EFFECTS OF BACKGROUND INFORMATION
AND SOCIAL MODELING
ON JUDGMENTS OF PAIN IN OTHERS

by

NEIL ALAN CURRIE
B.A., University of Alberta, 1977

A thesis submitted in partial fulfillment
of the requirements for the degree of

Master of Arts
in the
Faculty of Graduate Studies
Department of Psychology

We accept this thesis as conforming to the
required standard

THE UNIVERSITY OF BRITISH COLUMBIA
MAY, 1979

© Neil Alan Currie, 1979
In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the Head of my Department or by his representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Psychology

The University of British Columbia
2075 Wesbrook Place
Vancouver, Canada
V6T 1W5

Date June 16, 1979
ABSTRACT

Psychological research on pain has highlighted the apparent plasticity of the experience and the substantial impact that social events have as determinants of its expression. For example, a wealth of evidence has demonstrated that exposure to social models displaying relative tolerance or intolerance for painful stimulation induces subjects to alter verbal reports of pain in tolerant and intolerant directions, respectively. Research on these effects, employing Signal Detection Theory (SDT) methods, suggests that these effects may be mediated by alterations in sensitivity to painful stimuli (Craig & Coren, 1975; Craig & Prkachin, 1978).

Although the relevance of SDT methods to diagnostic decision-making processes has frequently been pointed out, relatively few studies have employed SDT methods to investigate diagnostic practices. The SDT perspective on diagnostic processes emphasizes the notion that a particular decision regarding the presence and severity of symptoms reflects the operation of two Factors: 1) evidence that a particular phenomenon is present in the patient, and 2) the diagnostician's readiness to accept weak or strong evidence as indicating the presence of the inferred phenomenon.

In pain evaluations, variables such as background information about the patient are important in determining the diagnostician's criterion for accepting a particular set of evidence as indicative of pain. For the pain sufferer the diagnostician's criterion is critical. A bias to interpret expressive behavior as indicative that little pain is present may
have drastic consequences on subsequent caretaking responses.

The present study was an attempt to evaluate the impact of a priori pain-relevant information on observers' readiness to report the occurrence of pain in others. A second focus was to evaluate the influence of exposure to social models on discriminability of the overt behavior of subjects experiencing pain. SDT methods were employed for both purposes.

Videotapes taken of subjects exposed to electric shocks of varying intensities were presented to 30 observers who attempted to determine the level of pain that observed "senders" were experiencing. Analyses of observers' judgments indicated that observers who were instructed that senders had had a pain-enhancing treatment were biased toward reporting pain in senders relative to observers instructed that senders had experienced a pain-reducing treatment and relative to controls. The behavior of senders exposed to a tolerant model was less discriminable and elicited lower average pain ratings relative to that of senders exposed to an intolerant model. Additional findings were that 1) males produced reliably higher discriminability ratings than females and 2) discriminability of pain expressions was inversely related to observer empathy. These results indicated that: 1) judgments of the presence and severity of pain experienced by others are substantially affected by background information, and 2) variations in social experience are capable of altering subjects' overt expressions of pain. Findings are discussed in relation to existing theories of social influences on pain, and in relation to diagnostic practices in the evaluation of pain in the natural setting.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>vi</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>vii</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHOD</td>
<td>19</td>
</tr>
<tr>
<td>RESULTS</td>
<td>27</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>36</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>51</td>
</tr>
<tr>
<td>APPENDIX A</td>
<td>57</td>
</tr>
<tr>
<td>APPENDIX B</td>
<td>58</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

FIGURE 1. Interaction between Modeling Condition and Discrimination level on the measure of discrimination (E) ............ 30

FIGURE 2. Mean A (average pain rating) values as a function of sender's Modeling Condition and Shock Intensity ............ 32
## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX A</td>
<td>Consent Form</td>
<td>..........</td>
</tr>
<tr>
<td>APPENDIX B</td>
<td>Post-Session Questionnaire</td>
<td>..........</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

I would like to thank the members of my thesis committee for their specific suggestions and for their support: Drs. Ken Prkachin, Park Davidson, and Ray Corteen. I owe my friend Ken Prkachin special mention for the months of good-humored and scholarly effort he spent, guiding this research. I would like to issue separate thanks to Dr. Ken Craig, through whose support this study was made possible, and who has provided me with research experience throughout graduate school. Dr. Larry Ward helped me avoid some blind alleys early on with his incisive recommendations. Howard Greenstein provided me with encouragement that stimulated rapid progress in the initial stages. Judy Hawkins and Pat Waldron typed the manuscript. Finally, special thanks to my wife Lyn for her unfailing emotional support at all times during this project.
INTRODUCTION

The present study was concerned with evaluating the influence of a variety of social manipulations on the discriminability of displays of pain, and biases in decisions about the presence and magnitude of pain. Two specific issues were of major interest: (1) the impact of exposing subjects experiencing pain to variably tolerant social models on the discriminability of their overt pain expressions, and (2) the effects of exposure to pain-relevant information on observers' judgments of the magnitude of pain experienced by others. These issues were examined in the context of an experimental analogue of clinical pain-diagnosis situations.

Social influences on pain reaction

Fordyce (1976) has made a basic distinction between operant and respondent pain behavior. The concept of respondent pain is most appropriately applied to instances of apparent pain that result from acute injury or those that are the direct consequence of effective tissue-damage. If a person is bombarded by peripheral noxious stimulation, respondent pain behaviors are likely to be emitted automatically. In addition to these reflexive components of noxious stimulation, Fordyce has proposed that episodes of apparent pain may also have prominent operant components, especially if such episodes are protracted. In instances involving operant pain, behaviour indicative of pain may be shaped, maintained or otherwise modified as a function of the social consequences of pain displays. This analysis of environmental factors that modulate pain behavior emphasizes that expressions of pain are frequently instrumental in the acquisition of social reinforcers or the termination of aversive social situations. Pain behaviors are strengthened in the absence of reinforcement for, or
perhaps punishment of, well behavior. This perspective underlines the fact that expressions of pain have come to be regarded as interpersonal communications partially under the control of social contextual events (Craig, 1978; Craig & Prkachin, in press).

**Cross Cultural Evidence**

A substantial body of systematic and anecdotal evidence dealing with cultural influences on reactions to painful events supports this perspective. In a recent review, Weisenberg (1977) identified differences among several ethnic groups related to rate of adaptation to and tolerance of electric shock. Tursky and Sternbach (1967) in a study examining reactions to the pain of electric shock found substantial correspondence between autonomic measures and attitudes toward pain. Yankees, defined as Protestants of British descent who expressed a phlegmatic, matter-of-fact orientation toward pain in a prior interview showed the fastest rate of adaptation to electric shock of diphasic palmar skin potentials. Irish subjects, described as inhibiting their expression of suffering and concern for pain, showed a lower palmar skin resistance, associated with the considerable anxiety which the Irish feel constrained not to verbalize or express overtly, as predicted from the prior interview. Italians, characterized as expressing desire for relief from pain, evidenced a positive correlation between upper pain threshold and heart rate. Jews, described as expressing concern for the implication of pain and distrusting palliatives, showed the opposite. Those with the highest upper threshold for pain had the lowest heart rate.

In a study of black, white, and Puerto Rican dental patients (Weisenberg, Kreindler, Schachat, & Werboff, 1975) attitudinal differences were obtained reflecting relative willingness either to deny or to avoid
dealing with pain, or to get rid of the pain. This was shown by response to such items as "The best way to handle pain is to ignore it", "It is a sign of weakness to give in to pain", or "When I am sick I want the doctor to get rid of the pain even before he finds out what the trouble is". Puerto Rican patients showed the strongest endorsement of these items, whites the weakest, blacks in between.

In a clinical study of whites, blacks and orientals (Woodrow, Friedman Siegelaub & Collen, 1972) tolerance of deep pain was measured. Subjects placed the heel of one foot on the floor with the achilles tendon positioned between two motor-driven rods. Whites were found to tolerate the greatest amount of pain, orientals the least, and blacks were in between. Weisenberg (1977) reasoned that such differences in sociocultural reactions to pain are determined in part by observing the reactions to pain of members of one's culture.

