Journal of Behavioral Medicine, Vol. 17, No. 4, 1994

Demand Characteristics Underlying Differential Ratings of Sensory Versus Affective Components of Pain

Ephrem Fernandez[1,3] and Dennis C. Turk[2]

Accepted for publication: November 27, 1993

In several investigations, differential ratings of sensory and affective components of pain can be explained by the expectations conveyed to subjects to provide different ratings for each pain component under conditions where they could readily recall their ratings. In Experiment I, such demand characteristics were controlled in one group by having subjects rate each pain component in a separate session 1 week apart, so as to minimize recall. This group failed to differentiate between sensory and affective pain; however, another group with demand characteristics left uncontrolled, provided disparate and parallel functions for the two pain components. These results imply that recall during concurrent ratings of the two pain components contributes to a spurious separation of ratings for each component. In the second study, with demand characteristics controlled, a medication placebo led to ratings of affective pain that were significantly lower than those for sensory pain, and a divergence between the functions for each component. This offers an approach to the veridical separation of sensory and affective components of pain.

KEY WORDS: demand characteristics; sensory pain; affective pain; placebo.

[1]Department of Psychology, Southern Methodist University, Dallas, Texas 75275.
[2]Pain Evaluation & Treatment Institute, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania.
[3]To whom correspondence should be addressed.

0160-7715/94/0800-0375$07.00/0

INTRODUCTION

In defining pain, the International Association for the Study of Pain (1986) stresses that "it is unquestionably a sensation in a part or parts of the body but it is also always unpleasant and therefore also an emotional experience" (S217). This distinction between sensation and affect has become an important feature of multidimensional models of pain (Loeser, 1980; Melzack and Casey, 1968). It has also become the subject of studies on the effects of drugs and psychological interventions on different components of pain (Gracely, 1992a, Price and Harkins, 1992, Rollman, 1992).

There have been several sources of ambiguity, however, in empirical efforts to separate sensory and affective components of pain, as recently reviewed by Fernandez and Turk (1992). One key problem is that the apparent separation of sensation and affect may have emerged under conditions where demand characteristics were operating. Demand characteristics refer to the totality of experimental cues which influence the subjects to respond in specific ways that validate the experimental hypothesis (Orne, 1962).

In the present context, the demand characteristics seem to be a by-product of the experimenter's instructions. A study by Johnson and Rice (1974) exemplifies the point. Subjects in this study underwent ischemic pain induced by the Submaximum Effort Tourniquet Technique or SETT (Smith *et al.*, 1966). They were advised as follows:

> While the tourniquet is on, you will be asked to record on scales your ratings about the sensations and distress you feel. Sensations means the physical intensity of what you will be feeling. The distress scale refers to the amount of distress the sensations cause. We want you to think of the degree of sensation you feel and how distressing that sensation is *as two separate things.* (p. 206; italics added)

Naturally, subjects would be inclined to provide separate ratings for sensory versus distress (affective) components of pain, when the experimental instructions themselves make a specific distinction between these two constructs; moreover, the instructions convey what Rosenthal (1967) calls a covert expectation — that subjects *should* differentiate between the two components in their responses even though differences may not be perceived. Thus, the discrepancies between distress scores and sensation scores as observed by Johnson and Rice (1974) could be a spurious result of the specific demand characteristics created by the investigators rather than a veridical separation perceived by the subjects. For the same reason, other inferences of sensory-affective separation in pain (Johnson, 1973, 1975) may be Type I errors produced by demand characteristics.

Given a set of expectations, subjects must also have the means at their disposal to execute the expectations — in order for demand charac-

teristics to be realized. If the expected response is clear and the subject is cognitively prepared to respond in the desired fashion but behaviorally unable to do so, then the demand characteristics may be less likely to confound the data in a systematic manner; instead, a high level of random error may be expected due to chance responding. In most of the studies in this area, however, it appears to have been feasible for subjects to comply with the expectations for a sensory-affective differentiation. This is illustrated in a series of studies (e.g., Harkins *et al.*, 1989; Price and Harkins, 1987; Price *et al.*, 1987) where the following standard set of instructions was delivered to subjects:

> There are two aspects of pain we are interested in measuring . . . . There are scales for measuring each of these two aspects of pain. Although some pain sensations may be equally intense and unpleasant, we would like you to judge these two aspects of your pain (or the temperatures you feel) independently. Please mark the line to indicate the relative intensity of your pain sensation; the further to the right, the greater the intensity. Mark the second dotted line to indicate the relative unpleasantness of the pain. (Price and Harkins, 1987, p. 3)

It is quite clear that there is an expectation of differential ratings between sensory pain and suffering [affect], but of critical importance is that subjects are *able to comply* with this expectation by relying on recall of the first rating if they are to ensure that the second rating is different. In the same way, several other studies using the concurrent ratings paradigm (e.g., Chen *et al.*, 1989; Duncan *et al.*, 1989) provide an avenue for compliance with demand characteristics.

