nevertheless, there is sufficient evidence to indicate success in changing verbal behavior in the appropriate direction.

B. Effects on Motor Performance Tasks

Group data for motor performance tasks are also presented in Figure 1. During the A phase or baseline, performance was high in both grip strength and rate of walking. All performance levels then drop in the ensuing A′ phase. Although it appears that the introduction of an interview session impaired motor performance, the initial enhanced performance can likely be attributed to demand characteristics of the experimental situation. Subjects in this experiment had never participated in a research project before and initial responses may reflect heightened motivation. Thus, the A phase served as a period of habituation to the tasks and procedures involved in the study. Changes in behavior as a function of the independent variable are estimated by comparison with the A′ phase.

Grip Strength

As shown in Figure 1b, grip strength decreases with an increase in arthritic pain verbalizations. However, grip strength does not increase as pain verbalizations decrease. Individual subject and group means are presented in Table 2. Although individual differences in performance are evident,

TABLE 2

Mean Grip Strength in Millimeters of Mercury

		PHASE			
		A	A'	B	C
Group Mean	Left	49.0	44.0	38.1	40.9
	Right	57.9	44.5	39.4	44.38
Subject					
1	Left	26.0	23.0	21.7	27.0
	Right	47.3	25.5	20.3	34.7
2	Left	40.0	23.8	19.0	23.3
	Right	43.3	25.3	19.0	24.6
3	Left	87.0	81.3	72.3	74.0
	Right	97.3	80.4	70.3	83.0
4	Left	43.4	48.1	39.3	39.3
	Right	44.0	46.3	48.0	37.0

the data clearly indicate a performance decrement with an increase in pain verbalizations for all 4 subjects when left hand strength was measured and for Subjects 1, 2, and 3 when right hand strength was measured. On the other hand, no substantial improvement occurs with the decrease in pain verbalizations. Only Subject 1 indicated any enhancement in grip strength during the C phase. Thus, an increase in pain verbalizations results in a decrease in grip strength but a decrease in pain verbalizations appears to have little effect.

Walking Rate

Group performance on the walking task is presented in Figure 1c. To facilitate the comparison, the time taken to walk 50 feet is converted to rate of walking in feet per second. The increase in pain verbalizations does not appear to effect the rate of walking over all subjects. However, walking rate improves with the removal of the B phase. Individual and group means for time taken to walk 50 feet are presented in Table 3. Means for Subjects 1, 2 and 4 indicate that the time taken to walk 50 feet increased as predicted with increased pain verbalizations. As in grip strength performance, walking rate shows no improvement with a decrease in pain verbalizations. This is supported by individual mean times taken to walk 50 feet (Table 3). Only Subject 1 demonstrated an improved performance during the C phase.

TABLE 3

Mean Time in Seconds Taken to Walk 50 Feet

	PHASE			
	A	A'	B	C
Group Mean	55.7	39.3	45.3	37.7
Subject				
1	54.0	35.1	39.7	29.9
2	20.0	26.6	30.0	29.6
3	22.7	28.7	27.7	27.0
4	126.0	66.6	83.7	64.3

In summary, increasing pain verbalizations results in a decrease in motor performance on tasks of grip strength and walking rate. Interestingly, decreased pain verbalizations did not effect either performance task.

C. Pain Ratings

Ratings of pain, weakness and stiffness were combined in an overall arthritis discomfort rating presented in Figure 2a. Discomfort ratings are highest during the increase in pain verbalizations; however, the ratings decreased substantially with a decrease in arthritic pain verbalizations. Individual subject and group means for pain ratings are presented in Table 4. Results for the B phase are mixed. Both Subject 1 and 2 rated their pain as more severe with the increase in pain verbalizations. Subjects 3 and 4, however, did not indicate such an increase. On the other hand, a decrease in pain verbalizations resulted in a decrease in pain ratings for Subjects 1, 2 and 3. All 4 subjects rated their overall discomfort as less with decreased pain verbalizations. Thus decreasing pain verbalizations decreased self-ratings although increasing pain verbalizations did not increase ratings for all subjects.

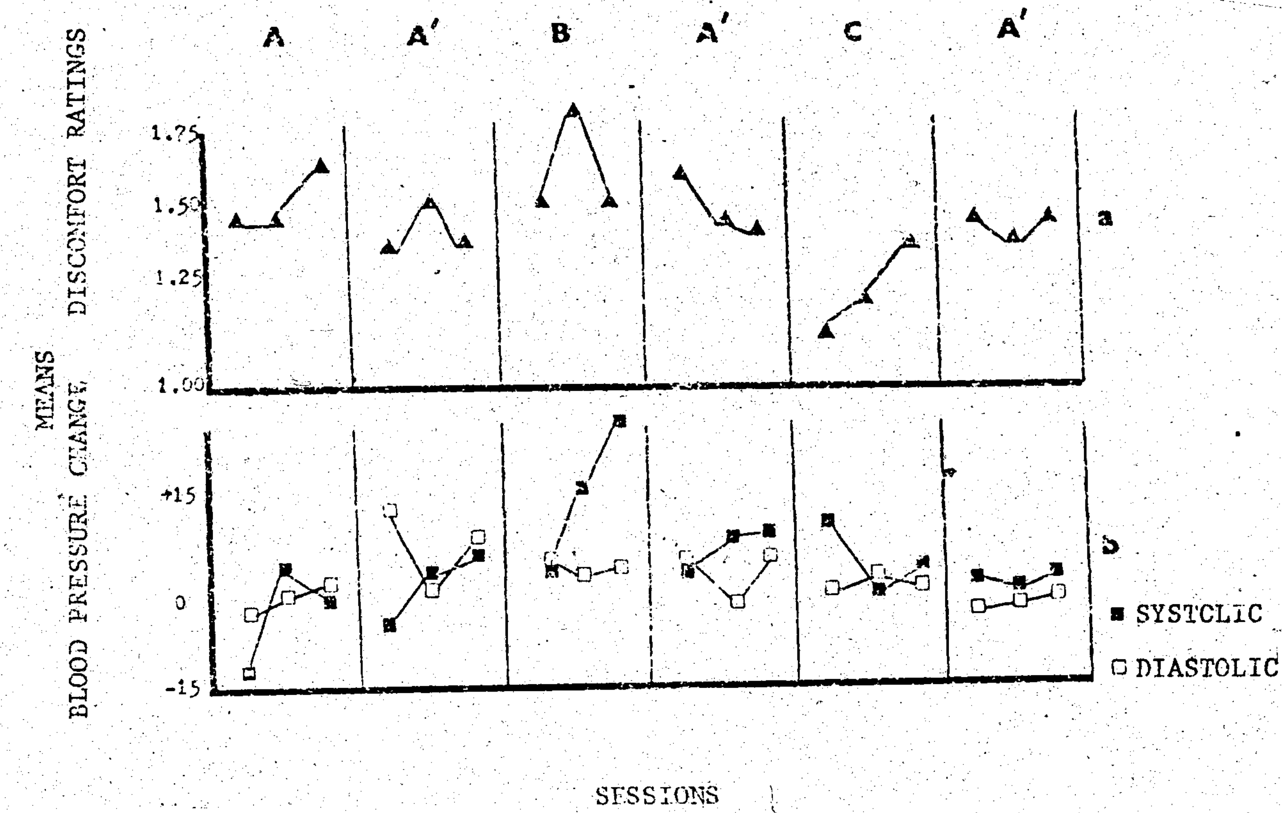

FIGURE 2: MEAN DISCOMFORT RATINGS AND CHANGE IN BLOOD PRESSURE

TABLE 4

Mean Ratings of Arthritic Symptoms

		PHASE			
		A	A'	B	C
Group Mean	Pain	1.13	1.18	1.47	1.00
	Stiffness	1.16	1.42	1.75	1.25
	Weakness	1.83	1.75	2.00	1.75
	Overall Discomfort	1.37	1.45	1.74	1.33
<u>Subject</u>					
1	Pain	1.00	1.44	2.00	1.00
	Stiffness	1.33	2.88	3.00	2.33
	Weakness	1.00	2.00	2.00	2.33
	Overall Discomfort	1.11	2.11	2.33	1.89
2	Pain	0.66	0.66	2.00	0.33
	Stiffness	0.66	0.66	0.00	0.00
	Weakness	2.66	2.66	3.00	3.00
	Overall Discomfort	1.33	1.33	1.33	1.11
3	Pain	2.67	2.22	2.00	2.00
	Stiffness	2.00	2.00	1.66	2.00
	Weakness	3.00	1.67	2.00	1.67
	Overall Discomfort	2.56	1.96	1.89	1.89
4	Pain	2.00	0.66	0.33	0.66
	Stiffness	1.00	0.33	0.33	0.00
	Weakness	0.66	0.66	1.00	0.66
	Overall Discomfort	1.22	0.55	0.55	0.41

D. Physiological Indices

Group mean changes in blood pressure from initial resting levels to post manipulation levels are illustrated in Figure 2b. No change in physiological measures were anticipated as a result of a change in verbal pain behavior. Although respiratory and pulse rate did not vary significantly, a consistent pattern of responding emerged from the blood pressure data. Increases in systolic blood pressure in the B phase surpassed increases noted in any other phase. Individual subject and group means are presented in Table 5. Subjects 2, 3 and 4 show a substantial increase in systolic blood pressure while Subjects 1 and 4 show an increase in diastolic blood pressure. The recovery measures during the B phase do not vary from the pre-manipulation measures in any significant way. Thus, the effect of the manipulation on blood pressure was not enduring.

TABLE 5

Mean Change in Blood Pressure

		PHASE			
		A	A'	B	C
Group Mean	SBP	0	+5.3	+9.5	+5.8
	DBP	+0.5	+1.0	+4.5	+1.8
Subject					
1	SBP	-5	-2	+2	+1
	DBP	0	+1	+11	+2
2	SBP	-8	+6	+10	+8
	DBP	-4	+3	0	+4
3	SBP	+5	0	+9	+5
	DBP	-1	-4	+1	-1
4	SBP	-8	+13	+17	+9
	DBP	+7	+4	+6	+2

SBP = systolic blood pressure
DBP = diastolic blood pressure

IV. Discussion

Experiment 1 examined the interaction of verbal and nonverbal responses in osteoarthritic pain. Complaints of pain and pain-related problems were manipulated in four subjects with a diagnosis of osteoarthritis. It was expected that increasing verbal pain behavior would result in an increase in nonverbal pain behavior, indicated by diminished motor performance. Similarly, it was predicted that decreasing verbal pain behavior would result in a decrease in nonverbal pain behavior, that is, improved motor performance.

The results indicate that an increase in verbal pain behavior decreased motor performance. Grip strength in both hands decreased for 3 out of 4 subjects, while the fourth subject showed a decrement in the left hand only. In addition, an increase in verbal pain behavior resulted in a decrease in walking rate for 3 out of 4 subjects. However, the effect of increasing verbal pain behavior on nonverbal performance is notable because of the short duration of each experimental phase (3 days). Clarke, Willis, Stenner and Nichols (1974), in a physiotherapy treatment evaluation study, found no significant change in walking over a three week period. They concluded that, in chronic conditions like osteoarthritis, any change in walking rate is unlikely over a short period of time. Nevertheless, in this study, a decrement was demonstrated in only 3 days.