Social modeling studies

Prkachin (1978) has argued that relative tolerance or intolerance of noxious stimulation may largely be the product of exposure to others displaying relative tolerance or intolerance of similar stimulation. One line of evidence supporting this position has come from studies in which the behavior of companions has been manipulated while subjects are exposed to painful stimulation and willingness to report pain employed as the dependent measure. Exposure to a model simulating relative tolerance for noxious stimulation has been shown to be effective in reducing pain reported by subjects undergoing radiant-heat stimulation (Neufeld & Davidson, 1971) and pressure-induced pain (Chaves & Barber, 1974).
The impact of modeling processes on pain threshold and tolerance judgements has been demonstrated in a series of laboratory studies. Craig and Weiss (1971) exposed undergraduate volunteers to six series of electric shocks gradually increasing in intensity. Subjects rated each shock on a categorical judgment scale ranging from "undetectable" to "painful". A confederate peer model who was ostensibly another subject undergoing the same procedure dissimulated either greater or lesser tolerance than the actual subject by making lower or higher ratings, or made ratings that were not contingent upon those of the subject. Subjects imitated the behavior of models in the two active modeling conditions, with those exposed to a tolerant model accepting significantly greater current intensities before reporting pain than those exposed to an intolerant model. Subjects exposed to the noncontingent co-participant accepted intermediate levels. Similar results were obtained in subsequent studies that employed a standard intensity of electric shock ordinarily rated as non-painful by uninfluenced subjects. Craig & Weiss (1972) and Craig, Best, & Reith (1974) reported that subjects exposed to an intolerant model rated the shock as painful 77% of the time while control subjects did so only 3% of the time.

In a later study (Craig & Neidermayer, 1974) behavioral (pain threshold report) and psychophysiological measures were employed in a similar paradigm in order to examine the degree of convergence of alternative measures of the response to noxious electrical stimulation. As in prior studies, subjects exposed to tolerant models accepted substantially more shock than those interacting with no model or a control model, while those exposed to an intolerant model accepted substantially less. Measures of skin conductance and heart rate, however, did not permit differentiation of the groups. The authors concluded that to the extent that the physiological variables
reflected the biological processes mediating the experience of pain and discomfort, subjects who were influenced to accept very high levels of shock suffered no more distress than those who described the lower levels of shock as painful. However, Tursky (1974) reported that palmar skin conductance data exhibit ceiling effects at low levels of stimulation, suggesting that Craig & Neidermayer's finding may have been artifactual. Tursky noted further that measures of skin potential exhibited close correspondence to levels of noxious stimulation.

In a later study, Craig & Prkachin (1978) sought to overcome the difficulties in the Craig and Neidermayer (1974) study by recording skin potential from forearm and abdominal sites. Subjects exposed to either a tolerant model or an inactive co-participant generated numerical magnitude estimates to shocks presented in a single ascending series, and a series of randomly-presented shocks at five standard intensities. Subjects exposed to a tolerant model exhibited significantly lower degrees of heart-rate acceleration to the current, and, unlike control subjects, the magnitude of their forearm skin-potential responses habituated over the course of the random series. As well, the tolerant modeling social influence strategy reduced reports of personal distress and diminished sensory-decision theory measures of sensitivity to noxious stimulation. The authors concluded that social influence techniques producing reductions in sensory sensitivity produce concomitant reductions in physiological arousal, reflecting a manipulation of fundamental characteristics of painful experience.

**Issues in the measurement of pain responses**

The use of autonomic responses as dependent measures in the studies by Craig & Neidermayer (1974) and Craig & Prkachin (1978) reflects recent concern over inferential difficulties involved with alternative measures
of pain reactions. It has been traditional in experimental studies of human pain reactions to use some form of verbal report as an index of the occurrence or magnitude of pain (Beecher, 1959; Clark, 1969; Hilgard, 1969). Tursky (1974) following Beecher (1959) identified two components of individuals' reactions to pain. One is a psychological or reactive component, a series of verbal or physical responses which are partly influenced by various psychological, cultural, and situational factors. The other is the sensory or perceptual component, and has been described as the actual sensation or hurt that the individual feels. Clark (1969) has argued that many of the dramatic elevations in pain threshold reported in the literature reflect a response bias to suppress reports of pain rather than an amelioration of the pain experience itself. In terms of Tursky's distinction, Clark's point is that alterations in pain threshold often reflect manipulation of the psychological-reactive component instead of the sensory-perceptual component of pain.

In an effort to investigate the latter component, researchers have turned to two psychophysical strategies. The first has been to employ S.S. Stevens' power law (Stevens, 1975) and numerical magnitude estimation (ME) tasks. ME methods do not limit an individual's assessment of noxious stimuli to a narrow range of categories devised by the experimenter but allow each person to construct as sensitive and unique a scale as is required (Grossberg & Grant, 1978). The resultant scale ratings yield a power function expressed by the equation:

$$\Psi = KS^n$$

indicating that the perceived magnitude $\Psi$ grows as the physical value of the stimulus $S$ raised to some power $n$. Thus the functional relationship
between stimulus and response is described in precisely quantifiable terms.

The second approach to investigation of sensory processes underlying the experience of pain has been the use of signal-detection theory (SDT) methods (Pastore & Sheirer, 1974). SDT methods have been employed in order to tease apart two parameters of response to noxious stimulation: response bias and discriminative performance (often termed "sensory sensitivity").

The application of SDT methods to the investigation of pain behavior is currently an extremely active area of research. In a recent review of SDT pain research, Rollman (1977) lists studies employing a wide variety of experimental methods, and such diverse sources of noxious stimulation as radiant heat, electrical stimulation of tooth pulp, and electric shock. Changes in pain responses produced by placebos (Clark, 1969), drugs (Chapman, Murphy & Butler, 1973), subject characteristics (Clark & Mehl, 1971), acupuncture (Clark & Yang, 1974), transcutaneous stimulation (Bloedel, Erickson, & McCreery, 1974) and social influences (Clark & Goodman, 1974) have been examined. As could be expected from such a diversity of independent variables and methods, no simple overall pattern of results is discernible in this field. For the present discussion it is sufficient to focus attention on the use of SDT to examine social influences on pain behavior.

SDT investigations of social influences on pain reactions

SDT investigations of the effect of an oral placebo (described as a potent analgesic) on subject responses to radiant heat stimuli indicated that criterion for reporting pain was increased while discriminability (d') was not altered (Clark, 1969; Feather, Chapman, and Fisher, 1972).
Both studies led to the conclusion that sensory effects of the radiant heat stimuli did not change as a function of exposure to analgesic suggestions, in spite of the fact that alterations were observed in conventional indices of pain threshold. Clark & Goodman (1974) investigated the effects of verbal suggestion on detection and tolerance thresholds for radiant heat stimuli. Suggestion that subjects could tolerate more stimulation before reporting pain was effective in altering the probability of a pain response, but it was without effect on subjects' ability to discriminate noxious stimulation. Again, the authors concluded that there was no alteration in the amount of pain experienced by the subjects.

SDT investigations of social modeling influences on pain reactions have provided evidence that exposure of subjects to tolerant or intolerant models is associated with alterations in sensitivity to noxious stimulation. In a study by Craig & Coren (1975) using sub-pain threshold intensities of electrical stimulation, exposure to an intolerant model was associated with an increase in a measure of sensory sensitivity, while exposure to a tolerant model had no effect on this index. To examine the impact of social modeling at clearly noxious levels of stimulation, Craig & Ward (1976) employed supra-threshold levels of stimulation. Results indicated that exposure to a tolerant model was associated with reduced sensitivity. However, these studies have been criticized on a number of methodological grounds. The levels of stimulus intensity accepted by subjects varied among groups exposed to different models, thus confounding stimulus intensity with groups. In addition, it has been pointed out that too few stimuli were presented at each intensity to allow reliable estimation of SDT parameters in these studies (Rollman, 1977). A third problem was that only an overall index of discriminability was calculated for each
subject; thus it was impossible to tell whether observed modulations in discriminative ability occurred at high shock intensities, low shock intensities, or both.

Craig and Prkachin (1978) re-evaluated modeling influences in a study that overcame the group/stimulus level confounding by administering standard current intensities to a tolerant modeling group and a no-modeling group. Subjects in the tolerant group exhibited lower overall ability to discriminate the shock, as in the Craig & Ward study. However, the generalizability of these results was weakened by the fact that there was no conclusive measure taken to show that the stimulation exceeded noxious levels for all subjects. As in the Craig & Ward study, ambiguity still existed as to whether the modulation in discriminability occurred at high or low intensities or both. A recent study (Prkachin, 1978) attempted to overcome the shortcomings of the prior SDT analyses of the effect of social modeling procedures on pain. Both noxious and non-noxious stimulus intensities, defined by subject behavior in a preassessment session, were employed. All groups received a standard series of intensity levels and the number of presentations at each stimulus intensity was increased to 54. The results of the experiment indicated that intolerant modeling was associated with increased sensory sensitivity at noxious levels of stimulation. Tolerant modeling was not associated with differential values of sensitivity, suggesting that previous positive findings be qualified.