The present study is an attempt to investigate experimentally the contribution of such demand characteristics to ratings of sensory and affective components of pain. As in the earlier-reviewed studies by Johnson and others, the pain induction procedure chosen was the Submaximum Effort Tourniquet technique or SETT (Smith *et al.*, 1966), since it has received empirical support as a reliable technique for producing ischemic pain sensations plus emotional arousal associated with the slow-building, long-lasting, and anxiety-arousing properties of this noxious stimulus (Fernandez, 1990; Postlethwaite *et al.*, 1980). The basic approach adopted here is to compare conditions in which subjects rate both pain components concurrently (thus reproducing the demand characteristics of previous studies) with conditions in which each component is rated in a separate session, with counterbalancing for order (thus minimizing demand characteristics). This also bears on the issue of whether or not the particular demand characteristics can be controlled. Furthermore, a second experiment is included to investigate the possibility of a veridical separation of the two pain components under an experimental intervention known to alter one component selectively, but with demand characteristics in check.

EXPERIMENT I

Method

Subjects

A sample of 20 subjects was obtained from a pool of male undergraduate student volunteers. Subjects were recruited with informed consent and assurance of confidentiality of results. They were screened to exclude anyone with diabetes, coagulopathies, heart disease, ongoing medication or psychiatric treatment, as customary in these experimental pain studies (Moore *et al.*, 1979).

Subjects were randomly assigned to one of two experimental groups. They were advised that they would be debriefed at the end of the study but that they were free to withdraw from the study at any stage without prejudice to themselves. Each subject was paid $20 at the end of their participation.

Apparatus

The equipment consisted of standard devices for the SETT (Smith *et al.*, 1966). These included a sphygmomanometer, an Ace bandage, and a hand dynamometer, all located within a subject booth furnished with a reclinable chair, a table, and a one-way observation screen.

Procedures

The first step in pain induction by the SETT was to assess the subject's maximal grip strength. This was ascertained by having the subject squeeze the dynamometer as much as possible with the nondominant arm, which was positioned horizontally on the table. Next while remaining seated, the subject was required to raise the nondominant arm to a vertical position. An Ace bandage was wrapped around the lower arm and the sphygmomanometer cuff was placed around the upper arm (5 cm above the elbow) and inflated to 200 mm Hg to occlude the flow of blood to the arm. The bandage was then removed and the subject's arm was lowered. After a 60-sec pause, the subject was required to squeeze the dynamometer at a fixed percentage (25%) of maximal grip strength, with the nondominant arm resting on the table. The exercise was repeated 20 times, each squeeze lasting 2 sec and separated by an interval of 2 sec. The result of

this set of procedures was ischemic pain, which usually began after cessation of the exercise and increased progressively.

The dependent measures were ratings of sensory and affective pain, respectively. Sensory pain was defined as "the physical intensity of the noxious stimulation," whereas affective pain was defined as "the distress or suffering associated with the noxious stimulation." No further suggestion or expectation of differences between the two components was conveyed.

Subjects rated each of these component responses on a 9-point Likert scale, where 0 indicated absence of the response (sensory or affective pain) being rated, 1 indicated a just-noticeable level of the response being rated, and 9 represented an intolerable level of the response. Subjects were asked to rate an increase in each response when it became evident or "just noticeable" to them. This approach was used in contrast to asking subjects to provide ratings at specific intervals set by the experimenter, thus curbing additional demand characteristics.

The experiment was terminated as soon as the subject reported a rating of nine, or whenever s/he wanted to quit, but no later than 30 min of cuff application. At that point, the experimenter deflated the cuff, gradually lowering the pressure to diastolic level and then releasing it altogether.

