THE USE OF IMAGERY FOR THE CONTROL OF EXPERIMENTALLY INDUCED
PAIN: PRESCRIBED VERSUS INDIVIDUALIZED IMAGERY

DISSERTATION

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By

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Measures of pain tolerance and threshold were obtained for 100 male and female subjects in a pretest treatment posttest experiment using the cold pressor test. Subjects were divided into five treatment groups with an equal representation of males and females in each group. In addition each group was divided into high and low locus of control, resulting in a 2 X 5, locus of control-by-treatment, experimental design. Treatment groups received one of the following five sets of instructions: prescribed pleasant imagery, prescribed angry imagery, self-generated pleasant imagery, self-generated angry imagery, and expectancy control. Credibility checks were obtained on all groups, and an ANOVA revealed no significant differences in credibility ratings among the groups. Imagery involvement was significantly correlated with pain tolerance for external, but not internal locus of control subjects. All imagery treatment groups demonstrated significantly greater gains in pain tolerance compared to the expectancy control group. In addition internal locus of control
subjects demonstrated greater pain tolerance than external ones. With pain threshold, an interaction with treatment and locus of control was obtained. For internal locus of control subjects, prescribed pleasant imagery and self-generated angry imagery were superior to all other treatment groups. For external locus of control subjects, the only significant difference in treatment groups is with self-generated pleasant imagery, which is superior to self-generated angry imagery and expectancy control. Internal locus of control subjects were superior to external ones with prescribed pleasant imagery and self-generated angry imagery. However, external locus of control subjects were superior to internal ones with self-generated pleasant imagery.
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THE USE OF IMAGERY FOR THE CONTROL OF EXPERIMENTALLY INDUCED PAIN: PRESCRIBED VERSUS INDIVIDUALIZED IMAGERY

Traditionally pain has been conceptualized in terms of neurological and biochemical phenomena. As such, research investigating the management of pain initially focused on its presumed sensory substrates. Pharmacologists, physiologists, and physicians spent great energy searching for effective pain control measures, and not without considerable success. However, their best efforts too often met with disheartening or at least less than optimal results. Today, despite a multimillion dollar drug industry, along with various sophisticated surgical techniques, pain remains a major reason for people seeking or avoiding professional health care. These difficulties, along with Beecher's (1956, 1959) evidence for a marked psychogenic component to the subjective pain phenomenon, prompted a renewed and expanded interest in pain and its control. Perhaps the most widely quoted definition of pain currently used in the literature is Sternback's (1968), which emphasizes the multidimensional nature of the pain phenomenon.

Pain is an abstract concept which refers to
(1) a personal, private sensation of hurt;
(2) a harmful stimulus which signals current or impending tissue damage; (3) a pattern of
responses which operate to protect the organism from harm. These responses can be described in terms which reflect certain concepts, i.e., in neurological, physiological, behavioral, and affective "languages." (p. 12)

Pain has come to be viewed as more than a sensory phenomenon. Emotional-motivational and cognitive dimensions have been included to aid in further understanding the complex psychological processes of the pain phenomenon.

Theories of Pain

The two longest lived current pain theories are specificity and pattern theory. Elements of both of these theories, which have long been at odds, have been combined by Melzack and Wall's (1965, 1970) gate-control theory in an attempt to account for both the physiological and psychological evidence at hand regarding pain phenomenon. These three theories will be briefly reviewed here.

Specificity theory postulates a specific set of peripheral nerve fibers, nociceptors, which are responsible for pain sensation (Mountcastle, 1974; Weisenberg, 1977). Simply stated, the theory asserts that stimulation of sets of free nerve endings at the periphery, A-delta and C fibers, are relayed through the lateral spinothalamic tracts in the spinal cord and projected to specific pain centers in the brain. One of the most questioned parts of this
theory is its psychological assumption that sensory experience reflects a one-to-one relationship with a corresponding pain receptor (Melzack, 1973). In other words, a given stimulus to a given receptor invariably results in a given amount of pain. This assumption has not been supported by research which, to the contrary, reports a diverse range of psychological variables mediating sensory input (Weisenberg, 1975). On the other hand, physiological evidence exists that specialization exists within the somaesthetic nervous system. This specialization does not extend, however, to specific types of receptors which elicit sensations in only a single psychological modality (Melzack, 1973). In short, while there is evidence for physiological specialization, there is no support for the hypothesis that pain is completely determined by a one-to-one transmission from specific 'pain receptors' to equally specific 'pain centers' in the brain.

In reaction to specificity theory, Goldschneider (1894) first proposed stimulus intensity and central summation as the critical determinants of pain. This view of pain, in its various forms, has been grouped under the heading 'pattern theory.' Goldschneider proposed (Melzack & Wall, 1965) that pain sensation was the result of transmission of nerve impulse patterns coded at the periphery. Pattern theory has evolved to include a modulation function
of central nervous system inputs, such as prior experience, emotional states, etc., in addition to the coding or patterning function at the periphery (Fordyce, 1976). Thus the evidence indicating marked modification of peripheral pain stimulation by cognitive, affective, and environmental factors is accounted for by pattern theory. However, the theory does not account for the physiological evidence of nerve fiber specialization (Melzack & Wall, 1965).