The present results also show that decreasing verbal pain behavior did not significantly effect motor task performance. Subject 1 did show an enhanced performance with the decrease in pain verbalizations, however, the generality of this finding is limited by the failure to replicate with any additional subjects. A possible reason for the failure of decreased verbal pain behavior to effect nonverbal behavior may be the content of the interview session. For example, if subjects had been differentially reinforced for talking about "well behavior", as opposed to anything other than pain (DRO), the predicted effect might have occurred. Support for this is found in Fordyce (1976) who claims that the absence of pain behavior does not automatically signal the presence of well behavior. Similarly, in the operant interaction studies (e.g. Sherman, 1964), nonverbal behavior is presumed to be a function of <u>related</u> verbal behavior. Thus, it may be that decreasing verbal pain behavior is not sufficiently related to well behavior in order to produce an increase in motor performance.

The subject's ratings of pain intensity and discomfort were also expected to vary as a function of verbal pain behavior. Increased verbalizations about arthritic pain should result in increased ratings of pain and discomfort, whereas decreased pain verbalizations should result in decreased ratings. Although the results indicate that ratings of pain and discomfort increased with an increase in verbal pain behavior, the decrease in verbal pain behavior exerted a stronger influence in decreasing ratings. This suggests that decreasing pain talk may have remedial value and supports the operant pain programs which incorporate a strategy for decreasing this behavior (Fordyce, 1976; Roberts, 1981).

Another explanation for these findings relates to the rating scale used in this study. Greater variability in ratings might have occurred using a scale with more reference points. For example, existing pain scales may have 4-100 different discrimination points. Therefore, a more variable distribution of ratings may have occurred with additional points. However, subjects in this study frequently had difficulty making distinctions between the 3 intensity levels using the 4 point scale. For example, one subject repeatedly said, "You either have it or you don't". In other words, the task of discriminating the degree of a sensation was a difficult one for this group. Furthermore, this would explain the stronger effect for the absence of pain talk since absence or "0" ratings require no finer discrimination.

The effect of increasing verbal pain behavior on blood pressure was surprising; three out of four subjects showed increases in systolic blood pressure, and two subjects showed increases in diastolic blood pressure with an increase in pain verbalizations. Recent studies suggest that the autonomic nervous system may be hyperactive in chronic pain patients (Keefe, 1982). In addition, increased blood pressure is a common phenomenon in the elderly. Frolkis (1977) explains this as a decrease in adaptive processes which then make the cardiovascular system more susceptible to disruption. Thus, the heightened response in this study may be a demonstration of increased physiological reactivity due to age or chronic pain.

It is also well established that environmental factors can influence blood pressure (Ostfield and Lebovits, 1968). An early study by Goldring, Chasis, Schriner and Smith (1954) focussed on patients with benign hypertension: a form of high blood pressure with no identifiable pathology. The treatment condition consisted of a placebo, an externally applied "electron gun", accompanied by a "regimen of reassurance". This procedure was effective in decreasing both systolic and diastolic blood pressure. In the same manner, the present study may have produced an increase in blood pressure by encouraging an increase in pain verbalizations, a "solicitous regimen".

Although marked elevation of both systolic and diastolic blood pressure is the most frequent physiological response pattern in experimental pain (Sternbach, 1968), blood pressure patterns in chronic pain have not been adequately identified. However, the interpretation of the blood pressure findings in this study must remain speculative. The manual recording procedure is now outdated by electrical recording equipment which constantly monitors blood pressure fluctuations. Nevertheless, the present results do indicate that a more thorough investigation of this effect is warranted.

V. Experiment 2

The second experiment was also designed to investigate the interaction of verbal and nonverbal operant responses in osteoarthritic pain. Specifically, this study examines the effect of altering antecedent nonverbal behavior on subsequent verbal behavior. In a recent study, Fordyce, McMahon, Rainwater, Jackins, Questad, Murphy, and DeLateur (1981) report a negative correlation between exercise and complaints of pain. Based on this study and the results of Bandler et al. (1968), it was proposed that exercise participation, an overt behavior, may influence subsequent verbal reports of pain. In other words, an increase in exercise should result in a decrease in verbal pain behavior.

Method

A. Participants

Two male and two female patients between 70 and 78 years old participated in this study. As in Experiment 1, all subjects had a confirmed diagnosis of osteoarthritis and were attending the Geriatric Day Hospital.

B. Measures

To measure the effect of increasing exercise on verbal pain behavior, a five minute interview was conducted following an exercise session. Subjects were asked a series of questions which required a minimum of prompting from the experimenter. For example, subjects were asked their views on "aging". In addition, subjects were asked how they were feeling that day and what they thought of the exercise session. Further discussion was prompted by such responses as "Is there anything else?" or "Can you tell me any more about that?". As much as possible, the interviewer attempted to respond directly to topics the subject introduced by reflecting, paraphrasing and acknowledging what the subject was saying. Verbal exchanges between the interviewer and the subjects were recorded and verbatim transcripts compiled.

The effect of increasing exercise on subsequent reports of pain was measured by the 4 point rating scale as employed in Experiment 1. The effect of increasing exercise on motor performance was also assessed. Grip strength and rate of walking were measured, as well as performance on a card turning task described by Agnew and Maas (1982). In the latter task, five 5 X 12cm white cards are placed on a table in front of the subject. The time taken to turn over the series of cards is then noted for each hand. Finally, physiological measures of pulse rate, respiratory rate and blood pressure were recorded. Again, these measures were taken 3 times during each session: an initial resting rate, a post exercise measure and a final rate taken at the end of the session.

C. Experimental Design

A single subject reversal design was used. Ideally, an A B C A C sequence was to be used with B and C phases representing different values of the independent variable, (i.e. time spent exercising). However, two subjects did not reach the criterion necessary for advancement to phase C and so were presented an ABAB sequence instead. The two other subjects completed the original sequence. Each phase of the experiment lasted a minimum of 3 days with one 20-30 minute session per day. The exercise used in this study consisted of pedaling a restorator: a bicycle-like apparatus connected to a chair.

Phase A

During Phase A, a baseline condition, operant levels were established for each dependent measure. Each session involved the measurement of initial physiological indices followed by the performance tasks, measurement of the second physiological indices and self-ratings. Because of the findings in the first experiment regarding the influence of verbal behavior on some measures, the interview session was conducted at the end of the session. Final physiological measures were taken after the interview.

Phase B

In this phase an exercise session was introduced. Following the initial physiological measures, subjects were accompanied to the exercise area of the Day Hospital. All subjects were familiar with the restorator. For this experiment no resistance was put on the circular pedal movement. Subjects were given the following instructions taken from Fordyce, McMahon, Jackins, Rainwater, Murphy and DeLateur (1981):

> "Do as much as you can until you feel tired, weak, or feel any pain. You decide when to stop".

In other words, subjects were instructed to exercise to tolerance. A five minute criterion was established for all subjects and the exercise session was stopped if criterion was met. Following the exercise session, the self-report measures, performance tasks and physiological measures were recorded. Finally, the interview session was conducted to sample subjects' verbal behavior.

Phase C

If subjects successfully reached the 5 minute exercise criterion for 3 days, the criterion was raised to 10 minutes. Dependent measures were recorded as in Phase B. Subjects were given the same exercise to tolerance instructions but in the C phase, exercise was stopped after 10 minutes. This phase was continued for a minimum of 3 days before the reversal A phase was introduced.

VI. Results

A. Manipulation of the Independent Variable

The experimental manipulation was the introduction of an exercise session. A maximum criterion of 5 minutes exercise duration was set for all four subjects. Subject 1 failed after 3 days to approach the 5 minute criterion. The exercise was tolerated a mean time of 1.5 minutes. Therefore, the exercise session was withdrawn for three days, then reinstated for an additional 3 days. No increase in exercise time occurred during the second series of exercise sessions. In fact, the subject began to complain that she was afraid the exercise may cause her to have leg cramps at night. After three days of exercise to tolerance remaining below criterion, the subject was discharged from the program. Subject 2 also did not reach criterion during the first three days of exercise. However, since improvement was noted (1.5 minutes increased to 2), the B phase was continued. Criterion was reached on the seventh day and maintained for three days. At that time the baseline phase was reintroduced for three days followed by three days of criterion level exercise.

Subjects 3 and 4 reached the criterion of 5 minutes on the first day of exercise. This was maintained for 3 days. At that time subjects were given the same instructions (i.e. exercise to tolerance) but the criterion was raised to ten minutes. Both Subjects 3 and 4 reached the ten minute criterion on the first day. Therefore, the ten minute criterion was continued for three days and was maintained by both subjects. Baseline was then reintroduced for three days followed by the ten minute exercise criterion which both subjects again maintained.

B. Verbal Pain Behavior

In Experiment 2, a decrease in verbal pain behavior was expected as a result of increasing exercise. Verbal pain behavior was measured by determining the number of arthritic pain verbalizations which occurred during each interview. Arthritic pain verbalizations were defined as in Experiment 1 (i.e. expressions of arthritic pain, arthritic symptoms and functional limitation attributed to arthritis). Verbatim transcripts of the conversational exchanges between the interviewer and each subject were coded by raters blind to the hypotheses and the conditions. For this experiment, raters were instructed to identify unprompted expressions of arthritic pain. An unprompted expression was defined as a statement not emitted in response to a question by the interviewer (Tracey et al. 1974). Overall rater reliability was 90% using the same formula as in Experiment 1.