To summarize, the investigation of social influences on pain reaction has highlighted the plasticity of the pain experience. Laboratory studies have demonstrated altered pain reaction as a function of such pervasive social influence as cultural descent, as well as directly manipulated influence in the form of placebos, verbal suggestion, and confederate models.
A wide variety of dependent measures have been employed, verbal reports of painfulness, willingness to tolerate noxious stimulation, as well as physiological measures. Sophisticated quantitative tools have evolved (ME and SDT methodologies) appropriate to the investigation of pain reaction, wherein the social influences are being shown to exert a complex impact.

**Implications of the social perspective: responses of others to evidence of pain**

In studies employing human subjects the typical research approach has been to employ verbal characterizations of the experience of pain as the dependent variable. Other components of the response to pain have been employed less frequently if at all. However, current conceptions of the complexity of pain reactions and the variables that control them have begun to emphasize the importance of examining other components of the response to pain (Liebeskind & Paul, 1977).

The socio-behavioural perspective on pain has implicated interpersonal events as critical variables affecting pain reactions in humans. Since the behaviour of others in response to displays of pain is of major significance in these accounts, it is important to evaluate the role of pain-modulation strategies in influencing phenomena that may exert powerful control over the behaviour of others. One major group of phenomena that influence the behaviour of others consists of overt, nonvocal displays of pain. Facial expressions of fear, including wincing, grimaces and distorted muscles, and protective bodily movements, including guarded action and movements, have considerable meaning to observers as information conveying the presence and magnitude of pain (Craig & Prkachin, in press).
Some indication of the important role that expressive behavior plays in determining evaluation of emotional states comes from research in the field of "nonverbal communication". Evaluations of a variety of internal states have been conducted, using nonverbal behavior as dependent variable, for example in research on lying (Kraut, 1978; Ekman & Friesen, 1974), anxiety (Waxer, 1977), pain (Prkachin, 1978), depression (Prkachin, Craig, &c. Papageorgia, & Reith, 1977), and social interpretation accuracy (Archer & Akert, 1977).

In research on the perception of inconsistent emotions, Mehrabian (1972) has concluded that 55% of the total impact of an emotion is attributed to facial channels. Other estimates as to the importance of nonverbal information have been generated. Birdwhistell offers the "guess" that "no more than 30 to 35% of the social meaning of an interaction is carried by the words" (1970, p. 197). Mehrabian's conclusion, however, is based on the way in which single words are judged in isolation, using posed, context-free contradictions between verbal and non-verbal channels. The artificiality of such a procedure is apparent (Archer & Akert, 1977). Estimates of the relative strength of various types of expressive cue vary widely, thus indicating that the formulation of a mathematical relationship between cues and perceived meaning is presently premature (Argyle, Alkema, & Gilmour, 1971).

Archer & Akert (1977) evaluated the relative contributions of verbal cues versus full-channel (verbal-plus-non-verbal) cues to accurate interpretation of a sequence of spontaneous social behavior. Subjects were exposed to a thirty-minute audiovisual presentation consisting of 20 natural sequences of behavior, each 30 to 60 seconds in length, in one of two
communication conditions. One group of subjects read a written record of
the dialogue of the videotaped scenes (verbal transcript). The second group
was exposed to the full audiovisual presentation (full channel).

The answers to 20 multiple choice questions (one per scene) were scored
according to an unambiguous criterion of accuracy (e.g., in one scene, two
men discuss a game of basketball they have just played, and the viewer is
asked to decide which man won the game).

Full-channel subjects averaged 8.85 correct answers, verbal transcript
subjects 5.50, out of 20. This difference was highly significant (p<.001).
Both samples differed significantly from the chance accuracy level, but
the transcript sample performed significantly below chance while the full-
channel sample performed significantly above chance. The authors concluded
that purely verbal information about interactions makes no independent con-
tribution to accurate interpretation, exclusive of that provided by non-
verbal information.

A common task faced by individuals in medical diagnostic settings is
to evaluate whether, or to what extent, pain is present in a given patient.
Since there is no single, objective criterion reflecting the severity of
pain, and since ambiguity as to the presence and severity of symptoms may
exist, the physician must consider and assign differential weights to a
variety of factors in coming up with an overall evaluation.

In such situations, the diagnostician relies heavily on the expressive
behaviour of the subject in formulating a decision. Spontaneous, nonverbal
expressions of pain are carefully observed and noted. In certain diagnostic
procedures, such as palpation and testing for range of motion, the phy-
sician deliberately undertakes to induce pain and concludes that it is pre-
sent when he or she observes some change in nonverbal behaviour, that
indicates pain. Such reliance on nonverbal behavior is consistent with evidence that certain types of nonverbal cue, particularly facial expressions, are less subject to dissimulation than verbal behaviour (Ekman & Friesen, 1969).

The similarity between diagnostic decisions and signal-detection tasks has frequently been pointed out. Swets (1972, p.8), for example, noted that:

> the detection of a weak signal by a physician depends not only upon his sensitivity but also upon his decision bias. The decision bias, in turn, depends upon the subjective probability of the signal in question and upon the utilities of the various possible decision outcomes.

Although the relevance of SDT methods to diagnostic decision-making processes has frequently been pointed out, relatively few studies have employed SDT methods to investigate diagnostic practices. In an analogue of a clinical diagnostic situation, Stenson, Kleinmuntz, & Scott (1975) attempted to evaluate the applicability of SDT methods to MMPI profile analysis. Subjects were two experienced clinicians, eight graduate students in clinical psychology, and twelve undergraduates. Instructions were to differentiate between 46 known abnormal MMPI profiles and 80 known normal ones. One of the two experts was required to sort the profiles into 12 categories from least to most likely to seek psychological treatment. The second expert sorted the profiles into five categories ranging from "definitely normal" to "definitely abnormal". Calculation of receiver-operating-characteristic (ROC) parameters based on hit and false affirmative probabilities revealed that the SDT parametric assumptions of normality of discriminative distributions and equal variances were met for these data.

The two groups of student judges sorted the profiles into "hospitalized" and "never hospitalized" categories. Two types of biasing information were
employed. In a manipulation designed to alter subjective probabilities, 10 of the students were told that the proportion of the profiles that belonged in the "hospitalized" pile was either 30% or 70%. The other 10 students were given one of two sets of instructions emphasizing differing utilities of the diagnostic decision. Five students were told that hospitalization was costly and stigmatizing; the other five students were told that the patients were dangerous to society. This manipulation of probabilities and costs produced no effects on d' values among groups. That the authors reported only the characteristics of d' (sensitivity) and not response bias as a function of the instructional manipulation testifies to the neglect of the response bias parameter in discussions of diagnostic decision-making.

In an application of SDT methods to the analysis of the perception of social cues, Thompson (1978) had 83 subjects judge how sure they were that approval had or had not been given in each of 104 videotaped remarks taken from scenes depicting a college professor commenting to a student about a submitted paper. Multiple regression analysis indicated that several variables predicted the non-parametric measure of sensitivity ($A'$, Grier, 1971): age, sex, need for approval and locus of control.

Lusted (1971) summarized studies using SDT comparisons of diagnoses based on chest X-rays through direct plate viewing. Direct viewing yielded significantly larger d' values, measuring the diagnosticians' ability to discriminate known positive from negative plates. In this field, SDT procedures have also been employed to assess the effect of training on technicians' diagnostic accuracy in judging chest X-rays, and to compare the accuracy in discriminating cancerous from noncancerous mammograms, of experienced radiologists compared to secretaries and X-ray technicians.
In later work Lusted (1975) has applied SDT methods to remote TV viewing of nuclear imaging scans (scintigrams). Diagnosis based on remote viewing was as accurate under certain conditions as that based on direct viewing; thus satellite stations that could not justify hiring high-salaried full-time nuclear diagnosticians could transmit diagnostic scintigrams to a central locus for reliable evaluation. In their review of clinical psychophysics, Gorssberg and Grant (1978) note other applications. For example recent work has employed SDT methods for lesion localization (Metz, Starr & Lusted, 1976; Starr, Metz, Lusted, & Goodenough, 1975) and detection of lumps in the human female breast (Adams et al., 1976).