Melzack and Wall (1965, 1970) proposed the gate control theory of pain in an attempt to reconcile the shortcomings of specificity and pattern theories. Gate control theories recognizes specialized skin receptors as well as uniquely patterned nerve impulses determining somaesthetic perception. In addition central inputs to pain sensation are postulated by the theory. Mendal and Wall (1965) showed that the substantia gelatinosa inhibits or facilitates sensory transmission from the periphery. The assumption is that efferent fiber systems from the brain can modulate afferent impulses. Furthermore, the dorsal column and dorso-lateral systems of the spinal cord are thought to have the capacity to stimulate central attention, memory, and prior experience processes which may then in turn mediate afferent pain impulses from the periphery.

Simply stated, then, gate control theory postulates a two-way communication system by which cortical mechanisms
modulate afferent sensory impulses, which in turn can initially stimulate these same mechanisms into action. The gate control system through which peripheral input transmission is mediated is thought to be the substantia gelatinosa. The major point is, to the extent the 'gate' is closed, pain is not experienced. This active inclusion of central mechanisms in pain perception provides an avenue of research directed at the psychological variables of pain. Conceptually, Melzack (1973) and Melzack and Wall (1970) have represented pain perception as a function of three different, interacting components: sensory-discriminative, motivational-affective, and cognitive-evaluative. The last component, comprising cognitive functions which are thought to modulate both the sensory-discriminative and motivational-affective components, has in the last two decades demonstrated a profound effect on pain perception. This component largely represents the psychological variables that are currently receiving increasing attention regarding pain control. A brief review of these major variables follows.

Psychological Modification of Pain

Pain reactivity has been shown to be a function of many diverse factors. Sex, age, personality attributes, and social and cultural background have all been shown to play a role in pain response (Weisenberg, 1977).
Most of this evidence is correlational and of limited use to the practitioner. Such an accumulation of data does, however, reiterate the aforementioned plasticity of pain perception and response. In addition these findings encouraged researchers to search for psychological manipulations of pain reactivity. No discussion of the psychological manipulation of pain would be complete without at least brief mention of suggestion and placebo in pain relief. The utility of the placebo response has been well documented. Beecher (1972) showed 35% of patients suffering from pathological pain benefited from placebo expectancies of pain relief. Wolf's (1950) classic study underscored the power of the placebo response. In this study patients suffering from nausea and vomiting obtained relief from ipecac, a known emetic, when told that the drug would relieve their symptoms. There is evidence that the utility of the placebo response derives from its impact on the labeling process of pain sensation. Feather, Chapman, and Fisher (1977) conducted a signal-detection analysis of placebos and found that the major effects of placebos were on this labeling process, not on sensory perception. Thus the effect seems more centrally determined than peripherally.

Expectations of effectiveness engendered by placebo treatments, whether in the form of suggestion or medication, have been shown to interact with other treatment modalities.
Suggestion alone can significantly increase the effectiveness of a typical anesthetic (Pollack, 1966). Melzack, Weisz, and Sprague (1963) showed that auditory stimulation, previously thought to suppress dental pain, was only effective when paired with strong suggestion for effectiveness. These results explained the then confusing inconsistencies dentists were having with the treatment. Auditory stimulation was only effective to the extent dentists could generate positive expectancies of benefits in their patients. Findings such as these highlight the hazards of prematurely ascribing specificity of effect to various pain control techniques without the benefit of suitable expectancy control comparisons.

The major impact of expectancies on pain perception is in keeping with the postulate of gate-control theory that cognitive factors can modulate sensory input. The last decade has seen increasing numbers of researchers investigating potential mechanisms as well as specific pain control techniques subsumed under these cognitive factors. The cognitive processes through which suggestion, meaning of pain sensation, and expectancy modulate pain perception are unclear and no doubt quite complex. Never-the-less pain control techniques have emerged in the literature which seem clearly cognitive in function and more specific in form than suggestion alone. To be sure these techniques
engender expectancies regarding pain perception, but the literature to date suggests that they obtain superior results to expectancies and suggestion alone. A review of these cognitive pain techniques follows.