Figure 3 illustrates the percentage of unprompted arthritic pain expressions for each subject. A 5 minute exercise session (or less) decreased pain verbalizations for Subjects 1, 2, and 3 but results are variable. Subject 4 shows an increase in pain verbalizations during the 5 minute

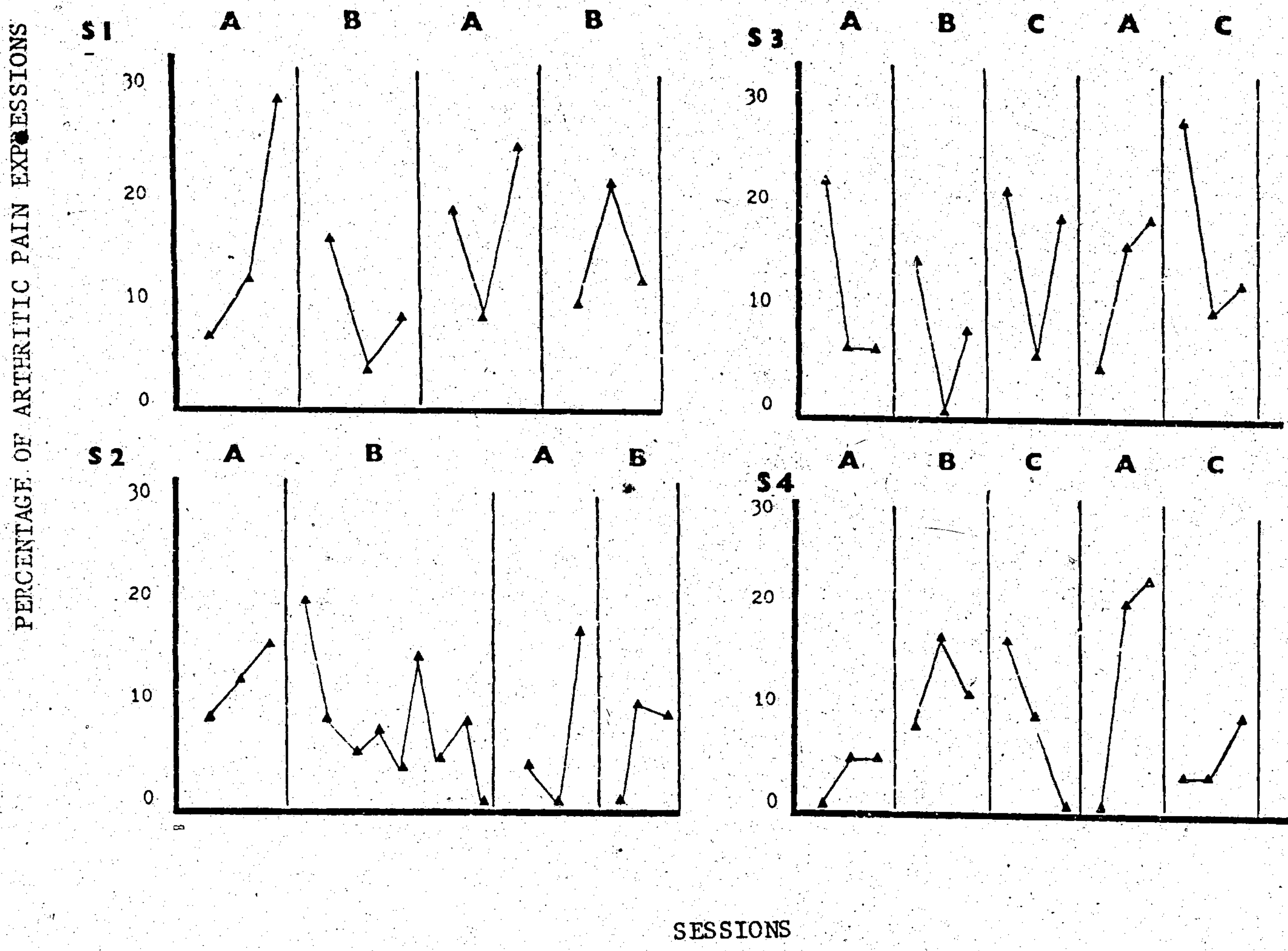

FIGURE 3: ARTHRITIC PAIN EXPRESSIONS AS A PERCENTAGE OF TOTAL INTERVIEW EXCHANGES

exercise session and a decrease during the 10 minute exercise session. The effect of 10 minutes of exercise is replicated with the subsequent removal and reinstatement of the exercise condition (i.e. the final A and C phase). Similarly, Subject 3 shows a decrease in arthritic pain verbalizations with the 5 minute exercise session but an increase in pain verbalizations with the 10 minute exercise session. Individual and group means for number of conversational exchanges and percent of unprompted pain expressions are presented in Table 6. In general, increasing exercise shows a weak tendency to decrease arthritic pain verbalizations. However, this tendency is not reliable over subjects or exercise duration and must be interpreted with caution.

C. Effects on Motor Performance

The motor tasks used in this study were grip strength, card turning and the rate of walking. An increase in performance was anticipated as a function of increasing exercise.

Grip Strength

Individual data for grip strength are presented in Figure 4. The 5 minute exercise criterion produced increased grip strength for Subjects 2, 3 and 4 while Subject 1 shows a continuous decline over all phases. Recall that Subject 1 did not reach the 5 minute exercise criterion. Furthermore,

TABLE 6

Total Conversational Exchanges and Percentage Pain Expressions

		PHASE		
		A	B	C
Group Mean	Total	23.9	25.7	28.7
	% Pain	11.2	8.9	10.9
Subject				
1	Total	19.66	20.3	-----
	% Pain	16.0	10.0	------
2	Total	25.5	29.8	-----
	% Pain	6.0	5.0	-----
3	Total	25.3	24.0	22.8
	% Pain	12.5	8.0	16.0
4	Total	25.0	28.6	34.5
	% Pain	10.0	12.7	5.7

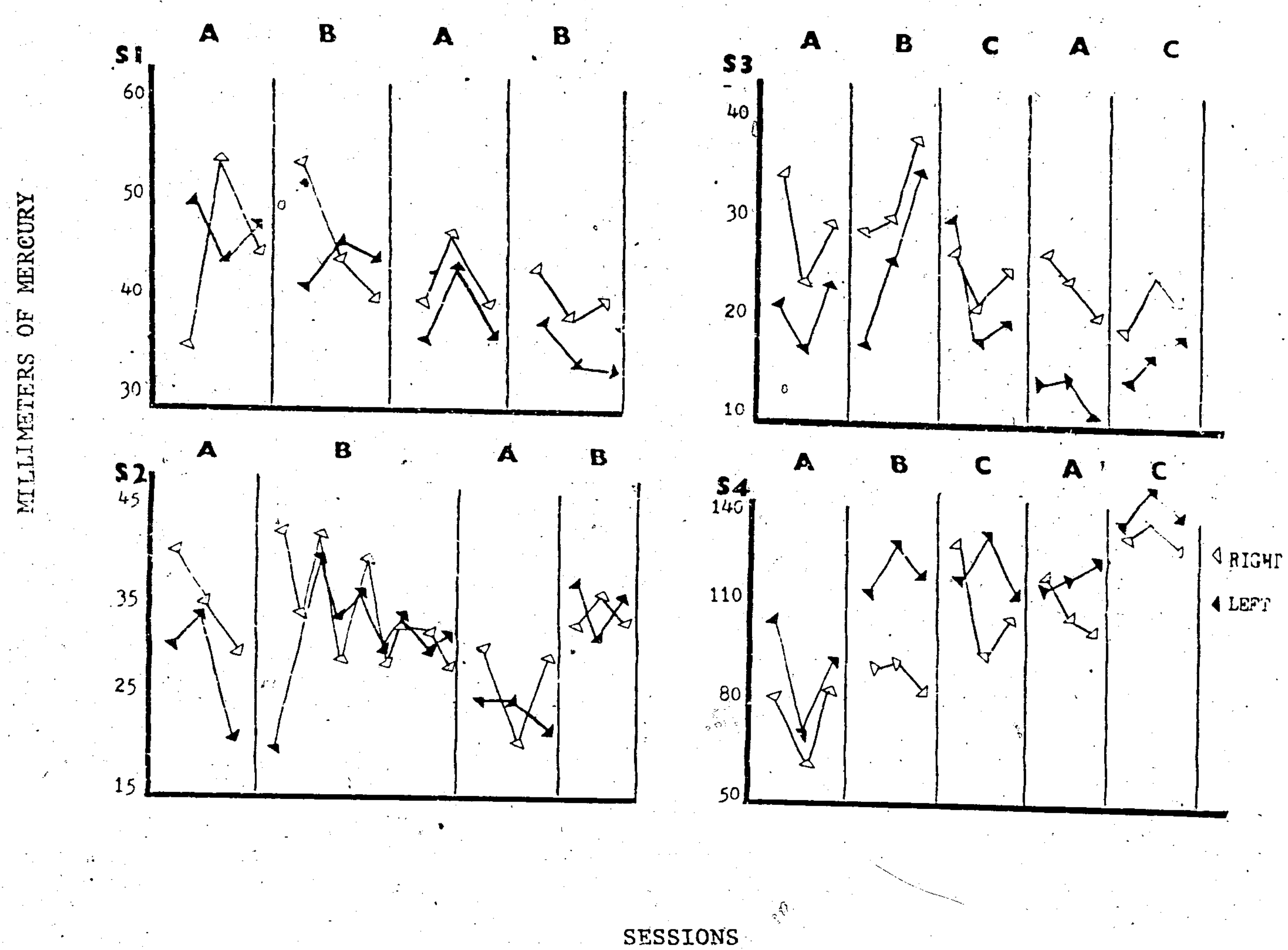

FIGURE 4: MEASURES OF GRIP STRENGTH FOR EACH SUBJECT AND CONDITION

the three subjects who did reach the 5 minute criterion, show a reversal of the effect during the appropriate phases. Individual and group means for grip strength over all conditions are presented in Table 7. Performance increases for Subjects 2, 3, and 4 are demonstrated during the 5 minute exercise session (phase B). During the 10 minute exercise session, however, Subject 4 continues to show an increase in grip strength while Subject 3 shows a decrease. Interestingly, this is the same pattern of responding reported for the percentage of pain expressions.

Card Turning

Individual subject and group means for time taken to perform the card turning task are presented in Table 8. Enhanced performance on this task would be demonstrated by a decrease in the recorded time. For the 5-minute exercise session, Subject 1 and 2 show a decrease in the time taken to complete the task. However, the relatively small improvement could be attributed to a practice effect and is likely not a function of the exercise session. Similarly, Subjects 3 and 4 show no systematic change in this measure. Therefore, performance on the card turning task was not enhanced by an increase in exercise. Data for each session are not presented since no indication of a significant effect is revealed.

TABLE 7

Mean Grip Strength in Millimeters of Mercury

		PHASE		
		A	B	C
Group Mean	Left	46.26	51.50	70.90
	Right	46.34	48.71	67.80
Subject				
1	Left	43.17	32.30	-----
	Right	42.33	43.33	-----
2	Left	23.00	31.10	-----
	Right	30.00	33.50	-----
3	Left	16.80	25.30	18.43
	Right	25.83	32.00	23.43
4	Left	102.05	117.30	123.50
	Right	71.30	86.00	112.17

TABLE 8

Mean Performance on Card Turning Task
in Seconds

		PHASE		
		A	B	C
Group Mean	Left	10.12	10.16	11.00
	Right	9.54	9.46	10.60
Subject				
1	Left	9.25	8.90	-----
	Right	8.42	8.07	-----
2	Left	9.28	7.99	-----
	Right	8.48	7.94	-----
3	Left	11.82	11.93	10.70
	Right	9.87	9.40	9.43
4	Left	10.13	11.80	11.30
	Right	11.38	12.43	11.77

Rate of Walking

Individual and group means for performance on the walking task are reported in Table 9. In this task, the time taken to walk 50 feet should decrease with the increase in exercise. In general, the results are not supportive. During the 5 minute exercise phase, Subjects 1 and 3 show a decrease in time taken to walk 50 feet, while Subject 2 and 4 show an increase. However, it should be noted that Subject 3's performance again decreases in the 10 exercise session while Subject 4's performance increases.