Prkachin (1978) extended SDT methodology to an analysis of the effects of social models on non-verbal pain behavior. The study was designed to investigate two issues: 1) whether observers could in fact discriminate expressive behavior resulting from different intensities of noxious stimulation, and 2) whether observers' ratings of the expressive behavior of subjects exposed to tolerant or intolerant modeling or control conditions would exhibit systematic variations. Videotapes taken of subjects undergoing one of three modeling conditions in a previous experiment were presented to observers who attempted to predict the levels of current that observed subjects were experiencing. SDT analyses of observers' judgments indicated that responses to intense stimuli were more readily discriminated than responses to less intense stimuli. The behaviour of subjects exposed to a tolerant model was less discriminable than that of intolerant subjects. The behavior of intolerants was less discriminable than that of controls. It was argued that tolerant modeling produces reductions in overt, non-vocal expressions of pain.
The SDT perspective on diagnostic processes emphasizes the notion that a particular decision regarding the presence and severity of symptoms reflects the operation of two factors: 1) evidence that a particular phenomenon is present in the patient, and 2) the diagnostician's readiness to accept weak or strong evidence as indicating the presence of the inferred phenomenon. In the case of pain evaluations, this perspective suggests that a diagnostician's decision regarding its presence and severity is determined only partially by the occurrence of behaviour indicative of pain. The final evaluation will additionally reflect the observer's tendency to require little or much evidence before concluding that pain is present. As pointed out by Swets (1972), the value of the observer's criterion will be determined by the utilities associated with a particular decision and by the diagnostician's subjective assessment of the probabilities of pain.

In pain evaluations, a wide variety of variables are likely to play an important role in determining the diagnostician's criterion for accepting a particular set of evidence as indicative of pain. Background data about the patient's personal characteristics, the history of the problem, its response to treatment, and other pain-relevant phenomena are at the clinician's disposal and are considered when an evaluation is formulated. While no systematic research into these processes has been conducted, clinical experience provides many examples. For example pain patients who display evidence of the concomitant presence of psychiatric disturbance are likely to be branded as "crocks" (Sternbach, 1974). This is likely to have the consequence of the clinician requiring an abundance of evidence of pain before concluding that a significant pain problem is present. Similarly, a common assumption in clinical settings (supported by some
research) is that certain ethnic groups respond differentially to similar amounts of pain (Weisenberg, 1977). Examples of this include the prevalent belief that Mediterranean people are excessively reactive to minimal noxious stimulation, while Orientals tend to be stoical and forebearing of great amounts of pain. A diagnostician presented with information regarding the patient's ethnic background could be expected to be less or more willing to accept manifest evidence as indicative of pain in these two respective instances. For the pain sufferer, the decision bias of his attending diagnostician is critical. A bias to interpret expressive behavior as indicative that little pain is present may have drastic consequences on subsequent caretaking responses.

The present study was an attempt to systematically examine some of the aforementioned issues by means of SDT methodology. One part of the experiment was designed as an attempt to replicate Prkachin's (1978) finding that exposure of subjects experiencing pain to differentially tolerant social models affects observers' ability to discriminate their behavior.

Observers rated videotapes of the behavior of subjects from Prkachin's experiment, exposed to one of three conditions designed to influence their reaction to noxious electrical stimulation: tolerant modeling, intolerant modeling, and exposure to an inactive companion. Observers made judgments as to the level of pain that observed subjects were experiencing. Prkachin's paradigm was modified significantly in the present study. The number of observed subjects was increased from 9 to 30 for each observer. In Prkachin's study each observer examined a relatively long sequence of behavior (54 stimulus presentations) for only 9 subjects. In the present study, the first six presentations each of low, medium, and high electric currents were taken from each of 30 subjects. Selection of these early
trials for rating by observers allowed an assessment of the relatively immediate impact on shocked subjects of exposure to the various social conditions. It was expected that observers rating subjects exposed to tolerant or intolerant models would experience poorer discriminability than observers rating subjects in the control condition.

A second focus of the present experiment was to systematically evaluate the impact of a priori pain-relevant information on observers' readiness to report the occurrence of pain in others. Two types of biasing information were presented to observers prior to observing the videotapes. In one condition, intended to decrease observers' tendency to report the occurrence of pain in observed subjects, observers were told that subjects had received two tablets of an analgesic drug before undergoing the series of electric shocks. In another condition, intended to increase tendencies to report pain in observed subjects, observers were told that subjects had been administered a pain enhancing treatment prior to undergoing the series of electric shocks. The influence of these treatments was assessed in relation to a group of subjects who received no prior information.
METHOD

Subjects

Thirty undergraduate volunteers (15 males, 15 females) were recruited from Introductory Psychology courses at the University of British Columbia (males' mean age = 19.87, S.D. = 2.53; females' mean age = 19.13, S.D. = 2.29). Subjects were contacted by telephone and solicited for participation in an experiment on "the influence of various treatments on the experience of pain." Of those who arrived at the laboratory for the session, none refused to participate.

Apparatus and Experimental Environment

Two videotapes were shown to subjects on a 23-inch television set via a Sony AV3400 videotape recorder playback unit.

The videotapes depicted samples of behaviour of thirty subjects who had taken part in a previous experiment (Prkachin, 1978). In the previous experiment, subjects were exposed to a series of electric shock ranging from 0.0 milliamperes to intensities that were judged by the subject to be painful enough that they did not wish to tolerate any greater. The excerpts on the videotape depicted the responses of these subjects to three sets of pairs of electric shocks occurring in a random order. The three pairs of shocks had been rated by the subjects on the videotapes as approximately sensation threshold (low), slightly below pain threshold (medium), and halfway between pain threshold and pain tolerance (high). Pairs of stimuli from each of these levels differed by 0.25 milliamperes in current intensity and were delivered approximately one to two seconds apart. Thus, each trial on
the videotape consisted of the reaction of the subject to the presenta-
tion of two electric shocks at three levels of current intensity.

The subjects (henceforth referred to as "senders") rated each cur-
rent on a 7-point categorical judgement scale while being exposed to
one of three social influence conditions designed to affect their
reactions to the shock. In one condition (tolerant), senders had been
exposed to a confederate model who dissimulated relative tolerance to-
ward the electrical stimulation. In another condition (intolerant),
senders had been exposed to a model who dissimulated relative intolerance
toward the stimulation. In the third condition (control) senders had
simply been exposed to an inactive co-companion.

The videotapes employed in this study sampled the behaviour of
senders during the initial trials of their exposure to randomly
occuring electrical stimulation. The first six presentations of each
stimulus level to each sender were sampled. Thus the videotapes com-
prised a sequence of 180 stimulus presentations, containing 60 stimulus
presentations of senders in each of the three social influence condi-
tions. The videotapes were 56 minutes in length.

Each excerpt showed the senders' upper bodies from about the
middle of the torso up to the face (the hands were usually not visible). To
the right of the sender, at about head-level, was a light which
came on at initial shock presentation, and terminated five seconds
later. Each excerpt of the behaviour of a sender occurred in the
following sequence. Following several seconds of TV black, the sender
was shown prior to the presentation of the shocks. This exposure was
measured in tape to be one foot long (approximately two seconds). Then
the light beside the sender's head came on for five seconds and the scene was cut one second after the light went out. Thus, each excerpt occupied a total exposure time of eight seconds. Eight to ten seconds of TV black separated each trial to give the observer sufficient time to make a rating.

Above the television screen was mounted a sheet of cardboard displaying the following rating categories that subjects were to employ in the experiment: A-UNDECTABLE, B-POSSIBLE SENSATION, C-NON-PAIN SENSATION, D-VERY FAINT PAIN, E-MILD PAIN, F-MODERATE PAIN, G-STRONG PAIN. This scale was identical to that used by Prkachin (1978) save one word. The experimental room contained the A/V equipment, a table, and four chairs. Subjects sat at a self-chosen distance from the television monitor, ranging from two to four feet. The experimenter sat beside the subject, facing the screen and recording the orally-given responses on a coding sheet.

Procedure

Upon arrival at the laboratory subjects were greeted and requested to take a seat. The experimenter informed them that the instructions for the study were tape-recorded and that he would occasionally be adding explanations to them. They were also told that they could interrupt anytime if they had questions. The tape-recorder was then turned on and the subject listened to the following preliminary instructions:

"In this study we are investigating how people respond to others in distress. More specifically, we are interested in how well you identify and judge the expressive behaviour of other people who are experiencing various levels of pain."
First, if you wish to participate you may give your consent."

The subjects were then given the consent form (Appendix A) to read and sign. All subjects gave their consent to take part. Following this, subjects were requested to complete a questionnaire measure of emotional empathy (Mehrabian & Epstein, 1972). After subjects had filled out the questionnaire, the tape recorder was then turned back on. At this point subjects listened to the following standard instructions:

"First of all, some description may help you understand what is happening. The people that you will be watching took part in an experiment on the perception of pain."

Depending on the experimental group to which the subject (henceforth referred to as "observer") had been assigned, one of the following sets of instructions then occurred.

**Sandpaper (S) group.**

"They (the senders) were seated in the laboratory and as part of the experiment, an abrasive surface that produces pain hypersensitivity was rubbed on their forearm, after which they had an electrode attached to their arm on the sensitized area. Then they were exposed to a series of electric shocks of varying intensities. These shocks were presented over and over to the subject many times. The particular type of surface, roughly akin to a medium grade sandpaper, that each subject elected to have administered to her forearm has a pain-enhancing property that lasts for 2 to 4 hours. All subjects had the option of discontinuing the experiment at any time. Your purpose is to provide ratings that will enable assessment of the effect of the abrasive surface on pain sensitivity."