All subjects participated in two identical sessions at the same time 1 week apart. The two groups of subjects, however, differed in terms of the temporal contiguity between ratings of sensory and affective pain. One group rated both pain components *concurrently within each of the two sessions* (CON group) to create some of the demand characteristics of previous studies. The second group rated only one component within a session and the other component in the *alternate session* (ALT group) so as to control for demand characteristics; counterbalancing for order, half of the ALT group of 10 rated the sensory component in session 1 and the affective component in session 2; the other half rated the affective component in session 1 and the sensory component in session 2. At the end of the second session, each subject was debriefed, paid, and thanked for participation.

Results

Repeated-measures analyses of variance revealed no significant differences for the order in which each pain component was rated (week 1 or week 2), for either the CON group or the ALT group. The relative invariance of ratings between sessions held true for the cumulative times taken to reach all levels of the 9-point rating scale, including threshold and tolerance.

However, there were marked differences between groups in terms of the degree of disparity between sensory and affective ratings of pain. The CON group produced disparate and parallel functions for these components in session 1 (Fig. 1) as well as in session 2 (Fig. 2). Analyses of variance revealed that these component differences were significant at all levels of the 9-point rating scale in session 1. The mean cumulative time taken to reach a sensory rating of 1 was 0.58 (SD = 0.37), and the mean cumulative time taken to reach an affective rating of 1 was 1.6 (SD = 0.73), and this difference was significant [$F(1, 18) = 15.46$, $p < .001$]. At the upper extreme of the scale, the cumulative times for sensory pain ($M = 12.52$, SD = 1.35) remained significantly different from that for affective pain ($M = 14.89$, SD = 1.42) [$F(1, 18) = 14.59$, $p < .002$]. In session 2, differences between components were also significant/marginally significant at all levels of the rating scale (except for rating 4). For example, the mean cumulative time taken to reach a sensory rating of 1 was 0.72 (SD = 0.39), while that for an affective rating of 1 was 1.86 (SD = 0.65), and this difference was significant [$F(1, 18) = 22.32$, $p < .0002$]. This difference remained significant at the upper end of the scale, where the mean cumulative times for sensory versus affective pain were 12.72 (SD = 1.41) and 14.75 (SD = 1.68), respectively [$F(1, 18) = 8.55$, $p < .01$]. It is further notable that the discrepancy between sensory and affective ratings was virtually constant at all levels of the 9-point rating scale, so that the slope of the two (pain component) functions was virtually identical.

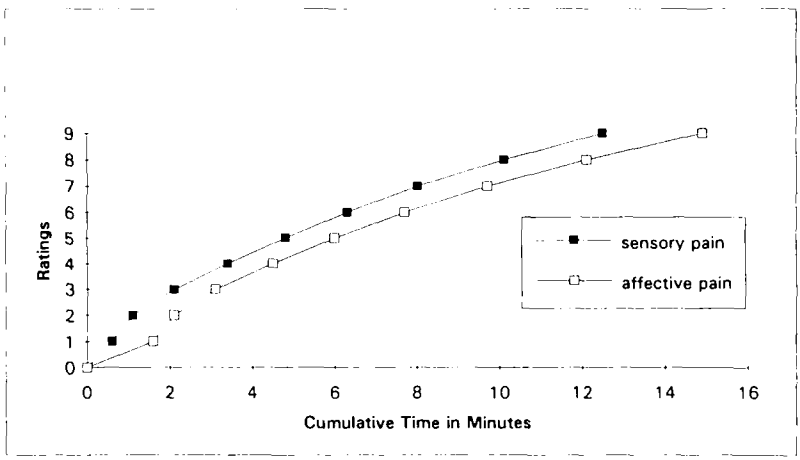

Fig. 1. Concurrent ratings of sensory and affective pain components in week 1.

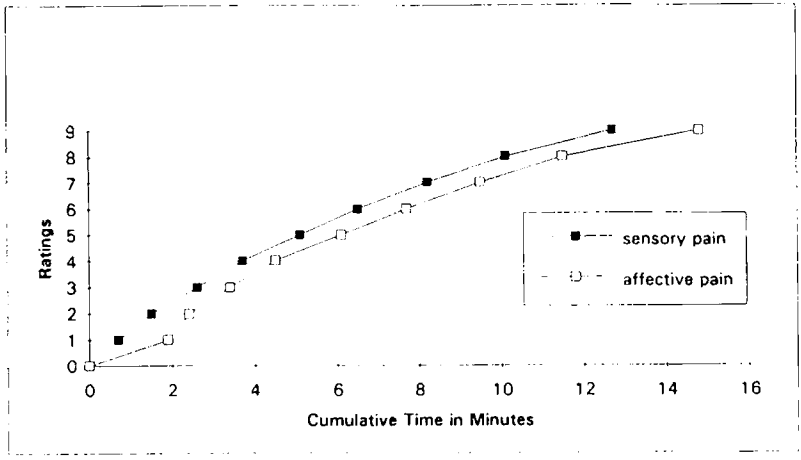

Fig. 2. Concurrent ratings of sensory and affective pain components in week 2.