In summary, the effect of exercise on motor performance varied with the task and the subject. The three subjects who completed at least 5 minutes of exercise exhibited an increase in grip strength. On the other hand, the card turning task was unaffected by the exercise session. The time taken to walk 50 feet was not consistently affected by the exercise session for all subjects. Interestingly, motor performance for Subject 3 and 4 in grip strength and walking rate reflect the same response pattern as found in the number of arthritic pain expressions. Hence, Subject 3 improves with 5 minutes of exercise but performance decreases with 10 minutes of exercise. Subject 4's performance deteriorates with 5 minutes of exercise but improves markedly with 10 minutes of exercise.

TABLE 9

Mean Time in Seconds Taken to Walk 50 Feet

	PHASE		
	A	B	C
Group Mean	29.1	29.9	31.0
Subject			
1	26.67	24.70	-----
2	27.68	29.50	-----
3	35.02	33.76	-----
4	27.12	31.80	24.25

D. Pain Ratings

Individual and group means for pain ratings are presented in Table 10. Subjects 1, 2 and 3 show a decrease in pain ratings with the introduction of an exercise session, while Subject 4 shows no change. However, as the exercise increases, ratings for Subject 4 decrease while those for Subject 3 increase. This reflects the same pattern shown on the performance tasks for these two subjects.

The combined mean ratings of arthritic discomfort including pain, weakness and stiffness are presented in Figure 5. For Subjects 1 and 2, discomfort ratings do not appear to vary systematically with the exercise session. On the other hand, Subject 3 and 4 rate their discomfort as less with increased exercise.

E. Physiological Indices

The introduction of an exercise session did not influence physiological responding in any consistent manner. Mean changes in blood pressure are presented in Table 11. Blood pressure readings failed to show any significant change. The lack of significant change in physiological responding seems to indicate that the exercise session was not particularly stressful and likely did not produce a physiological conditioning effect.

TABLE 10

Mean Ratings of Arthritic Symptoms

		PHASE		
		A	B	C
Group Mean	Pain	1.42	1.14	0.83
	Stiffness	1.88	1.83	1.00
	Weakness	1.13	1.54	0.67
	Overall Discomfort	1.47	1.50	1.00
Subject				
1	Pain	0.67	0.50	-----
	Stiffness	1.00	1.17	-----
	Weakness	0.83	1.16	-----
	Overall Discomfort	0.72	0.67	-----
2	Pain	2.33	2.08	-----
	Stiffness	3.00	2.50	-----
	Weakness	1.83	2.00	-----
	Overall Discomfort	2.05	2.19	-----
3	Pain	1.33	0.67	0.83
	Stiffness	2.33	2.66	1.83
	Weakness	0.83	1.67	0.33
	Overall Discomfort	1.50	1.50	1.00
4	Pain	1.33	1.33	0.83
	Stiffness	1.17	1.00	1.17
	Weakness	1.33	1.33	1.00
	Overall Discomfort	1.28	1.22	1.00

Maximum = 5
Maximum = 6

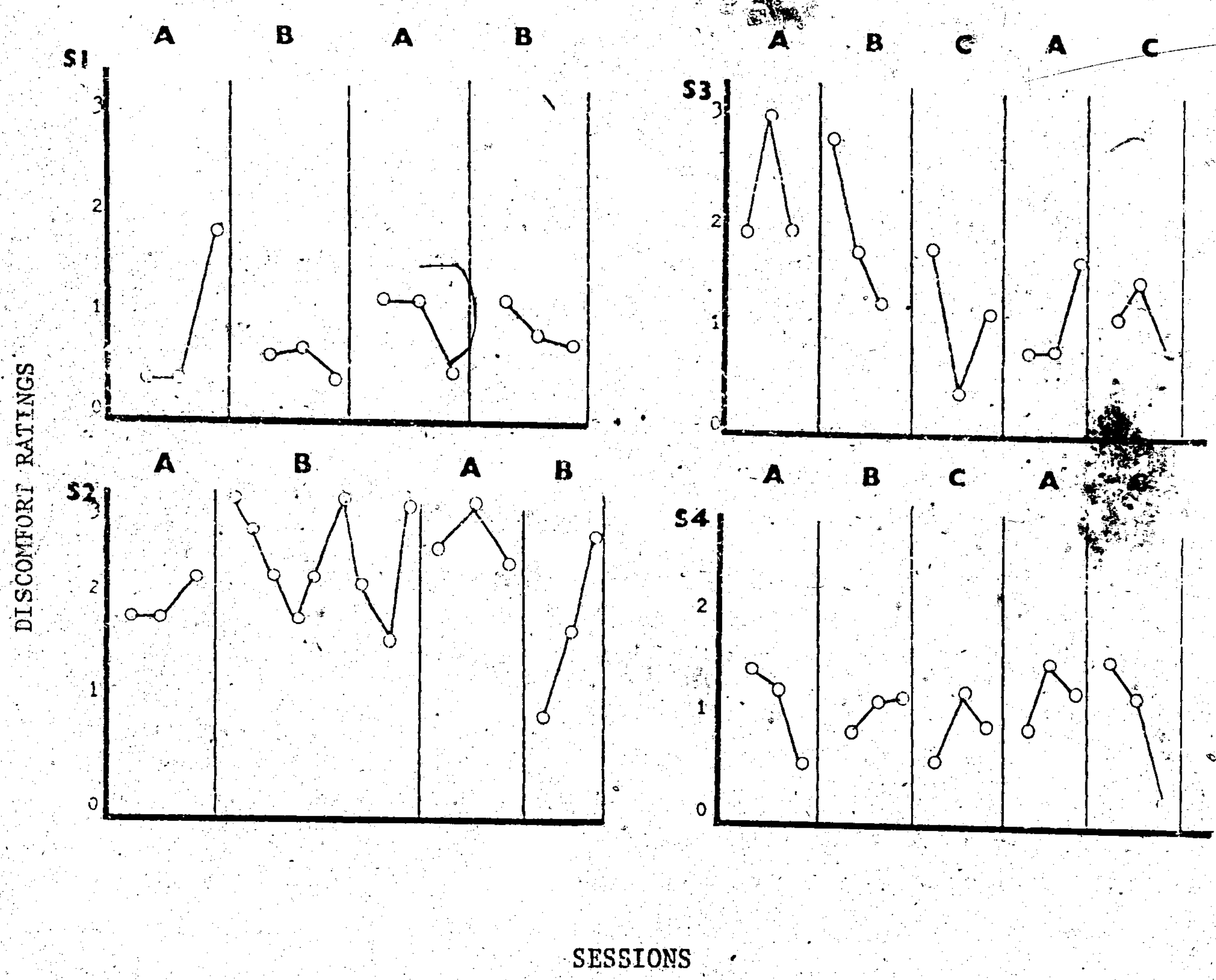

FIGURE 5: MEAN RATINGS OF PAIN, STIFFNESS AND WEAKNESS

TABLE 11

Mean Change in Blood Pressure

		PHASE		
		A	B	C
Group Mean	SBP	+5.0	-3.0	+1.5
	DBP	-1.25	-1.0	0.0
Subject				
1	SBP	+8.0	+1.0	-----
	DBP	+2.0	+2.0	-----
2	SBP	0.0	-4.0	-----
	DBP	-4.0	-1.0	-----
3	SBP	+26.0	-1.0	+2.0
	DBP	+3.0	+2.0	-1.0
4	SBP	-7.0	-5.0	+1.0
	DBP	-6.0	0.0	+1.0

SBP = systolic blood pressure
DBP = diastolic blook pressure

VII. Discussion

Experiment 2 examined the interaction of verbal and nonverbal responses in osteoarthritic pain. Time spent in exercising to tolerance was manipulated in four subjects with a diagnosis of osteoarthritis. Increasing exercise, a nonverbal response, was expected to result in a decrease in verbal pain behavior, as indicated by a decrease in arthritic pain expressions. Similarly, it was predicted that increasing exercise would result in a decrease in arthritic pain ratings. Furthermore, performance on motor tasks was expected to improve as a function of increasing exercise.

The results indicate that an increase in exercise did not consistently decrease pain verbalizations. Israel and O'Leary (1973) have suggested that nonverbal behavior may be less effective in controlling verbal behavior than vice versa. Their study involved reinforcing correspondence between saying and doing as well as doing and saying for children's play activities. They found that the do-say sequence produced correspondence only after previous say-do training. Therefore, nonverbal behavior may simply not be as salient for verbal behavior as verbal behavior is for nonverbal behavior.

Another reason for the variable influence of exercise on verbal pain behavior may be the instructional control used to elicit the exercise behavior. Instructions were such that subjects could stop at any time, however, as in the Fordyce et al. (1981) study, social sanction for compliance with the request to exercise is implied. Thus, subjects may not have felt free to stop exercising. Further support for the effect of instructional control is derived from Corah and Boff (1970). In a study analogous to Bandler, Madaras and Bem (1968), Corah and Boff assessed the effect of perceived control on self observation in response to aversive stimulation. The aversive stimulus in the Corah and Boff experiment was white noise. Subjects were assigned to either a choice or no choice condition. In the choice condition, subjects could choose to endure or escape the white noise. In the no choice condition, subjects were told that certain presentations of the white noise could not be stopped and must be endured. Subjects rated discomfort greater for the noise from which they could escape. In the no choice condition, the opposite occurred. Subjects rated discomfort greater for the noise they endured. In other words, subjects with no choice as to enduring or escaping the aversive stimulus may not have been influenced by their overt behavior in judging discomfort intensities. Similarly, in the present study, subjects may not have been influenced by their overt exercise behavior because the response was under instructional control.

Further evidence for this position is provided by Catania, Mathews and Shimoff (1982). In their study of human operant responding on a button pressing task, they found that shaped verbal behavior controlled subsequent nonverbal behavior. However, instructed verbal behavior had variable effects on the related nonverbal behavior, that is, sometimes verbal behavior controlled nonverbal, sometimes it had no effect and sometimes verbal behavior was controlled by nonverbal behavior. By extension, one may surmise that the instructed nonverbal behavior in this experiment also showed variability in its control of verbal behavior. If the exercise behavior had been shaped, and not instructed, perhaps the control would have been more consistent.

One other source of variability in the effect of exercise on verbal pain behavior must be considered. Sampling of verbal behavior took place at the end of the experimental session. This was arranged because of the possible influence of verbal responses on motor performance and pain ratings, as demonstrated in Experiment 1. However, the intermediate behavior (i.e. the series of behaviors that occur between the exercise and the interview session) may have influenced verbal responding. For example, immediately following the exercise session, subjects were asked to perform the motor tasks and pain ratings. An improved performance on the motor tasks may also have provided cues upon which inferences could be made regarding their discomfort. Thus the verbal responses may reflect the immediately prior motor performance rather than the earlier exercise performance. Evidence for this is provided by the pattern of responses noted for Subject 3 and Subject 4. Motor task performance, pain ratings and verbal pain expressions show the same response pattern.