**Darvon (D) group:**

"They were seated in the laboratory and had an
electrode attached to their arm. As part of the experiment, each person was given two analgesic or pain-relieving tablets which they ingested before proceeding. Then they were exposed to a series of electric shocks of varying intensities. These shocks were presented over and over to the subject many times.

"The particular type of tablet, Darvon, that each subject elected to take, has a pain-reducing property that lasts for 2 to 4 hours. Your purpose is to provide ratings that will enable assessment of the effect of the tablets on pain sensitivity."

Control (C) group.

"They were seated in the laboratory and had an electrode attached to their arm. Then they were exposed to a series of electric shocks of varying intensities. These shocks were presented over and over to the subject many times."

Following exposure to one of the above instructional manipulations, instructions continued as follows for observers in all groups. The videotape was turned on, displaying a sample of sender behaviour.

"Each time the light goes on in the film the person was shocked twice for about a half second."

Then there was a five second pause while the light came on in the film.

"After the light has been on for two seconds, the shocks end, and the person describes in words how the shock felt. You will look at the screen and each time the light goes on, try to determine how much pain the person is feeling. In front of you is a chart providing a scale for rating the person's pain. The scale goes from A to G. In each case, you'll look at the screen and each time the light goes on you will view the person receiving two brief shocks. Then after the shocks end, you will look at the scale and choose a letter from A to G that best corresponds to how much pain the person in the film seemed to be feeling upon receiving the shocks. You will then say the letter out loud. If you have any questions, please ask them now."
At this point, observers were encouraged to ask questions and the tape was turned off. Some additional description about the scale was given by the experimenter.

"The scale goes from weak to strong ... a rating of "A" means it looked like the person couldn't feel anything ... a "B" means it looked as though the person MAY have felt something but they may NOT have, you're not really sure. A "C" means it looked as though the person definitely did feel something, but it was not painful. A "D" means they did feel something and it WAS painful. The other ratings stand for successively higher pain sensations. Is that clear?

"Now, we'll try a few practice trials. Before we begin, I want to draw your attention to one thing. There is no sound on these videotapes. In the experiment itself, the subjects could hear a sound that indicated to them when the shock was being administered. It was a clicking noise. Since the light in the film stays on for 5 seconds, it tends to deceive people into thinking that the shock lasts for 5 seconds. So for the practice trials, I'll simulate the sound that the subject hears so that you get the idea of how long the shocks actually lasted."

Then six practice trials were run, with the experimenter simulating the clicking noise that occurred at the onset of each shock. At the end of the practice trials, the tape recorder was turned on again, and observers listened to the following set of instructions.

"Remember to pay close attention to that first two seconds because that is when the person is being shocked. The behaviour of the person AFTER the two second period shows her making up her mind about the shock she just received and describing it. Here are some final points. First, when making your ratings on the scale, try to spread your responses out, that is, try to use all of the categories from A to G. Avoid repeating the same letter over and over. Second, some people will be easy to judge, others may seem quite difficult. Please pay close attention and try to do your best throughout. Third, it may have occurred to you that the people you'll be seeing are not
really being shocked at all, but are just faking it. This is not the case. On each trial, every subject is receiving a shock. Fourth, the trials appear in random order and do not necessarily follow an actual sequence in time. Now you will have some more practice trials."

At this point, observers had six more practice trials, with experimenter substituting the word "NOW" at the point at which the shock ended on each trial. Observers were then asked if they felt they had had enough practice. All indicated that they had had enough. Finally, the tape recorder was turned on again, and the following instructions were given.

"Now you will see more videotapes of people experiencing different levels of pain. We are interested again in how well you can determine how much pain they are feeling. At this point I will remind you again: when making your ratings on the scale, try to spread your responses out; that is, make sure to use all of the categories from A to G. Try to avoid repeating the same letter over and over. If you have any questions, please ask them now."

At this point the explicit instructions about the treatment (either sandpaper, darvon, or control) were repeated as above.

Darvon and Sandpaper observers were then asked if they understood the procedure described. All indicated that they had. The experimental task then began. Following completion of the task, observers completed a two-page debriefing questionnaire (see Appendix B). The questionnaire contained items addressing observers' understanding of the experimental task, observers' attitudes toward the task, and more specifically, observers' beliefs about the effectiveness of the treatment (darvon or sandpaper) on senders and on their own ratings. It also investigated the importance of elements of the filmed presentation in their ratings. When the questionnaire had been completed, the
experiment was explained to the participants and any questions were answered. Subjects were then thanked for their participation and requested not to talk about the experiment.
RESULTS

For the purpose of SDT analyses, the discriminability measure $E$ (Simpson & Fitter, 1973) was used. $E$ is a non-parametric measure of discriminability defined as follows:

$$E = (I_A - I_B)\left(\frac{2}{s^2_A + s^2_B}\right)^{1/2},$$

where $I_A$ and $I_B$ are the average ratings given to the stimuli A and B and $s^2_A$ and $s^2_B$ are the variances of the two rating distributions. $E$ is equivalent to the area under the receiver operating curve, $P(A)$.

Frequency tables were generated for use in the calculation of a response-bias measure, average scale rating (hereafter referred to as $A$). This measure was obtained by taking the average of the 7-point scale ratings given by observers to samples of sender behaviour elicited by high, medium, and low shock intensities, and was calculated separately within tolerant, control, and intolerant modeling conditions.

The data derived were investigated by analysis of variance (ANOVA). Three potential effects were of principal interest in these analyses: (1) whether the SDT parameters varied systematically as a function of the discrimination that observers performed (that is, did $E$ and/or $A$ differ between the high vs. medium (HM) and medium vs. low (ML) discrimination); (2) whether the parameters varied systematically as a function of the modeling condition to which observed subjects had been exposed; and (3) whether the parameters varied systematically as a function of the instructional condition to which observers were exposed.

The analysis of $E$ was conducted according to a 3 (Instructional...
Condition) \times 2 (Sex) \times 2 (Discrimination Level) \times 3 (Modeling Condition), ANOVA with repeated measures on the last two dimensions. The analysis of A was the same except that the 3 level Shock Intensity variable replaced the Discrimination variable of the E analysis.

The analysis of E resulted in a significant Discrimination effect, $F(1,24) = 173.14, p < .001$, a significant Modeling Condition effect, $F(2,48) = 28.59, p < .01$, and a significant Sex effect, $F(1,24) = 8.75, p < .01$. A significant interaction occurred between Modeling Condition and Discrimination Level, $F(2,48) = 8.23, p < .001$.

Examination of means revealed that E values for the HM discrimination were greater than those for the ML discrimination (mean $E = 0.509$ and $-0.126$, respectively). Thus, the ability to discriminate shock-elicited expressive behaviour was closely related to the magnitude of current the observed subject was exposed to.

Mean E values for the significant Modeling Condition main effect were $0.039$ for group T, $0.248$ for group I, and $0.288$ for group C. The differences between the tolerant group and the other two groups exceeded the critical value for Dunn's multiple comparison procedure ($t' D .01/2; 3,48 = .08$). Thus, observers exhibited reliably lower E values when observing the behaviour of subjects exposed to a tolerant model than when they observed the behaviour of subjects exposed to an intolerant model or to controls. Examination of means revealed that E values for male observers were greater than those for female observers (mean $E = 0.232$ and $0.151$, respectively. Thus, males exhibited better performance in discriminating shock-elicited expressive behaviour than did females.
The significant Modeling x Discrimination interaction is depicted in Figure 1. Test of this interaction for simple effects indicated a significant difference among Modeling Conditions at the HM level of discrimination, $F(2, 48) = 52.47, p < .01$. Test for a simple effect between HM and ML levels of discrimination revealed a significant difference at tolerant, $F(2, 48) = 20.09, p < .01$, control, $F(2, 48) = 105.37, p < .01$, and intolerant, $F(2, 48) = 59.04, p < .01$, modeling conditions. Further post-hoc analysis ($\alpha = .05$) with Tukey's HSD procedure revealed that the significant difference among Modeling Conditions at the HM level of discrimination occurred between group T and the other two groups with groups I and C not differing, critical value = 0.17. Thus, the expressive behaviour of senders exposed to a tolerant model was significantly less discriminable relative to senders exposed to an intolerant model or an inactive companion, at the HM level of discrimination.

Results of the analysis of $A$ indicated a significant main effect for Instructional Condition, $F(2, 24) = 4.22, p < .03$, for Discrimination Level, $F(2, 48) = 186.28, p < .001$, and for Modeling Condition, $F(2, 48) = 20.46, p < .001$. A significant interaction occurred between Modeling Condition and Discrimination Level, $F(4, 96) = 26.37, p < .001$.