For the ALT group, on the other hand, the disparity in ratings between components was minimal. Sensory pain ratings from session 1 almost converged with affective pain ratings obtained in an identical session a week later (Fig. 3). Similarly, affective pain ratings from session 1 overlapped considerably with sensory pain ratings obtained in an identical session a week later (Fig. 4). Repeated-measures analyses of variance confirmed the

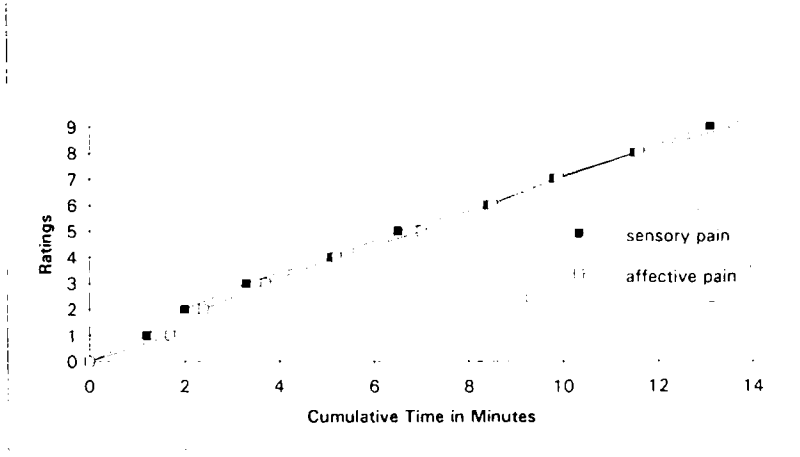

Fig. 3. Alternate ratings of sensory pain in week 1 and affective pain in week 2.

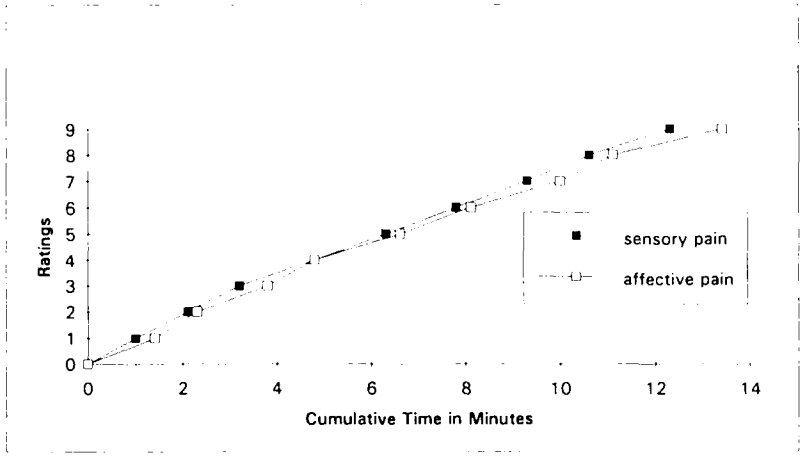

Fig. 4. Alternate ratings of affective pain in week 1 and sensory pain in week 2.

absence of any significant differences between pain components when each was rated in an alternate session so as to minimize the effects of recall; this held true for all levels of the 9-point rating scale and regardless of the sequence in which each component was rated (week 1 or week 2).

Discussion

The cumulative time taken to reach each level of the 9-point rating scale was virtually the same between sessions for each component of pain, across both groups of subjects. Inasmuch as the sessions were procedurally identical (right down to the time of day), subjects seem to have perceived little change in each pain component from one week to the next.