One problem that emerged from the exercise procedure is that both Subjects 1 and 2 expressed a "belief" that exercise was of no value. Subject 1 went so far as to suggest that it may cause her physical discomfort at a later date. On the other hand, Subjects 3 and 4, who readily attained criterion levels both stated that exercise was helpful, especially for their stiffness. These statements seem to indicate between subject differences in history of reinforcement for exercise, and a possible effect of self-instruction concerning the benefits of exercise. The effect of this was not controlled for in the present study. In the operant program for the treatment of chronic pain, described by Fordyce (1976), patients are carefully selected for inclusion in the program. Furthermore, up to 40% of those included, may drop out of the program (Roberts, 1981). Therefore, patients who continue in the operant pain management program may have a history of positive experiences concerning the benefits of the program components while those who don't have such a history may simply drop out. Further research attempting to manipulate and/or control for this variable may be useful.

Results of this study do not support the findings of Fordyce et al. (1981). In their study a negative correlation was found between exercising to tolerance and concurrent complaints of pain. The authors concluded that exercise is incompatible with pain behavior. However, exercise may be incompatible with many concurrent behaviors including such positive behaviors as laughing or smiling. A more important question would be whether exercise effects a decrease in subsequent verbal pain behavior. The present experiment differs with the Fordyce et al. (1981) study in that exercise was an antecedent condition rather than a concurrent condition. and fails to consistently demonstrate such an effect.

In summary, these results suggest that overt behavior such as exercise may influence subsequent verbal and nonverbal responses related to osteoarthritic pain. However, the data are variable. The variability may be accounted for by the instructional control of the procedure which may have interfered with subjects perception of their own behavior. Furthermore, variability may also be due to the nature of the intermediate behavior.

VIII. General Discussion

Experiment 1 demonstrates that verbal expressions of arthritic pain can, by their occurrence, control some forms of nonverbal behavior in osteoarthritis. Specifically, it was demonstrated that increasing pain verbalizations decreases performance on certain motor tasks. In addition, it was shown that blood pressure, a physiological response, is sensitive to increases in verbal pain behavior. Finally, Experiment 1 demonstrates that the absence of verbal expressions of pain results in lower ratings of pain and discomfort. Experiment 2, on the other hand, failed to demonstrate consistent control of verbal pain behavior by the manipulation of a nonverbal behavior, namely, exercise.

From a theoretical standpoint, the present results suggest that verbal responses may readily influence nonverbal responding but the opposite may not necessarily occur. Perhaps this indicates the degree to which the verbal component of pain behavior is predominant over the nonverbal component. For example, the occurrence of pain is usually communicated to others by verbal behavior. Nonverbal behavior in the form of decreased motor performance, is not as readily distinguished as an aspect of pain behavior. For example, decreased walking rate may indicate fatigue as well as pain. Therefore, in terms of operant interaction, the subjects' verbal behavior may be highly salient as a discriminative stimulus for subsequent pain behavior, while nonverbal behavior such as exercise may be much less salient. Further research on this issue would be informative. One could, for instance, manipulate which aspects of verbal behavior serve as possible affective cues for subsequent nonverbal behavior through differential reinforcement of certain interactions.

However, it is interesting to consider possible implications derived from the literature on say-do correspondence training. Karlan and Rusch (1982) describe possible interactions of verbal and nonverbal responses. The interactions described center on negative and positive forms of correspondence. Positive correspondence occurs when a say-do or do-say correspondence occurs. Negative correspondence on the other hand, occurs in a not say not do and not do-not say correspondence. In the present study, reinforcing not talking about pain did not result in a corresponding decrease in nonverbal pain behavior (i.e. a negative correspondence). One may speculate that reinforcing correspondence between not saying and not doing may have produced the desired effect.

The effect of correspondence training in pain behavior has applied implications. For example, patients participating in an exercise program may not verbalize their progress initially. Verbal reports of pain may continue to lag behind actual physical gains. Such a lag between behavior and self-report has been described by Fordyce (1976) and Roberts (1981). Both authors claim that patients showing increased activity and decreased medication continue to maintain verbal reports of pain. Decreases in verbal reports may eventually occur months after the patient has been discharged from treatment. Reinforcing correspondence between nonverbal and verbal well behavior may facilitate change in the verbal report of pain. In addition, correspondence training may instruct patients to attend to environmental and internal cues which indicate wellness. Thus, chronic pain patients have already become sensitive to internal cues and environmental events which signal illness, but not wellness.

Another important issue emerges from the procedural differences in experiments 1 and 2. In Experiment 1, verbal pain behavior was manipulated by differential social reinforcement and resulted in a change in nonverbal pain behavior. This effect is supportive of the findings of Tracey et al.(1974) and Lovaas (1961). Both of these studies increased a nonverbal behavior by reinforcing a verbal behavior. In Experiment 2, however, the manipulation of nonverbal behavior was not produced by differential social reinforcement but was produced by instructional control. Given that the manipulation in Experiment 2 was less effective than in Experiment 1, perhaps the instructional procedure was a factor. Generalization between behaviors may not readily occur when behavior is manipulated by instructions as opposed to direct exposure to the contingencies.

The present study has other implications of applied importance. In the first experiment, nonverbal behavior frequently used in functional assessment was altered by an increase in pain verbalizations. This suggests the potential influence medical personnel may exert on the assessment and treatment outcomes by engaging the patient in conversation related to the pain problem. Patients are frequently encouraged to discuss their problems as a therapeutic intervention (Rudd, 1981; Smith, 1979). The results of this study would seem to indicate that the opposite may be more beneficial. The decrease in self-ratings of pain by decreasing talking about arthritic pain seems to indicate that not talking about pain may be more therapeutic. At the very least, medical personnel should monitor the possibility of such influences on the patient's reports of pain and subsequent motor behavior.

Generally, further analysis of chronic pain behavior in osteoarthritis and other chronic pain conditions seems desirable. Recent support for operant pain management rely heavily on group design and rarely incorporate a comparison control group (Linton, 1982). Within subject designs have been utilized by Varni, Bessman, Russo and Cataldo (1980) to demonstrate the effective decrease in pain behavior but only for a single subject. The results in the second experiment, reported here, showed significant variation between subjects. A failure to replicate over several subjects would appear to limit the applicability of any treatment procedure.

In conclusion, further analysis of pain behavior in osteoarthritis and other chronic conditions seems warranted. Possible benefits of reducing suffering and thereby improving the quality of life using operant methodology cannot go unheeded. However, to prevent operant pain management from becoming another fad in the history of behavior modification, requires a methodology based on the functional analysis of behavior. In the rush to produce successful treatment outcomes, the analysis is left for later exploration, perhaps to the detriment of the treatment programs themselves.

References

Agnew, P. & Maas, F. An interim Australian v[illegible]ion of the Jebsen test of hand function. [illegible]alian Journal of Physiotherapy, 1982, 28, 2[illegible]

Bandler, R., Madaras, G., and Bem, D. Self-observation as a source of pain perception. Journal of Personality and Social Psychology, 1968, 9, 205-209.

Baskin, S., Smith, L., Hoey, L., Levy, P., and Goldfarb, A. Age-associated changes of responses to acetylsalicylic acid. PAIN, 1981, 11, 1-8.

Bluestone, R. The diagnosis and management of rheumatic disease in the elderly: A special challenge. in M.Kay, J.Galpin, T.Makinodan (Eds.), Aging, Immunity and Arthritic Disease, New York: Raven Press, 1980.

Bond, M. PAIN. Edinburgh: Churchill Livingston, 1979.

Brady,E. Drugs in the elderly. in R.Kayne, (Ed.), Drugs and the Elderly, Berkeley: University of Southern California Press, 1978.

Cairns, D. and Pasino, J. Comparison of verbal reinforcement and feedback in the operant treatment of disability due to chronic low back pain. Behavior Therapy, 1977, 8, 621-630

Catania, C., Mathews, B. and Shimoff, E. Instructed versus shaped human verbal behavior: Interactions with nonverbal responding. Journal of the Experimental Analysis of Behavior, 1982, 38, 233-248

Clarke, G., Willis, L., Stenner, L., and Nichols, P. Evaluation of physiotherapy in the treatment of osteoarthritis of the knee. Rheumatology and Rehabilitation, 1974, 13, 190-197.

Coni, N., Davison, W., and Welster, S. Osteoarthritis - chronic destructive arthropathy Lecture Notes on Geriatrics. London: Blackwell Scientific Publications, 1977.

Corah, N. and Boffa, J. Perceived control, self-observation and response to aversive stimulation. Journal of Personality and Social Psychology, 1970, 16, 1-4.

Finch, L., & Melzack, R. Objective pain measurement: a case for increased clinical usage. Physiotherapy Canada, 1982, 34, 343-346.

Fordyce, W., McMahon, R., Rainwater, G., Jackins, S., Questad, K., Murphy, T., and Delateur, B. Pain complaint-exercise performance relationship in chronic pain. Pain, 1981, 10, 311-321.

Fordyce, W. Behavioral Methods for Chronic Pain and Illness. St. Louis: C.V. Mosby, 1976.

Frolkis, V. Aging of the Autonomic Nervous System. in J. Birren and K. Schaie, Handbook of the Psychology of Aging, Toronto: Van Nostrand Reinhold Company, 1977, 177-189.

Greenfield, S., Solomon, N., Brook, R. and Davies-Avery, A. Development of outcome criteria and standards to assess the quality of care for patients with osteoarthrosis. J. of Chronic Disease, 1978, 31, 375-388.

Goldring, W., Chasis, H., Schreiner, G. & Smith, H. Reassurance in the management of benign hypertensive disease. Circulation, 1956, 4, 260-264.

Harris, A. Human Measurement, London: Heinemann Educational Books Ltd., 1978.

Hart, F. The control of pain in the rheumatic disorders., in F. Hart (Ed.), The Treatment of Chronic Pain, England: Medical and Technical Publishing Co. Ltd., 1974.

Hart, F. and Huskisson, E. Pain patterns in the rheumatic disorders. British Medical Journal , 1972, 4, 213-216.

Hollander, J. (Ed.) The Arthritis Handbook. West Point, P.A.: Merck, Sharp, and Dohme, 1974.

Huskisson, E. Osteoarthritis: Changing concepts in pathogenesis and treatment. Postgraduate Medicine, 1979, 65, 97-104.

Israel, A. and O'Leary, K. Developing correspondence between children's words and deeds. Child Development , 1973, 44, 575-581.

Karlan, G. and Rusch, F. Correspondence between saying and doing: Some thoughts on defining correspondence and future directions. Journal of Applied Behavior Analysis , 1982, 15, 151-162.

Keefe, F. Behavioral assessment and treatment of chronic pain : Current Status and Future Directions. Journal of Consulting and Clinical Psychology, 1982, 50, 896-911.

Kirkendall, W., Burton, A., Epstein, F. & Freis, E. Recommendations for human blood pressure determination by sphygmomanometers. Circulation, 1967, 36, 980-988.

Linton, S. A critical review of behavioural treatments for chronic benign pain other than headache. British Journal of Clinical Psychology, 1982, 21, 321-337.