Mean $A$ values for the significant Instructional Condition main effect were 2.772 for group D, 2.963 for group C, and 3.466 for group S. The difference between groups S and D and the difference between S and C exceeded the critical value for Dunn's multiple comparison procedure ($t' D .05/2; 3.24 = .45$). Thus, observers exhibited higher $A$ values when instructed that an abrasive (sandpaper-like)
Figure 1. Interaction between Modeling Condition and Discrimination level on the measure of discrimination (E).
$E$ (Discriminability) Value

Tolerant  Control  Intolerant

Modeling condition of sender
surface had been administered to the forearm of subjects, relative to observers instructed that subjects were receiving darvon and relative to controls.

Mean $A$ values for the significant Shock Intensity effect were 3.431 for high, 2.959 for low, and 2.810 for medium levels of shock. The differences between all three means exceeded the critical value for Tukey's multiple comparison procedure (0.13). Thus, observers exhibited reliably lower $A$ values when observing the behaviour of subjects receiving high levels of shock relative to when they were observing the behaviour of subjects receiving low levels of shock, and, paradoxically, they exhibited even lower $A$ values when observing the behaviour of subjects receiving medium levels of shock.

Mean $A$ values for the significant Modeling Condition effect were 2.927 for group T, 3.068 for group I, and 3.205 for group C. The differences between all three means exceeded the critical value for Tukey's multiple comparison procedure (0.13). Thus observers exhibited reliably lower $A$ values when observing the behaviour of subjects exposed to an intolerant model relative to when they were observing the behaviour of controls, and they exhibited even lower $A$ values when observing the behaviour of subjects exposed to a tolerant model relative to when they observed either intolerant or control subjects.

The significant Modeling x Shock Intensity interaction is depicted in Figure 2. Analyses of simple effects indicated a significant difference among Modeling Conditions at the high shock intensity, $F(4,96) = 69.32, p<.01$. Post-hoc analysis with Tukey's HSD procedure revealed that all three Modeling Conditions differed significantly (critical
Figure 2. Mean A (average pain rating) values as a function of sender's Modeling Condition and Shock Intensity.

Note: A value of 1 = Undetectable shock, a value of 7 = strong pain.
2.1 Tolerant Control

Tolerant Control Intolerant

Modeling condition of sender

A (Bias) value

HIGH
LOW
MEDIUM
value = 0.15). Test for simple effects among Shock Intensity revealed significant differences at tolerant, $F(4,96) = 26.90, p < .01$, control, $F(4,96) = 344.81, p < .01$, and intolerant, $F(4,96) = 135.49, p < .01$, modeling conditions. Further post-hoc analysis indicated that means for high, medium, low shock intensities differed at tolerant and control modeling conditions. At the intolerant modeling condition the high level of shock intensity differed significantly from the low and medium levels, which were insignificantly different from each other.

**Empathy Ratings and Body Area Ratings**

Analyses of observer scores on the questionnaire measure of emotional empathy were conducted according to a $3 \times 2$ ANOVA (Instructional Condition x Sex). This analysis revealed a significant main effect for Sex, $F(1,24) = 25.36, p < .001$. Examination of means revealed that empathy score values were higher for females than for males (means = 65.87, 29.47, respectively). Relationships between observer empathy scores and other response parameters were analyzed by Pearson correlation coefficients. Average values of $E$(discriminability) were calculated for each observer. These values correlated $-.37 (p < .05)$ with scores on the emotional empathy scale, while average values of $A$ (response bias) for each observer correlated $+.13$ (n.s.) with scores in the same scale. These results indicate that observers obtaining highest $E$ scores tended to obtain relatively low emotional empathy scores.

Observer ratings on the post experimental questionnaire evaluating the importance of body areas were investigated by a $3 \times 2 \times 10$ ANOVA (Instructional Condition x Sex x Body Area). Average ordinal ratings
are presented in Table 1 and as can be seen from this Table, observers indicated that areas of the face, particularly the eyes, were the most important areas that they attended to when making their ratings.
Table 1

Average Ordinal Ratings of Body Areas

<table>
<thead>
<tr>
<th>Average Rating</th>
<th>Body Area (cf. Waxer, 1977)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7</td>
<td>eyes</td>
</tr>
<tr>
<td>3.1</td>
<td>eyebrows</td>
</tr>
<tr>
<td>3.2</td>
<td>eyelids</td>
</tr>
<tr>
<td>3.7</td>
<td>mouth</td>
</tr>
<tr>
<td>5.6</td>
<td>angle of head</td>
</tr>
<tr>
<td>5.7</td>
<td>forehead</td>
</tr>
<tr>
<td>7.4</td>
<td>shoulder posture</td>
</tr>
<tr>
<td>7.5</td>
<td>torso position</td>
</tr>
<tr>
<td>8.3</td>
<td>arm position</td>
</tr>
<tr>
<td>8.9</td>
<td>hands</td>
</tr>
</tbody>
</table>
DISCUSSION

The findings of this study may be summarized as follows. Observers were capable of discriminating differences in the behaviour elicited by low, medium and high shock levels. The ability to discriminate shock-elicited behaviour was closely related to the magnitude of current to which the sender was exposed. The difference between behavior elicited by high levels of shock and behavior elicited by medium levels of shock was more readily discriminated than was the difference between behavior elicited by medium levels of shock and behavior elicited by low levels of shock. The discriminability of shock-elicited expressions varied systematically as a function of the modeling condition of the sender, with the behavior of senders exposed to a tolerant model associated with the lowest values of $E_-$, and the behavior of senders exposed to an inactive co-participant associated with the highest $E_-$ values. Variation in this effect occurred between the medium vs. low (ML) and the medium vs. high (HM) discrimination, indicating that the reduction in $E_-$ for senders in the tolerant modeling condition occurred only at the HM discrimination. Males discriminated sender behavior more accurately than did females.

Observers reported observing less distress in senders (lower $A$ scores) when instructed that senders were receiving darvon, relative to observers instructed that an abrasive surface had been administered to the forearm of senders and relative to controls. Observers reported less sender distress when observing the behavior of senders receiving low levels of shock, and paradoxically, they reported even less sender distress when observing the behavior of senders receiving medium levels of shock. This effect occurred across all modeling condition levels except in the Intolerant condition where-in low and medium did not differ significantly. Observers reported less
sender distress when observing the behavior of senders exposed to an intolerant model than when they observed controls, and they exhibited even lower values when observing the behavior of senders exposed to a tolerant model relative to when they observed either intolerant or control senders. Variation in this effect occurred among the three levels of shock intensity, indicating that the reduction in A for senders in the intolerant modeling condition and the further reduction in A for senders in the tolerant modeling condition occurred only at high levels of shock. Observers who exhibited good discriminative performance tended to obtain relatively low emotional empathy scores. Observers' post-observation ratings indicated that areas of the face, particularly the eyes, were the most important areas that they attended to when making their ratings.

The fact that the HM discrimination was associated with greater values of E than the ML discrimination replicates Prkachin's (1978) findings. This effect was thus effectively generalized to a larger sample of observed senders. The current intensities presented to observed senders were selected, prior to their undergoing electric shock, from 3 subject-defined levels: (1) the non-aversive sensation threshold (L), (2) slightly below pain threshold (M), (3) the clearly painful midpoint between pain threshold and pain tolerance (H) (cf., Prkachin, 1978, Experiment 1). Only the latter stimulus level would be expected to reliably elicit expressive responses clearly indicative of pain. Observer E values for the HM discrimination were much higher than for the ML discrimination, suggesting that the superior performance was due to the occurrence of expressive responses clearly indicative of pain among senders receiving levels of current intensity (H) previously determined to be painful.
The fact that observers reported greater sender distress (higher A values) for senders receiving high levels of shock supported the expectation that expressive responses indicative of pain would occur and be observed more readily at this level of current intensity than at non-painful levels. The finding that observers reported greater sender distress for senders receiving low levels of shock relative to senders receiving medium levels of shock provides some interpretive problems. The differences, although small in rating scale value, are significant for two modeling conditions (tolerant and control). One possible explanation derives from the incidental aspects of sender response to noxious stimulation. Senders generated a variety of behavior apparently unrelated to the occurrence of the electric shock, for example, chewing gum, turning the head, or gazing around the experimental room. Among senders receiving non-painful levels of shock (Medium and Low), such incidental movements may have appeared to observers as relatively major sources of variation in sender response to the experimental stimulus. It was observed by the experimenter that the onset of the stimulus usually inhibited or terminated such incidental movements. Senders receiving painful levels of shock (H) generally evidenced considerable inhibition of incidental movement in addition to expressive behaviors more clearly indicative of pain. Medium levels of shock may have produced somewhat less interruption of incidental movement and low levels the least. It may be hypothesized that, among medium and low levels of shocks in the absence of clear indications of pain, observers may have mistakenly interpreted greater residual amounts of incidental movement as indicative of more pain, and thus reported more distress, for senders receiving low levels of shock relative to medium levels. This explanation could be tested by rating senders on amount of movement (incidental or otherwise), then examining the correspondence between observer reports of
sender movement and sender discomfort.