On the other hand, there were striking differences between the two groups, in line with the predicted differences between sensory versus affective pain. The CON group produced highly dissimilar ratings for sensory versus affective pain, whereas the ALT group produced virtually the same ratings for each component. Both groups had received the same definition of each component that inevitably carried with it a low-level expectation for the two to be distinguished in some way. However, because the CON group rated both components concurrently within each session, it was able to increase the likelihood of a difference between the two components by recalling one component rating before giving the other. In contrast, the ALT group could not rely on recall to any great degree, since they rated

each component a week apart; they had also not been told in advance about what they would be rating in the succeeding week. Thus, subjects tended to exaggerate differences between sensory and affective pain when they are able to comply with specific demand characteristics about differences between the two; but in the absence of those avenues for compliance, the components are virtually indistinguishable in subjects' ratings.

EXPERIMENT II

Since the only condition in Experiment I to result in a separation of sensory and affective ratings was the one in which demand characteristics operated, Experiment II was designed to determine if a veridical separation of the two pain components could be achieved by some alternative manipulation. Specifically, the aim was to keep demand characteristics at a minimum as in the ALT group of Experiment I but to superimpose an experimental/treatment intervention previously shown to affect only *one* of the components of pain.

Certain psychological manipulations have been reliable in their selective effect on a pain component, in particular, the affective component. Price *et al.* (1980) demonstrated that lowering one's expectations of avoiding pain had the effect of reducing affective responses but not sensory responses to noxious skin temperatures. Expectancy manipulations by placebo have been shown to alter response bias rather than neural sensitivity to pain, in signal detection theory experiments (Clark, 1969; Feather *et al.*, 1972).

Experiment II of this study was designed to determine if an expectancy manipulation by placebo would differentially alter ratings of sensory versus affective components of pain. It was predicted that despite the control of demand characteristics, a separation of the two pain components would emerge to the extent that the placebo attenuated the affective component of pain.

Method

Subjects

A group of 10 subjects was randomly selected from the same pool of undergraduate student volunteers used for Experiment I. Each subject was paid $20 for participation and the same rules of informed consent and medical screening were adhered to as previously. Subjects were also asked

if they had any reluctance whatsoever to try a nonprescription medication for pain; all expressed willingness to do so and were retained.

Apparatus

The same equipment from Experiment I was used here. In addition, 20 medication placebos were incorporated. These consisted of glucose capsules, colored in orange and red, and filled with brewer's yeast. The preparations were made available by a local pharmacy and were declared completely inert in terms of any possible analgesic or psychotropic effect.

Procedures

As in Experiment I, ischemic pain was induced in all subjects using the SETT. The dependent variables of sensory and affective pain were defined in the manner described earlier, and unsolicited measures of each of these were obtained on a 9-point rating scale as previously described.

All subjects in this condition (P-ALT) rated each pain component in identical, alternate sessions (a week apart) as had the ALT Group of Experiment I. Again, there was counterbalancing for order, so that half the group rated the sensory pain component in week 1 followed by the affective pain component in week 2, while the other half rated the components in reverse order.

The main departure from the ALT group of Experiment 1 was that subjects in the P-ALT group were also administered a medication placebo that was described as a "safe but potent pain killer selected specially for its effects on the kind of ischemic pain induced in this study." Subjects ingested the placebo with a drink of water 5 min before the commencement of pain induction procedures.

The steps in administration and termination of pain induction were identical to those in Experiment I. At the end of the second session, subjects were debriefed that they had been administered a placebo and this was explained in the context of the hypotheses under investigation. Finally, each subject was paid and thanked for participating.

Results

One subject failed to reach a rating of 9 within 30 min of cuff application; as stipulated in the procedures, the experiment was nevertheless terminated at the 30-min mark and the subject's data were excluded from

analyses. An alternative subject who fulfilled all inclusion criteria was obtained to restore the sample size to 10.

As with the ALT group, repeated-measures analyses of variance revealed no significant differences for either pain component, depending on whether it was rated in the first week or the second week. This held true for all levels of the 9-point rating scale except for sensory pain ratings 4, 5, and 6. However, significant differences were observed between sensory versus affective components of pain at each level of the 9-point scale. For the subgroup that rated sensory pain first, the mean cumulative time taken to reach a sensory rating of 1 was 1.62 (SD = 0.68), and that taken to reach an affective rating of 1 was 3.68 (SD = 1.20), this difference being statistically significant [$F(1, 8) = 11.08, p < .01$]. The significant difference persisted at all levels to the upper end of the scale where the means for sensory and affective pain were 16.24 (SD = 2.37) and 22.50 (SD = 4.11), respectively, this difference being significant [$F(1, 8) = 8.69, p < .02$]. For the subgroup that rated affective pain first, the mean cumulative time taken to reach a sensory rating of 1 was 1.96 (SD = 0.84), and that taken to reach an affective rating of 1 was 4.58 (SD = 0.98), this difference being statistically significant [$F(1, 8) = 20.61, p < .002$]. The significant difference continued to the upper end of the scale, where the means for sensory and affective pain were 18.56 (SD = 1.37) and 24.08 (SD = 3.06), respectively, this difference being significant [$F(1, 8) = 13.55, p < .01$].