Lovaas, O. Interaction between verbal and nonverbal behavior. Child Development, 1961, 32, 329-336.

MacDonald, M. and Butler, A. Reversal of helplessness; Producing Walking Behavior in Nursing Home Wheelchair Residents Using Behavior Modification Procedures. Journal of Gerontology, 1974, 29, 97-101.

Meichenbaum, D. and Goodman, J. The developmental control of operant motor responding by verbal operants. Journal of Experimental Child Psychology, 1969, 7, 553-565

Melzack, R. The McGill Pain Questionnaire: Major properties and scoring methods. Pain, 1975, 1, 277-299.

O'Dell, A. Pain associated with arthritis and other rheumatic disorders. in A. Jacox (Ed.), Pain: A sourcebook for Nurses and Other Health Professionals, Boston: Little, Brown and Co., 1977, 349-372.

Ostfield, A., & Lebovits, B. Blood pressure lability: A correlative study. Journal of Chronic Diseases, 1960, 12, 428-439.

Risley, T. and Hart, B. Developing correspondence between the non-verbal and verbal behavior of preschool children. Journal of Applied Behavior Analysis, 1968, 1, 267-281.

Roberts, A. The behavioral treatment of pain. in J. Ferguson and C. Taylor (Eds.), The Comprehensive Handbook of Behavioral Medicine, New York: Spectrum Publications, 1981.

Rodnan, G. (Ed.) Primer on the rheumatic diseases. Journal of the American Medical Association, 1973, 224, 78-82.

Rogers-Warren, A. and Baer, D. Correspondence between saying and doing: Teaching children to share and praise. Journal of Applied Behavior Analysis, 1976, 9, 335-343.

Rudd, E. Psychosocial and clinical factors in managing patients with arthritis. Behavioral Medicine, 1978, 4, 9-13.

Sherman, J. Modification of Nonverbal Behavior through reinforcement of Related verbal behavior. Child Development, 1964, 35, 717-723.

Skinner, B.F. Science and Human Behavior. New York: Macmillan, 1953.

Smith, L.L. Helping to manage the emotional affects of arthritis. Health and Social Work, 1979, 4, 135-150.

Sternbach, R. Pain: A Psycholphysiological Analysis. New York: Academic Press, 1968.

Tracey, D., Briddell, D., and Wilson, T. Generalization of verbal conditioning to verbal and nonverbal behavior: Group therapy with chronic psychiatric patients. Journal of Applied Behavior Analysis, 1974, 7, 391-402.

Ward, M. and Blatman, M. Drug therapy in the elderly. American Family Physician, 1979, 19, 143-145.

Varni, J., Bessman, C., Russo, D. and Cataldo, M. Behavioral management of chronic pain in children: A case study. Archives of Physical Medicine and Rehabilitation, 1980, 61, 375-378.

Appendix A: Literature Review

Operant Pain Management

Chronic pain is a medical problem with pervasive social implications. Often a chronic pain patient ceases to be a contributing member of society, requiring instead, constant attention from health care services. The enormous costs in time and money, as well as the frequent failure of standard medical treatment, precipitated the development of alternative approaches to chronic pain management. Rather than supplant traditional therapeutic regimens, however, the alternative interventions are designed to enhance medical treatment outcomes by incorporating psychological methods. Hence, existing multimodal treatment programs often combine the traditional therapies (e.g. physical, occupational, pharmacological) with psychological interventions (e.g. hypnosis, operant conditioning, biofeedback). Behavioral treatment of chronic pain based largely on behavior modification techniques, is now supported by a considerable literature, already reviewed by Sanders (1976); Turner and Chapman (1980); Keefe (1982), and Linton (1982). The purpose of the present review is to examine current evidence supporting the operant approach to chronic pain management. Of major interest is the delineation of the environmental contingencies already identified as controlling chronic pain behavior.

The possibility of a systematic relationship between chronic pain behavior and environmental events was first proposed by Fordyce, Fowler, Lehman, and Delateur (1968). Based on Skinner's (1953) functional analysis of behavior, Fordyce suggested the application of operant methodology to the treatment of chronic low back pain (Fordyce, Fowler, Lehman, DeLateur, Sand and Trieschman, 1973). While acknowledging that responses to pain are usually elicited by an antecedent noxious stimulus, Fordyce (1974a) proposed that such responses may also be subject to the same contingencies of reinforcement as any operant behavior. Thus, certain pain behaviors, when followed by positive consequences, have a higher probability of recurring, independent of the presence of a noxious stimulus. Therefore, Fordyce (1974b) concluded that the successful treatment of chronic pain must include an examination of possible contingencies maintaining or contributing to the exhibited pain behavior.

Fordyce's (1976) operant approach to chronic pain management and similar programs reported by Roberts (1981); Swanson, Maruta, and Swenson (1979); Greenhoot and Sternbach (1974) have three primary objectives. The first objective is to decrease the noxious stimulus, usually by continuing standard medical treatment. The second objective is to decrease pain behavior by withdrawing contingent positive reinforcement. The third objective is to increase "well behavior" which is identified as responses incompatible with pain behavior. The increase in well behavior is brought about by differential positive reinforcement of the specified target response (e.g. spending time out of bed). In general, results of the operant programs appear promising. Linton (1982) concludes that the operant method of treating chronic pain leads to increased activity, decreased pain and decreased drug intake. That operant programs consistently increase activity and decrease drug use is also supported by Turner and Chapman (1980).

Unfortunately, considerable gaps remain in the supporting research and in the analysis of the contingencies pertinent to pain behavior. As noted by Turner and Chapman (1980), patients participating in operant programs are carefully selected on the basis of predetermined criteria. In addition, up to 40% may drop out of the program before completion (Roberts, 1981). Outcome and follow-up studies consist primarily of either a group design with pre and post-treatment measures or a single case study; single subject experimental designs have rarely been employed. Finally, since the operant pain programs have three concurrent objectives, multiple treatment modalities are incorporated with little emphasis on determining which components are responsible for treatment outcomes. In light of these deficiencies, it seems pertinent to re-examine the underlying operant principles upon which the intervention programs were originally based. In addition, recent research in operant pain management requires further explanation in terms of its contribution to elucidating operant principles.

A. Increasing Activity

A major objective of operant pain management is to increase activity, under the assumption that a decrease in pain behavior will result. Fordyce and Steger (1979) claim that activity is incompatible with pain behavior. Although no empirical test of this hypothesis has been done, a negative relationship between activity and patient pain ratings was demonstrated by Fordyce, Brena, Holcomb, DeLateur and Loeser (1978). In their study, increases in walking correlated with decreases in complaints of pain. In a later study, Fordyce, McMahon, Rainwater, Jackins, Questad, Murphy and DeLateur (1981) found a negative correlation between exercise performance and observed pain behavior. Thus, there is some indication that increasing activity is related to chronic pain behavior.

Activity has been operationalized in a number of ways for purposes of investigation. For example, activity may refer to a general level of function or specific task performance. Cairns, Thomas, Mooney and Pace, (1976) measured activity by recording hours of "uptime". Recently, Sanders (1983) developed a portable instrument for recording locomotor activity over an extended period. Activity has also been measured by exercise tolerance, including number of repetitions or time spent exercising (Fordyce, 1976; Roberts and Reinhardt, 1980). Other specific measures of activity in operant treatment are strength and joint range of motion (Malec, Cayner, Harvey and Timming 1981). Activity has also been defined by physical capabilities such as the ability to perform activities of daily living (Chapman, Brena, and Bradford, 1981), as well as, participation in social or therapeutic activities (Cairns, Thomas, Mooney and Pace, 1976) or work assignments (Greenhoot and Sternbach, 1974). As expected, all these different activities have been demonstrated to increase when reinforcement is made contingent on their occurrence. Thus, operant pain programs have adequately demonstrated the law of effect with respect to activity levels.

Besides the operational definition of the target behavior, the programmed consequences also vary across programs. The most commonly used consequence contingent on increased activity is some form of social reinforcement, usually described as attention and praise (Morgan, Kremer, Gaylor, 1979; Anderson, Cole, Gullickson, Hudgens and Roberts, 1979). Too often the form of social reinforcement is not specified clearly, however, and the reinforcer is simply described as encouragement or support. Another reinforcer often used is performance feedback in the form of graphs (Roberts and Reinhardt, 1980). Cairns and Pasino (1977) compared the effectiveness of verbal reinforcement and feedback in graph form. Three groups were employed in the design including a control group. One group received verbal reinforcement (i.e. praise and engaging in conversation) contingent on increased walking and bicycle riding. A second group was reinforced for the same activities by a graph alone. After 8 sessions, the second group received verbal reinforcement and the graph. The results indicated a significant increase in the two activities with verbal reinforcement and graph + verbal reinforcement than either the control group or the graph alone. Interestingly, walking and bicycle riding increased with the contingent verbal reinforcement as did "uptime", which was not directly reinforced. Thus verbal reinforcement appears to be an effective manipulation.

Other consequences have been used as reinforcers for increased activity. In the Cairns, Thomas, Mooney and Pace study, (1976), in-patients were required to obtain signatures from the physical and occupational therapy departments which indicated daily attendance. Providing patients met weekly attendance requirements, a weekend pass was issued. A program described by Chapman, Brena, and Bradford (1981), employed a unique reinforcer. Combined increases in activity and decreases in drug intake were reinforced by administration of a nerve block. A nerve block consists of an analgesic injected into or near a nerve at the site of noxious stimulation (Bonica, 1974). Thus pain medication was contingent on "well behavior" as opposed to the usual contingency of "pain behavior".

Originally, Fordyce (1976) recommended that exercise performance be followed by rest, (i.e. performance contingent rest) rather than exercising until pain occurs, (i.e. pain contingent rest). In the latter, patients are instructed to continue exercising until pain or fatigue causes them to stop. Problems arose, however, with the discovery that not all patients find rest reinforcing. Fordyce (1974b) suggested that perhaps this group could be reinforced by making participation in other activities contingent on exercise performance. However, no systematic study of the effectiveness of rest contingent on increased activity has been done.

In summary, many relatively untested contingencies are included as part of the operant pain program. Nevertheless, most studies report a significant increase in a variety of activities using various reinforcers.

B. Decreasing Drug Intake

Another target for operant intervention in pain management is decreasing medication use. One procedure for decreasing this behavior is placing medication on a time contingent as opposed to a pain contingent schedule of delivery (Fordyce, 1976). In other words, medication is administered in the same amounts but on an hourly or fixed time basis. This eliminates requests for medication and, in effect, makes medication response independent. The time between administrations is then gradually increased (e.g. from every 2 hours to every 4 hours etc.) until a minimum dosage or complete withdrawal is reached (Seres and Newman, 1976).