A second possible interpretation derives from the observation that senders receiving low levels of shock appeared more frequently to exhibit an expression of intense concentration while attempting to discern the presence or absence of the barely detectable (threshold) stimulus. Such an expression bears a resemblance to someone in distress and could have produced artifactual elevations in ratings. The fact that observers reported least distress (lower $A$ values) when observing the behavior of senders exposed to a tolerant model and most distress when observing senders exposed to an inactive co-participant indicates that both active modeling inferences (especially the tolerant model) produced discernible reductions in expressive reaction to noxious stimulation. Epley's (1974, p. 273) observation that "a companion that emits calm responses in a threatening situation may elicit similar behaviors from the observing subject" is supported in that both the tolerant and intolerant model made ratings in an expressive style that was quite dispassionate (independent of the actual content of their ratings) and both produced reductions in pain display of senders. The inactive co-participant made no expressive communication, thus minimizing any calming influence that might arise through the expressive style of a companion.

Reliable differences in the discriminability of shock-elicited expressions were obtained as a function of the modeling condition of the sender, for discriminations involving noxious levels of stimulation. The behavior of senders exposed to a tolerant model was less discriminable than the behavior of senders in both of the other groups. In contrast to Prkachin's (1978) study, however, only the behavior of senders exposed to a tolerant model was significantly less discriminable than that of control subjects. In Prkachin's experiment, which used similar stimulus materials, a similar pattern of findings
emerged, with the behavior of senders exposed to a tolerant model being less discriminable than that of subjects exposed to an intolerant model or controls. The behavior of subjects exposed to an intolerant model was also less discriminable than that of control subjects. It is likely that the source of this discrepancy lies in the manner in which excerpts of behavior were chosen for viewing by observers in the two studies. In Prkachin's study, observers viewed fewer senders but for longer periods of time. In the present study, observers viewed only the first two examples of sender behavior at each of the three levels of shock intensity for 30 subjects. For the foregoing reason it can be concluded from the present study that the impact of exposure to a tolerant model on pain displays of senders is relatively powerful and immediate. The reductions in pain displays for senders exposed to an intolerant model apparently occurred less rapidly than did reductions in pain displays for senders exposed to tolerant models. The relative delay in the effectiveness of exposure to an intolerant model in reducing pain displays may imply that the intolerant and tolerant modeling influences may have elicited different processes in senders exposed to them. While both models may have exerted a calming effect on senders (Epley, 1974), it is possible that higher subjective pain ratings given by the intolerant model exerted an effect on senders that was superimposed upon the calming effect. The numerical estimate information provided by the intolerant model, while salient during the initial stages of the shock series, may have diminished in importance after several exposures to the shock, as the sender became aware of the compelling fact of the intolerant model's dispassionate demeanor.

The differences in expressive response produced by modeling influences may have important relationships to other aspects of the experience of pain.
In a series of studies, Kleck, Lanzetta, and their colleagues have marshalled evidence consistent with the notion that the experience of pain may be directly modulated by overt expressive behavior. In three experiments designed to explore the relationship between expressive behavior and the intensity of emotional arousal, Lanzetta, Cartwright-Smith & Kleck (1976) asked subjects either to exaggerate, or to conceal the facial display associated with the anticipation and reception of painful shocks that varied in intensity, in order to examine the effects of augmentation and reduction of facial expression on self-reports of pain and skin conductance measures of arousal. Results indicated parallel changes in both indices among subjects instructed to alter facial responses. Both the magnitude of skin conductance responses and self-reports of discomfort were lower during pose-no shock trials compared to pose-intense-shock trials. The authors accounted for these findings by proposing that subjects may have responded to the request to pose facial expressions by reappraising the painfulness of the shock in order to make their expressions appear authentic. This cognitive reappraisal was suggested to have reduced or augmented the actual level of stress.

In an extension of this paradigm, Kleck, Vaughan, Cartwright-Smith, Vaughan, Colby, and Lanzetta (1976) examined the effects of the presence of an observer on expressive responses to painful stimuli and on subjective and autonomic reactions. Subjects who were led to believe they were being observed behind a one-way window evidenced attenuated expressive responses to shock, accompanied by a general decrease in subjective pain reports and autonomic responses to the noxious stimuli. The authors explained the covariance of expressive and subjective indices of pain in terms of classical conditioning. Expressive responses as well as autonomic activity were conceived as uncondi-
tioned responses to emotionally arousing stimuli. By taking the temporal relationships between the two sets of responses into account, it was suggested that the former invariably precede, and often overlap, the latter responses. Thus expressive cues may come to function as conditioned stimuli for autonomic responses. Expressive cues and autonomic responses may be conceptualized as interacting with the unconditioned stimulus, so that changes in one component of the interaction may produce parallel changes in one or both of the others.

Colby, Lanzetta, & Kleck (1977) instructed subjects to adopt facial expressions of pain of various intensities under conditions in which they terminated increasingly intense electric shocks at their tolerance level. This procedure was instituted to investigate whether overtly instrumental responses related to pain, in addition to subjective and autonomic responses, are subject to modulation via facial expression. Although the effect of posing on level of shock tolerated by subjects was not significant, the previously obtained correspondence between facial expression and skin conductance was observed. Subjects in one condition of the study were provided with direct control over the stressor, thus obviating the potential instrumental value of facial expression in terminating the pain. The link between facial expression and skin conductance remained however, leading the authors to suggest that facial feedback effects are not limited to conditions in which expressions may play a communicative or instrumental function.

Although the specific mechanisms responsible for the covariance of expressive and subjective indices of pain are not clear, the classical conditioning explanation offered by Kleck et al. (1976) may prove fruitful, in its conception of expressive behavior working in reciprocal influence with subjective and autonomic responses to potentially painful stimuli. Such a view
reflects recent conceptions of the cause of behavior in which behavior is no longer considered to be a by-product of interdependent persons and situations, but is recognized as an interlocking determinant in the causal process (Bandura, 1978).

The instructions designed to increase reports of observed pain were relatively effective in elevating reports of observed pain while those designed to decrease reports of observed pain were relatively ineffective in producing such decreases. Thus, providing observers with pain-relevant information prior to observing senders was effective in altering reports of observed pain without altering the discriminability of pain behavior. The relative ineffectiveness of the darvon instructions is not clarified by observer responses to the debriefing questionnaire (Appendix B). On a scale where 1 was very much so and 5, not at all, observers gave the darvon and sandpaper treatments mean ratings of 2.4 and 2.7, respectively as making a difference to the senders' experience of pain. In response to the questionnaire item asking whether knowledge of the treatment affected their ratings, 44% of the observers receiving darvon and 30% of observers receiving sandpaper instructions responded affirmatively.

The ineffectiveness of the darvon instructions in influencing pain reports downward may indicate the operation of a kind of basement effect. Sender expressive displays produced an average rating by uninfluenced observers of 2.963 on the 7-point scale. This number corresponds approximately to the third lowest scale category, non-pain sensation. The fourth lowest scale category (very faint pain) is, by definition, the threshold for pain observation. The average observer rating of 2.963 indicates that the majority of sender responses were rated as below this threshold. Thus it may be that the darvon
instructions were ineffective in reducing observer reports of sender pain because observers were already reporting very little pain. The effectiveness of the sandpaper instructions is interesting in light of numerous incidental observer comments which suggested that observers in the sandpaper group believed this treatment to be less effective due to the generally low level of distress they perceived in observed senders subsequent to being informed of the highly painful sounding experience to which they had been exposed. Apparently the prior biasing information exerted an effect on observer ratings despite considerable doubt as to its effectiveness. This suggests that observer willingness to report pain can be influenced independently of direct evidence of pain.
The finding that prior pain-relevant information is effective in altering reports of observed pain is an important one. The importance and validity of this phenomenon would increase with a demonstration that altered biases have further behavioral consequences for observers of pain. It would be possible to provide observers with an opportunity to demonstrate overt caretaking responses to persons in distress by means of a design whereby observers would receive biasing pain-relevant information, then would rate a sender’s expressive behavior, as in the present study, with the following modifications.