The cumulative time taken to reach each affective rating was consistently longer than that taken to reach a comparable sensory rating; alternately, at any point in time, the scale value of the affective rating was lower than that for its sensory counterpart. In other words, the rate of increase in affective ratings was consistently slower than that for their sensory counterparts whether they had been individually rated in week 1 (Fig. 5) or in week 2 (Fig. 6). A visual inspection of these graphs in relation to Figs. 1 and 2 further reveals that the disparity between components was greater than that observed for the CON group (note different scales for the X axis). Also, greater divergence between the two functions was observed compared to the more or less parallel functions obtained for the CON group.

Discussion

Given the findings of Experiment I that the impact of demand characteristics was greatest when subjects could recall component ratings within the same session, the P-ALT group rated each component in a separate but identical session 1 week apart with counterbalancing for order. As in

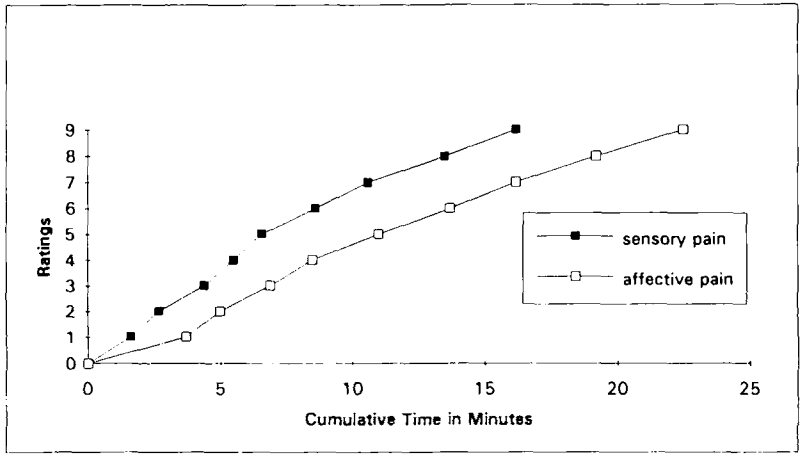

Fig. 5. Alternate ratings of sensory pain in week 1 and affective pain in week 2, under placebo manipulation.

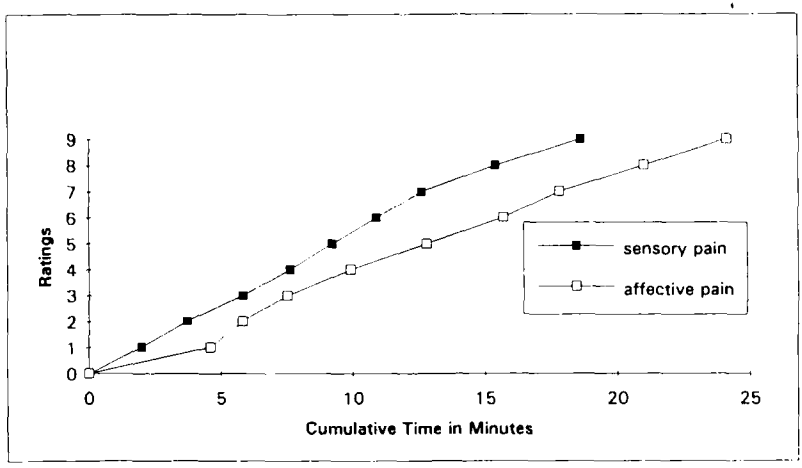

Fig. 6. Alternate ratings of affective pain in week 1 and sensory pain in week 2, under placebo manipulation.

Experiment I, the absence of order effects was replicated. Again, this may be attributed to the fact that the two sessions were procedurally identical (even with regard to time of day of the session), and subjects hence experienced minimal variation in their responses.