Another procedure employed to decrease medication use is fading (Fordyce, 1976). Initially, all medication is combined in a pain cocktail which includes a fruit flavored syrup to mask the taste. Over the course of treatment, the amount of analgesic in the cocktail is gradually decreased. When all medication is eliminated the remaining syrup is gradually withdrawn. In other words, the medication is assumed to be a discriminative stimulus for relief from pain. Therefore, a gradual removal of this stimulus by fading should not disrupt the pain relieving effect. Success with this procedure has been reported by Malec et al. (1981). Similarly, Cairns, Thomas, Mooney and Pace (1976) use time contingent medication but if pain behavior persists, fading is introduced. The usual procedure is a combination of fading and time contingent delivery (Roberts and Reinhardt, 1980).

C. Decreasing Overt Expressions of Pain

Another frequent target of operant intervention is overt expressions of pain. This includes visible or audible nonverbal signals as well as verbal reports of pain. Since the appearance of specific pain behavior is usually idiosyncratic, different behaviors are targeted for each patient. Typically, these behaviors are decreased by removing social reinforcement; thus, staff are instructed to ignore pain verbalizations (Greenhoot and Sternbach, 1974). Removing social reinforcement is also described as following pain behavior with a neutral response (Swanson, Maruta, and Swenson, 1978). Unfortunately, no data exist as to the effectiveness of this strategy nor is it clear what constitutes a neutral response. Since reinforcement is not controlled, the likely effect is that the relative rate of reinforcement for well behavior (activity) is greater than that for pain behavior. In other words, more reinforcement is available for well behavior than for pain behavior. Thus, outcome measures may show a decrease in the occurrence of verbal and nonverbal pain expressions, however, patients reports of pain do not always show such a decline (Newman, Seres, Yospe and Garlington, 1978). Several explanations have been given for this discrepancy. Fordyce (1976) suggested a lag between observed patient behavior and the patient's self report. Others simply dismiss the discrepancy as another indication that self-report does not correspond with actual behavior (Kremer, Block and Gaylor, 1981). In fact, few operant studies use a self report measure stating that such indices encourage the patient to focus on the pain problem (Roberts, 1981). When pain ratings have been used, they tend to decrease only moderately (Linton, 1982). It is also difficult to assess the reported decrease in pain ratings since each study tends to use a different scale of intensity (range 3-100 discrimination points).

D. Generalization

Generalization in the operant pain programs is measured in terms of medical services utilization. A decrease in use suggests that the decrease in pain behavior has generalized to environments outside the hospital setting and is being maintained. Decreased utilization has been reported in follow-up studies by Ignelzi, Sternbach and Timmerman, (1977); Newman, Seres, Yospe and Garlington, (1978); and Malec, Cayner, Harvey and Timminy, (1981). Planned generalization strategies include teaching the spouse to recognize and withdraw reinforcement for pain behavior (Roberts and Reinhardt, 1980; Seres and Newman, 1976). Although no systematic studies have been done addressing the maintainence of desirable responses, Fordyce and Steger (1979) suggest that an uninvolved spouse is a limiting factor in operant program effectiveness. Other limiting factors proposed are compensation, refusal to decrease medication and failure of social reinforcement to be effective. Thus, the presence of these factors may also prevent generalization and maintenance outside the hospital environment.

E. Analysis of Pain Behavior

Now that the operant pain programs have been demonstrated to be relatively effective compared with other forms of adjunct therapy, current research trends have focussed more on analysing the contingencies responsible for the effects. Thus the trend is toward investigation of single variables and as yet unexplored contingency relationships. For example, Klein and Charlton (1980) recently attempted to analyze pain behavior of acute burn patients during treatment procedures. They observed verbal interactions between patients and staff recording occurrences of complaints and positive statements in 5 minute intervals. Results indicated, first, that such observations can be useful in assessing pain behavior and, secondly, that positive statements occurred more frequently than pain complaints, even when patients were undergoing painful treatment procedures.

Only recently has a similar observational procedure been used to analyse nonverbal pain behavior (Keefe and Block, 1982). Five categories of behavior were observed: grimacing, bracing, guarded movement, sighing and rubbing. Patients were attending a program for chronic low back pain. Results of the study indicated that the frequency of such behaviors was directly related to subjective pain ratings and decreased with the introduction of treatment. Therefore, the authors concluded that observational recording of nonverbal pain behavior may be useful in evaluating treatment effectiveness.

Sanders (1979) suggested that more attention be focussed on antecedent stimuli in pain behavior; however, only one study has thus far tried to examine possible discriminative stimuli. Block, Kremer and Gaylor (1980a) investigated reports of pain in chronic low back patients. In one condition, patients were told their spouse was observing through a one-way mirror. In the other condition, the same patients were told that a neutral observer (ward clerk) was watching. Results indicated that when the patient thought a solicitous spouse was watching, reports of pain were greater than when they thought a neutral person was watching. Thus, it appears that the presence of a solicitous person may become a discriminative stimulus for increased pain behavior.

The effects of schedules of reinforcement have not been investigated in relation to chronic pain management. Although Fordyce (1976) recommends a continual reinforcement schedule to begin with, tapering off to some form of variable rate, he acknowledges the difficulty of controlling schedules of reinforcement in an applied setting. The possible effect of schedules of reinforcement and their application to chronic pain management have been discussed by Block, Kremer and Gaylor, (1980b). For example, in their study of variables affecting treatment outcome, the authors compared two groups of patients receiving treatment. One group was receiving remuneration for being ill (i.e. workman's compensation, insurance benefits) and the second group was not. The compensation group reported more pain and showed less improvement over the treatment period than the non-compensation group. Furthermore, compliance with treatment protocols was considerably lower for the compensation group (64% compared with 84%). Similar results are reported by Hammonds, Brena and Unikel (1978). Interestingly, Block et al. (1980b) discuss their results in terms of differential reinforcement of low rate responding (DRL). That is, patients on workman's compensation attend therapy and comply with treatment programs at the lowest possible rate to maintain payment, but not sufficiently high to benefit from the program. In conclusion, while little research regarding schedule effects has been done, there is indication that this may be a useful area for further investigation in operant pain management.

Fordyce (1976) also speculated that avoidance conditioning is a process in operant pain behavior acquisition. Two kinds of avoidance behavior have been suggested. In the first, emitting pain behavior may result in negative reinforcement, in that patients may effectively avoid aversive consequences such as going to a job one hates. Although frequently discussed as "secondary gain", no systematic study of this process has been undertaken. However, the second reason avoidance behavior may develop is that, initially, the patient was avoiding the original noxious stimulus. For example, limping avoids the painful consequences of full weight-bearing on a sprained ankle. Therefore, limping may continue after the injury has healed because the behavior was so successful in avoiding the aversive consequence. Fordyce, Shelton and Dundore (1982) describe a single case study of pain behavior which they describe as acquired by avoidance conditioning. In their study, walking is re-established in the patient's repertoire by shaping and reinforcing the speed of performance.

Another unexplored area of pain behavior is the effect of verbal and nonverbal operant interactions. Since pain behavior is comprised of both verbal and nonverbal components, interaction effects seem likely. In addition, both verbal and nonverbal pain behaviors communicate information to medical personnel which is used to augment diagnostic tests (Fordyce, McMahon, Rainwater, [illegible] Questad, Murphy and DeLateur, [illegible]). Thus, the verbal and/or nonverbal behavior may contribute to the diagnostic classification. However, possible interactions of these two response classes have not been explored in relation to pain behavior. Although Fordyce et al. (1981) speculate that patients may vary what they do according to how they feel, a further extension suggests that patients may vary what they do according to how they say they feel. Furthermore, patients may vary what they say according to what they do. Thus, there may be "say-do" as well as "do-say" interactions in operant pain behavior.

The say-do and do-say paradigm has been investigated in other behaviors. Originally, it was assumed that some connection existed between verbal and nonverbal operant classes (Lovaas, 1981). The majority of studies, however, focus on training correspondence between saying and doing as well as doing and saying, especially in children (Karlan and

Rusch, 1982; Israel, 1978). For adults, it is assumed that correspondence is already established (Tracey, Briddel and Wilson, 1974). Thus operant interaction in adult behavior has not received much attention.

There is some evidence that operant interactions may effect pain perception in adults. Bandler, Madaras and Bem (1968) conducted a study using an experimental pain procedure. Subjects were assigned to a condition whereby they could either endure or escape electrical shocks. Escape required pressing a lever. Although all shocks were of the same intensity, subjects rated the escaped shocks as being greater than those endured. Thus, the authors demonstrated that overt nonverbal behavior influenced judgements about pain intensity. These results support Bem's self-perception theory (1972). Based on Skinner's (1953) analysis, Bem proposed that people may make inferences about private events, including pain, by observing their own behavior. Although the above experiment demonstrated the effect of nonverbal behavior on pain perception, Bem's theory also suggests that any overt behavior, verbal or nonverbal, may influence pain perception. Hence, overt behavior provides cues used in the description of internal events. In other words, pain intensity may be partially inferred from observing one's own behavior.

Assuming interaction effects occur in pain behavior, the question arises as to the possible forms of the interaction. Lovaas (1961) suggests that the relationship between verbal and nonverbal response classes may be described in several ways. For example, the relationship may be due to the discriminative cue properties of one class for related behavior in another response class. Thus talking about pain may be a discriminative stimulus for subsequent nonverbal pain behavior. Another possible relationship is that both categories of responses may have similar, if not the same, consequences. For example, a grimace or verbal description of pain may elicit sympathy from an observer. A third possible relationship is that verbal behavior may have a directing influence on nonverbal behavior. Thus, a statement that one has a headache may prompt appropriate headache behavior.

Recently, Catania, Mathews and Shimoff (1982) further elaborated on possible verbal/nonverbal operant interaction in human operant responding on a button pressing task. Their results showed that shaped verbal responses controlled nonverbal responding. However, control of nonverbal responses by instructed verbal responding was inconsistent. This implies that instructing patients not to talk about their pain may be less effective in producing a change in pain behavior than changing the contingencies for verbal pain behavior.

Although not addressed as an operant interaction, Fordyce et al. (1981) report a negative correlation between the verbal operant of complaining about pain and the nonverbal operant of exercise. In their experiment, chronic pain patients were observed during a physical therapy exercise session. Patients were instructed to exercise until pain, fatigue or weakness caused them to stop. Complaints of pain were observed and recorded by the attending physical therapist. Results indicated that the more exercise performed, the fewer the pain complaints. This suggests that the nonverbal behavior of exercise may, in some manner, be controlling verbal pain behavior.

As noted previously, most operant pain programs have multiple components. Verbal pain behavior is decreased and activity is increased as two separate operations. The possibility that one response may be controlling the other has not been adequately investigated. The implications of such effects are interesting to consider. First, it may be possible to change one class of behavior by changing the other. Thus, decreasing verbal pain behavior may produce a change in nonverbal pain behavior. In this manner, certain components of the operant treatment regimen may, in fact, be superfluous. Another implication is that decreases in nonverbal pain behavior that precede decreases in patients' report of pain (Fordyce, 1976), may actually represent a temporary lack of correspondence between doing and saying. The lack of correspondence suggests that it may take longer for nonverbal cues to produce changes in verbal behavior than vice versa.