First, the observer would actually be present during the administration of the shock; second, the observer would make ratings on paper, rather than aloud; third, the observer would be requested to assist in ensuring the comfort of the person receiving the shocks, and so would be instructed to engage in one of a variety of caretaking responses following each rating. For example, if a 7-point scale were employed by observers, where 1 is UNDETECTABLE SENSATION, 7 is STRONG PAIN, and 4 is VERY FAINT PAIN, observers would be instructed to rate the amount of pain observed for each presentation of shock to the sender. Additionally, they would be informed of their option to communicate, after any trial; a message of succor to the sender, such as a request as to how the sender was feeling, or a reminder of the sender's right to terminate the session at any time.

It would thus be possible to investigate the effect of prior pain-relevant information in altering not only reports of observed pain, but also overt behavioral responses to pain displays. Of note is the additional fact that observers' caretaking responses would be made directly to shocked senders, enabling investigation of possible shaping influences of
the caretaking responses on sender judgments of current intensity. Although details of this example are not complete, it suggests a design that might clarify naturally-occurring processes of mutual influence between pain sufferer and caretaker.

The finding that observers who obtained highest discriminability scores tended to obtain relatively low emotional empathy scores requires some discussion. In reviews of research on empathy, Mehrabian & Epstein (1972) note two different approaches to empathy. The first is represented by Dymond's (1949) cognitive role-taking approach; an empathic person is said to imaginatively take the role of another and can understand and predict that person's thoughts, feelings, and actions. In this context, the neutrality and detachment of the empathizing person was viewed as aiding accuracy (e.g., Rogers, 1957). The second approach defined empathy as a vicarious emotional response to the perceived emotional experiences of others. The critical difference is that cognitive role-taking is the recognition of another's feelings, whereas empathic emotional responsiveness includes sharing of those feelings, at least at the gross affect (pleasant-unpleasant) level. Scores on Mehrabian & Epstein's empathy scale reflect the second definition of empathy. The significant negative correlation between empathy scale scores and observers' discrimination scores has some interesting theoretical implications. The notion that empathic processes are critical conditions for successful psychotherapy is a fundamental proposition of client-centered therapy (Rogers, 1957), and is a widely held belief among clinicians and researchers alike. Mehrabian and Epstein (1972), among others, have suggested that high levels of emotional empathy may predict success of beginning therapists. Taken at face value, the relationship discovered in the present study suggests a more cautious
attitude toward such speculation. Observers who obtained high empathy scores tended to be poor observers of behavior. Assuming the validity of this relationship, at least two possible interpretations having relevance to therapeutic processes can be offered. One is that effective therapeutic change occurs when a therapist behaves in an emotionally empathic manner, and that skill in observing the behavior of another is irrelevant to therapeutic change. Alternatively, if it is accepted that effective therapy requires accurate observation of behavior on the part of the therapist, it may be that employing therapists who are naturally empathic, or training therapists in empathy, focuses on a factor that makes for ineffective therapy.

Strong sex differences in scores on the empathy scale and in discriminative performance were observed: men obtained much lower emotional empathy scores ($\bar{X} = 29.47$) than women ($\bar{X} = 65.87$) and higher $E$ scores (means 0.232 and 0.151, for males and females, respectively).

In the present study, use of SDT methodology allowed the separation of two components of observers' response to evidence of pain in others: ability to discriminate differences in shock-elicited expressions and tendency to report the presence of pain. The finding that instructional manipulations were capable of affecting the second component has potential implications beyond the experimental setting employed in this study. The task undertaken by observers in this study was roughly analogous to the type of activity engaged in by physicians attempting to assess the magnitude of pain experienced by patients.
The present findings indicate that information about a patient's treatment may be an effective determinant of a diagnostician's criterion for accepting a particular set of evidence as indicative of pain. A great number of variables have the potential to influence the decisions of diagnosticians in the natural setting. The effectiveness of information about a patient's personal characteristics, the history of the problem, its response to treatment, the presence of psychiatric disturbance, and the patient's ethnicity, may prove of differential importance in pain diagnosis.

Theoretically, the signal detection parameters of discriminability and bias are conceived to be independent of one another. Factors that produce alterations in one index need not have any effect on the other that can be specified a priori. Clark (1974) has empirically demonstrated such independence with respect to direct psychophysical judgments by subjects undergoing painful experience. The fact that the instructional manipulations employed in the present study exerted their effect exclusively on the measure of bias and had no impact on the measure of discrimination is, of course, consistent with the common belief that instructional manipulations affect only decision-making processes.

It is possible, however, that certain pain-relevant information could induce alterations in both the tendency of a diagnostician to accept behavioral evidence as indicative of pain, and in the accuracy of the diagnosticians' judgments. For example, in the natural setting, prior information regarding a number of characteristics might affect diagnostic accuracy by way of influencing factors such as willingness to spend sufficient time with a patient in order to observe an adequate sample of his/her behavior, or
closeness of attention to details of a patient's behavior in arriving at a decision.

Consider a hypothetical example in which diagnosticians are required to evaluate the severity of two groups of patients' pain expressions in relation to some category scale. Assume that prior calculation of discriminability scores of two groups of diagnosticians reveals exactly equal values (e.g., $E = 1.0$) for the two groups of patients. Another two groups of diagnosticians are now presented with the same pain expressions, except that this time, one group is told that the patients are all Italian, whereas the second group is told that the patients have psychiatric problems and are obsessive neurotics. Conceivably, both types of information could induce similar biases against diagnosing severe pain in both patient groups. For example, what was formerly judged as severe pain might now be accepted as evidence for mild pain. This would be revealed as a criterion shift when SDT parameters were calculated. However, the presence of biasing information might additionally affect processes underlying diagnostic accuracy as well. For example, if the information that the patient was Italian tended to make diagnosticians relatively less attentive to the patient's behavior and less willing to spend sufficient time before arriving at a decision, the accuracy of the judgment could be vitiated. If, on the other hand, the information that the patient was obsessive induced a relatively close scrutiny of his behavior and a more thorough examination than for a non-obsessive patient, judgment accuracy could be enhanced. It can be seen how a difference in closeness of attention and time spent making a judgment could affect hit and false alarm rates in a signal detection task. For this hypothetical case, subsequent calculation of judgment accuracy scores
on the decisions generated by each group of physicians under the influence of one of the two types of biasing information conceivably could reveal that the physicians informed that the patient was Italian evidenced average $E$ scores of 0.7 while those informed that the patient was obsessive evidence average $E$ scores of 1.2.

In this example, both types of biasing information could be equally effective in altering the physicians' tendency to accept a particular set of evidence as indicative of pain. However, one type (ethnic information) produced a decrease in diagnostic accuracy ($E$ went from 1.0 to 0.7) while the other type (psychiatric information) produced an increase in diagnostic accuracy ($E$ went from 1.0 to 1.2). Various types of pain-relevant information could be evaluated in this way as being potentially valuable, useless, or even detrimental to diagnostic decision-making. Subsequent identification of the influence on specific factors determining judgment accuracy of biasing information could stimulate research into processes underlying accurate diagnostic decision-making, and possibly result in increases in accuracy.


APPENDIX A

CONSENT FORM

NAME_________________________

I hereby consent to participate in a research project that involves that I:

1) fill out a 33-item personality questionnaire

AND

2) view a number of videotapes taken of 30 people who participated in another experiment where they were subjected to electric shocks of differing intensities, and rate the discomfort of each person in the videotape.

All of this will take approximately one hour, thirty minutes.

At no time during this experiment will I receive any shocks myself.

I may withdraw from this experiment at any time. I understand that the risks are minimal. The personality questionnaire data and ratings will only be available to the personnel involved in this research project.

Signature_________________________________

Date_______________________________________
APPENDIX B

POST-SESSION QUESTIONNAIRE

1. Do you think the treatment made a difference to the pain of the persons receiving the shocks?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>very much</td>
<td>so</td>
<td>not at all</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Why or why not?

2. Did you feel confident about your ratings of the pain of each person in the film?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>very</td>
<td>confident</td>
<td>not at all</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comment:

3. What do you feel was the purpose of this experiment?

4. Did anything seem odd or suspicious throughout?

5. Rank each of these time periods from 1st most important to 4th most important in making your ratings.

   1) before the light came on.
   2) when the light came on until 2 seconds later.
   3) more than 2 seconds after the light came on until it went off.
   4) after the light went off.

6. Do you feel that your knowledge of the treatment affected your ratings of each subject's discomfort? If so, how?

7. Rank the following in terms of how important they were in determining your judgments. Use 1 for the most important, 2 for the next, etc.

   forehead ___
   eyebrows ___
   eyelids ___
   eyes ___
   mouth ___
   angle of head ___
   shoulder posture ___
   arm position ___
   torso position ___
   hands ___

THANK YOU FOR PARTICIPATING.