There was significant differentiation between components of pain at each level of the 9-point scale. The cumulative time taken to reach affective pain was consistently longer than that for its sensory counterpart. This suggests that subjects were slower to respond with increases in affective distress than they were to increases in sensory intensity of the noxious stimulus. The lag between affective versus sensory pain was greater than that observed for all groups in Experiment I. This may be accounted for by the placebo manipulation. Being biochemically inert, the placebo is unlikely to alter sensory features of pain but it does generate an expectancy effect that can dramatically reduce the distress reactions to nociceptive stimuli (Clark, 1969; Feather *et al.*, 1972).

Of comparable significance to the observed separation of pain components, is the divergence in functions for each component. Unlike the CON group of Experiment I, which did yield moderately disparate but parallel functions for the two components, the P-ALT group witnessed far less parallel functions. This divergence of affective from sensory pain ratings is attributable to the selective effect of a placebo on the emotional rather than physical properties of pain, as predicted a priori.

CONCLUSIONS

Experimenter-suggested differences between sensory and affective pain can produce spurious separation of these two components, especially if subjects are able to comply with such suggestions. All groups in the two studies received some suggestion of sensory-affective differences in the very definition of these components. However, the CON group in Experiment I was the only one that could comply with these expectations by virtue of its ease of recall of one component rating when giving a concurrent rating for the other component. The parallel separation of components by this group is hence very likely related to demand characteristics from the experimenter's instructions.

This contrasts with the ALT group that rated each component in a *separate* but identical session 1 week apart. Deprived of the means to comply with any expectations of sensory-affective differences, this group failed to distinguish between the two pain components in their ratings.

A third group, P-ALT, deprived of the same demand characteristics as the ALT group but administered a medication placebo for the pain, revealed a unique set of results. This condition led to disparate and divergent ratings for pain components, attributable to the selective impact of the placebo intervention on the affective features of pain. As noted earlier, placebos are well documented in their potential to reduce distress reactions

to noxious stimuli even though they may leave the sensory properties of the same stimuli virtually invariant. This selective alteration of one component at the expense of another represents a viable approach to the separation of sensory and affective components of pain (Fernandez and Turk, 1992; Gracely, 1992b; Price *et al.*, 1980).

The spurious separation of sensory and affective components of pain can be controlled by minimizing demand characteristics. These demand characteristics typically originate from investigators' instructions alluding to differences between the components or maybe even directly commanding subjects to rate the components differently. Should subjects be able to comply with these expectations, then there is a high risk that the data will be contaminated by demand characteristics. The total removal of such characteristics is probably unattainable, but the careful construction of bias-free instructions is the first step in any attempt to separate these pain components (Fernandez and Milburn, 1994; Fernandez and Turk, 1992; Turk, 1989). The present study demonstrates that it is possible to achieve this end and then to separate pain components under an experimental/treatment intervention known to selectively alter one of the two components. This approach contributes to the evolving methodology for investigating mechanisms by which certain pharmacological and medical interventions alleviate pain, as well as builds upon previous research that has already accrued important clinical information on the differential effects of various treatments (e.g., hypnosis, biofeedback, cognitive strategies) on components of pain.

ACKNOWLEDGMENT

This study was partially funded by a grant to the first author from Winthrop Laboratories, Division of Sterling Winthrop Pty. Ltd, Australia.

REFERENCES

Chen, A. C. N., Dworkin, S. F., Haug, J., and Gehrig, J. (1989). Human pain responsivity in a tonic pain model: psychological determinants. *Pain* 37: 143-160.

Clark, W. C. (1969). Sensory-decision theory analysis of the placebo effect on the criterion for pain and thermal sensitivity (*d'*). *J. Abnorm. Psychol.* 74: 363-371.

Duncan, G. H., Bushnell, M. C., and Lavigne, G. J. (1989). Comparison of verbal and visual analogue scales for measuring the intensity and unpleasantness of experimental pain. *Pain* 37: 295-303.

Feather, B. W., Chapman, C. R., and Fisher, S. B. (1972). The effects of a placebo on the perception of painful radiant heat stimuli. *Psychosom. Med.* 34: 290-299.

Fernandez, E. (1988). Distinguishing between sensation and affect in pain, Paper presented at the Twenty-Fourth International Congress of Psychology, Sydney, Australia, Sept.

Fernandez, E. (1990). Artifact in pain ratings, its implications for test–retest reliability and correction by a new scaling procedure. *J. Psychopathol. Behav. Assess.* 12: 1-15.