In conclusion, studies reported over the past 15 years appear to support the principles of operant conditioning in their application to pain behavior. Hopefully, future endeavors will remain tied to operant methodology and will continue to analyze the contingencies of which pain behavior is a function. Operant pain management programs have successfully utilized a number of methods in changing target behaviors. Increasing activity, decreasing drug intake and decreasing overt pain behavior have all been effectively manipulated. Research in operant pain behavior is now persuing a more analytic approach in an attempt to identify discriminative stimuli and explore the effectiveness of particular reinforcers. One area of potential importance, as yet largely unexplored, is the interaction of verbal and nonverbal operants in pain behavior.

References

Anderson, T., Cole, T., Gullickson, G., Hudgens, A., Roberts, A., Behavior modification of chronic pain. Clinical Orthopedics, 1977, 129, 96-100.

Bandler, R., Madaras, G. and Bem, D. Self-observation as a source of pain perception. Journal of Personality and Social Psychology, 1968, 9, 205-209.

Bem, D. Self-perception theory. In L. Berkowitz (Ed.) Advances in Experimental Social Psychology. London: Academic Press, 1972.

Block, A., Kremer, E. and Gaylor, M., Behavioral Treatment of Chronic Pain: The spouse as a discriminative cue for pain behavior. Pain, 1980a, 9, 242-243.

Block, A., Kremer, E. & Gaylor, M., Behavioral treatment of chronic pain: Variables affecting treatment efficacy. Pain, 1980b, 8, 367-375.

Bonica, J., Current role of nerve blocks in diagnosis and therapy of pain. in J. Bonica (Ed.), Advances in Neurology. N.Y.: Raven Press, 1974.

Cairns, D., Thomas, L., Mooney, V. & Pace, J., A comprehensive treatment approach to chronic low back pain. Pain, 1976, 2, 301-308.

Cairns, D. and Pasino, J., Comparison of verbal reinforcement and feedback in the operant treatment of disability due to chronic low back pain. Behavior Therapy, 1977, 8, 621-630.

Catania, C., Mathews, B., Shimoff, E. Instructed versus shaped human verbal behavior: Interactions with nonverbal responding. Journal of the Experimental Analyses of Behavior, 1982, 38, 233-248.

Chapman, S., Brena, S., & Bradford, A., Treatment outcome in a chronic pain rehabilitation program. Pain, 1981, 11, 255-268.

Fordyce, W., Fowler, R., Lehmann, J. & De Lateur, B. Some implications of learning in problems of chronic pain. Journal of Chronic Diseases, 1968, 21, 179-190.

Fordyce, W. E., Fowler, R. S., Lehmann, J. F., De Lateur, B. J., Sand, P. L. and Trieschmann, R. B. Operant conditioning in the treatment of chronic pain. Archives of Physical Medicine and Rehabilitation, 1973, 54, 399-408.

Fordyce, W., Behavioral Methods for chronic pain and illness. St. Louis: C. V. Mosby, 1976.

Fordyce, W. Pain viewed as learned behavior. in Advances in Neurology, Vol. 4, J. Bonica (Ed.). New York: Raven Press 1974a, 415-423.

Fordyce, W., Treating Chronic Pain by Contingency Management in Advances in Neurology, Vol. 4, J. Bonica (Ed.). New York: Raven Press 1974b, 583-593.

Fordyce, W. and Steger, J., Chronic pain. in Pomerleau, O. and Brady, J. (Eds.) Behavioral Medicine: Theory & Practice, Baltimore: Williams & Wilkins Co. 1979, 125-154.

Fordyce, W., Brena, S., Holcomb, R., De Lateur, B., Loeser, J., Relationship of patient semantic pain descriptions to physician diagnostic judgments, activity level measures and MMPI. Pain, 1978, 5, 293-303.

Fordyce, W., McMahon, R., Rainwater, G., Jackbins, S., Questad, K., Murphy, T., & De Lateur, B., Pain complaint - exercise performance relationship in chronic pain. Pain, 1981, 10, 311-321.

Fordyce, W., Shelton, J. and Dundore, D. The modification of avoidance learning pain behaviors. Journal of Behavioral Medicine, 1982, 5, 405-414.

Greenhoot, J. & Sternbach, R., Conjoint treatment of chronic pain. in J. Bonica (Ed.), Vol. 4. Advances in Neurology, New York: Raven Press, 1974, 595-603.

Hammonds, W., Brena, S., & Unikel, I., Compensation for work-related injuries and rehabilitation of patients with chronic pain. Southern Medical Journal, 1978, 71, 664-666.

Israel, A. C. Some thoughts on correspondence between saying and doing. Journal of Applied Behavior Analysis, 1978, 11, 271-276.

Ignelzi, R., Sternbach, R., and Timmermans, G. The pain ward follow-up analyses. Pain, 1977, 3, 277-280.

Karlan, G. and Rusch, F. Correspondence between saying and doing: Some thoughts on defining correspondence and future directions. Journal of Applied Behavior Analysis, 1982, 15, 151-162.

Keefe, F. Behavioral assessment and treatment of chronic pain: Current status and future directions. Journal of Consulting and Clinical Psychology, 1982, 50, 896-911.

Keefe, F. and Block, A. Development of an observation method for assessing pain behavior in chronic low back pain patients. Behavior Therapy, 1982, 13, 363-375.

Klein, R. and Charlton, J., Behavioral observation and analysis of pain behavior in critically burned patients. Pain, 1980, 9, 27-40.

Kremer, E., Block, A. & Gaylor, M., Behavioral approaches to treatment of chronic pain: The inaccuracy of patient self-report Measures. Archives of Physical Medicine & Rehabilitation, 1981, 62, 188-191.

Linton, S. A critical review of behavioural treatments for chronic benign pain other than headache. British Journal of Clinical Psychology, 1982, 21, 321-337.

Lovaas, O. Interaction between verbal and nonverbal behavior. Child Development, 1961, 32, 329-336.

Malec, J., Cayner, J., Harvey, R. & Timming, R. Pain management: Long-term follow up of an in-patient program. Archives of Physical Medicine & Rehab., 1981, 62, 369-372.

Morgan, C., Kremer, R. and Gaylor, M., The behavioral medicine unit: A new facility. Comprehensive Psychiatry, 1979, 20, 79-89.

Newman, R., Seres, J., Yospe, L. & Garlington, B., Multidisciplinary treatment of chronic pain: Long-term follow-up of low back pain patients. Pain, 1978, 4, 283-292.

Roberts, A. The behavioral treatment of pain. in Ferguson, J. & Taylor, C. (Eds.). The Comprehensive Handbook of Behavioral Medicine, Vol. 2. New York: Spectrum Publications 1981.

Roberts, A. & Reinhardt, L. The behavioral management of chronic pain: Long-term follow-up with comparison groups. Pain, 1980, 8, 151-162.

Sanders, S. Behavioral assessment & treatment of clinical pain: Appraisal of current status. In Progress in Behavior Modif., Hersen, M., Eisler, R. & Miller, P., Vol. 8, 1979. N.Y.: Academic Press, Inc., 249-284.

Sanders, S. Automated versus self-monitoring of "up-time" in chronic low-back pain patients: a comparative study. Pain, 1983, 15, 399-405.

Seres, J. and Newman, R. Results of treatment of chronic low-back pain at the Portland Pain Center. Journal of Neurosurgery, 1976, 45, 32-36.

Skinner, B. F. Science and Human Behavior. New York, Macmillan, 1953.

Swanson, D., Maruta, T. & Swenson, W. Results of behavior modification in the treatment of chronic pain. Psychosomatic Medicine, 1979, 41, 55-61.

Tracey, D., Briddell, D. and Wilson, T. Generalization of verbal conditioning to verbal and nonverbal behavior: Group therapy with chronic psychiatric patients. Journal *of Applied Behavior Analysis*, 1974, *7*, 391-402.

Turner, J. and Chapman, C. Psychological interventions for chronic pain: A critical review. II. Operant conditioning, hypnosis, and cognitive-behavioral therapy. *Pain*, 1982, *12*, 23-46.

Appendix B

Materials

PHYSICAL SENSATIONS QUESTIONNAIRE FORM A

INSTRUCTIONS:

BELOW ARE A NUMBER OR WORDS WHICH REFER TO POSSIBLE PHYSICAL SENSATIONS. BESIDE EACH WORD IS A SERIES OF NUMBERS FROM 0 TO 3. IF THE WORD DESCRIBES A SENSATION THAT YOU ARE EXPERIENCING RIGHT NOW CIRCLE THE CORRESPONDING NUMBER. FOR EXAMPLE, IF YOU DO NOT FEEL THAT PARTICULAR SENSATION RIGHT NOW CHOOSE THE NUMBER 0. IF YOU FEEL IT A LITTLE CHOOSE THE NUMBER 1. IF YOU FEEL IT QUITE A BIT CHOOSE THE NUMBER 2. IF YOU FEEL IT AN EXTREME AMOUNT, CHOOSE THE NUMBER 3.

RIGHT NOW ARE YOU FEELING: __________?

	NOT AT ALL	A LITTLE	QUITE A BIT	EXTREMELY
1. TIRED	0	1	2	3
2. RELAXED	0	1	2	3
3. HAPPY	0	1	2	3
4. PAIN	0	1	2	3
5. CALM	0	1	2	3
6. SAD	0	1	2	3
7. WEAK	0	1	2	3
8. STIFF	0	1	2	3
9. NERVOUS	0	1	2	3
10. HUNGRY	0	1	2	3

Procedure for Motor Tasks

1. Grip Strength (Agnew and Maas, 1982)

Procedure: a) Subject is seated in a chair

b) Inflate cuff of sphygmomanometer to 20 millimeters of mercury

c) Place cuff in subjects' hand with the dial facing the experimenter

d) Test the non-dominant hand first, then the dominant hand

e) Repeat procedure three times and record the mean reading (minus 20)

Instructions:

1. Please hold this device in your left hand to measure your grip.
2. Grip as hard as you can.
3. Now grip the device with you other hand and grip as hard as you can.
4. Now repeat it with the opposite hand.

2. Card Turning (Agnew and Maas, 1982)

Procedure: a) Subject is seated at a table

b) A row of 5 cards (5 x 12cm) is placed on the table

c) Demonstrate the method of picking up and holding the card. e.g.,

i. using the second, third and fourth fingers opposed to the thumb.

2. turn card from a pronated to a supinated position.

d) The time the subject takes to turn over all cards for each hand is measured, non-dominant hand first

Instructions:

1. Using your left hand, when I say "go" turn the cards over as quickly as you can, starting with the card on the far right. Don't worry about placing them neatly. Ready? Go.
2. Now use your right hand.

3. Walking 50 feet

Procedure: a) Measure and mark 50 feet contained within a longer distance where subject can walk uninterrupted.

b) Have subject stand at starting point

c) The time the subject takes to walk the marked distance is recorded..

Instructions:

1. When I tell you to begin, walk to the end of the hall. Ready? Begin.