Fernandez, E., and Milburn, T. (1994). Sensory and affective predictors of overall pain, and emotions associated with affective pain. *Clin. J. Pain* 10:3-9.

Fernandez, E., and Turk, D. C. (1992). Sensory and affective components of pain: Separation and synthesis. *Psychol. Bull.* 112: 205-217.

Gracely, R. H. (1992a). Affective dimensions of pain: How many and how measured? *Am. Pain Soc. J.* 1: 243-247.

Gracely, R. H. (1992b). Evaluation of multi-dimensional pain scales. *Pain* 48: 297-300.

Harkins, S. W., Price, D. D., and Braith, J. (1989). Effects of extraversion and neuroticism on experimental pain, clinical pain, and illness behavior. *Pain* 36: 209-218.

International Association for the Study of Pain (1986). Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. *Pain* Suppl. 3: S1-S226.

Johnson, J. E. (1973). Effects of accurate expectations about sensations on the sensory and distress components of pain. *J. Personal. Soc. Psychol.* 27: 261-275.

Johnson, J. E. (1975). Stress reduction through sensation information. In Sarason, G., and Spielberger, C. D. (eds.), *Stress and Anxiety: Vol. 2,* Hemisphere, Washington, DC, pp. 361-378.

Johnson, J. E., and Rice, V. H. (1974). Sensory and distress components of pain. *Nursing Res.* 23: 203-209.

Knox, V. J., Morgan, A. H., and Hilgard, E. R. (1974). Pain and suffering in ischemia: The paradox of hypnotically suggested anesthesia as contraindicated by reports from the "Hidden Observer." *Arch. Gen. Psychiat.* 30: 840-847.

Loeser, J. D. (1980). Perspectives on pain. In *Proceedings of the First World Conference on Clinical Pharmacology and Therapeutics,* Macmillan, London, pp. 313-316.

Melzack, R., and Casey, K. L. (1968). Sensory, motivational and central control determinants of pain: A new conceptual model. In Kenshalo, D. R. (ed.), *The Skin Senses* Charles C Thomas, Springfield, IL, pp. 423-443.

Moore, P. A., Duncan, G. H., Scott, D. S., Gregg, J. M., and Ghia, J. N. (1979). The submaximal effort tourniquet test: Its use in evaluating experimental and chronic pain. *Pain* 6: 375-382.

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *Am. Psychol.* 17: 776-783.

Postlethwaite, R., Grieve, N., Santacroce, T., Renfree, L., Wilson, G., and Peck, C. (1980). An analysis of pain produced by the submaximum effort tourniquet test. In Peck, C., and Wallace, M. (eds.), *Problems in Pain: Proceedings of the First Australia-New Zealand Conference on Pain,* Pergamon, Sydney, pp. 128-135.

Price, D. D., and Harkins, S. W. (1987). Combined use of experimental pain and visual analogue scales in providing standardized measurement of clinical pain. *Clin. J. Pain* 3: 1-8.

Price, D. D., Barrell, J. J., and Gracely, R. H. (1980). A psychophysical analysis of experiential factors that selectively influence the affective dimension of pain. *Pain* 8: 137-149.

Price, D. D., Harkins, S. W., and Baker, C. (1987). Sensory-affective relationships among different types of clinical and experimental pain. *Pain* 28: 297-307.

Riecken, H. W. (1962). A program for research on experiments in social psychology. In Washburne, N. F. (ed.), *Decision, Values and Groups. Vol. II,* Pergamon, New York, pp. 25-49.

Rollman, G. B. (1992). Cognitive effects in pain and pain judgments. In Algom, D. (ed.), *Psychophysical Approaches to Cognition,* Elsevier, Amsterdam, pp. 515-574.

Rosenthal, R. (1967). Covert communication in the psychological experiment. *Psychol. Bull.* 67: 356-367.

Smith, G. M., Egbert, L. D., Markowitz, R. A., Mosteller, F., and Beecher, H. K. (1966). An experimental pain method sensitive to morphine in man: The submaximal effort tourniquet technique. *J. Pharmacol. Exp. Ther.* 154: 324-332.

Turk, D. C. (1989). Assessment of pain: The elusiveness of latent constructs. In Chapman, C. R., and Loeser, J. D. (eds.), *Advances in Pain Research and Therapy: Vol. 12. Issues in Pain Measurement,* Raven Press, New York, pp. 267-279.