**Cognitive Pain Control Procedures**

Clinical pain is most responsive to opiate, placebo, or hypnosis treatment when associated with elevated anxiety (Weisenberg, 1977). The correlation of anxiety reduction with decreased pain reactivity suggests relaxation, an anxiety antagonist (Wolpe, 1969), as a treatment for pain control. Bobey and Davidson (1970) found relaxation superior to control in increasing pain tolerance to radiant heat and pressure-algometer analog pain. Thompson (1977) used relaxation to reduce pain reactions in dental patients. Grimm and Kanfer (1976) found relaxation superior to control in reducing heart rate, but not tolerance in a study using the cold pressor test as analog pain. However, in a component analysis study of stress inoculation for cold pressor pain, Hackett and Moran (1980) found a significant positive main effect of relaxation and deep breathing on pain tolerance. No pain control studies comparing relaxation to an equally credible placebo control treatment have been located in the literature. Weisenberg (1977) points out that while relaxation has been shown to be an effective pain control procedure, experimental investigations regarding its utility have produced mixed results.
Other cognitively based treatments have produced more consistent experimental results. Covert self-talk and imagery fostering denial, distraction, dissociation, and reinterpretation of pain stimuli have been shown to be superior to expectancy controls in increasing pain tolerance (Avia & Kanfer, 1980; Beers & Karoly, 1979; Grimm & Kanfer, 1976; Horan, Hackett, Buchanan, Stone, & Demchik-Stone, 1978; Scott & Barber, 1977; Winslow & Rimm (unpublished manuscript); Worthington, 1978). Intensity and threshold ratings of pain have also been reduced when pain tolerance is not a variable (Chaves & Barber, 1974; Spanos, Horton, & Chaves, 1975). However, several investigators have had difficulty reducing both pain tolerance and intensity simultaneously (Avia & Kanfer, 1980; Beers & Karoly, 1979; Kanfer & Goldfoot, 1966; Scott & Barber, 1977). Scott and Barber (1977) suggest that reducing both pain tolerance and intensity essentially requires two tasks of the subjects: to tolerate pain for a longer period of time and to experience less pain. The studies reviewed to date suggest that while succeeding at both tasks simultaneously is more difficult than accomplishing one alone, either task is amenable to cognitive intervention strategies.

The specific cognitive strategies used in the experimental investigation of pain can generally be broken down into training in covert self-verbalization or imagery.
Strategies focusing on self-verbalizations typically instruct subjects in statements designed to minimize or transform negative affect and absolutist cognitive evaluations (Beers & Karoly, 1979; Hackett & Horan, 1980; Horan et al., 1978; Jaremko, 1978; Meichenbaum & Turk, 1976; Scott & Barber, 1977; Worthington, 1978; Worthington & Shumate, 1981). Results of these strategies have been somewhat mixed. Beers and Karoly (1979), Jaremko (1978), and Worthington (1978) all found cold pressor pain tolerance increased by self-verbalizations. Conversely, Hackett and Horan (1980) and Worthington and Shumate (1981) found no such effect on cold pressor pain. Both of these studies, however, reported low compliance with the use of the self-instructions during pain stimulation. Hackett and Horan (1980) reported 55% of subjects who received cognitive evaluative training used the coping skills training during pain stimulation, as opposed to 100% for subjects trained in imagery based coping strategies. Similarly, Worthington and Shumate (1981) reported a 26% compliance with self-instruction as opposed to an 81% compliance with imagery training. These studies suggest that subjects may more readily utilize imagery based cognitive pain control strategies, although self-instructional training does appear to be a potentially effective technique.
Studies using some form of imagery or coping strategy for pain control report markedly consistent positive effects. Typically these studies try to induce subjects to use some type of goal directed fantasy activity to lower pain sensitivity. Generally, these pleasant imagery strategies have been found superior to no-treatment control and expectancy control treatments for reducing pain reactivity (Beers & Karoly, 1979; Chaves & Barber, 1974; Grimm & Kanfer, 1976; Scott & Leonard, 1978; Worthington, 1978). However, the expectancy controls in these studies have not been assessed for credibility. Kazdin and Wilcoxin (1976) pointed out that to establish specificity of effect, outcome studies must utilize equally credible placebo controls. Whether or not the expectancy controls used in these studies were as credible to subjects as the cognitive strategies employed is unknown. However, Winslow and Rimm (unpublished manuscript) did find pleasant imagery superior to an equally credible control group, which strengthens the notion of specificity of effect of imagery induced cognitive coping strategies for pain control. The current study intends in part to replicate Winslow and Rimm's (unpublished manuscript) results.

Laboratory studies investigating the effect of imagery on pain reactivity typically attempt to induce subjects into engaging in pleasant imagery during aversive stimulation.
This strategy has consistently increased pain tolerance while occasionally providing concomitant reductions in self-report of pain (Chaves & Barber, 1974; Grimm & Kanfer, 1976; Horan, Layng, & Purcell, 1976; Scott & Barber, 1977). The difficulty in comparing these imagery tasks to neutral imagery strategies was pointed out by Worthington (1978). Typically, the neutral imagery tasks involve having subjects project imaginal numbers on a blank piece of paper, imagine a blank wall, or engage in imagery not related to pain. These somewhat static, impersonal cognitive strategies seem not so complex or personally involving as are the more successful pleasant imagery tasks. Consequently, they may be less effective in occupying a subject's attention for a prolonged period of time. Worthington (1978) attempted to control for complexity and personal relevance of imagery content while varying the affective component from pleasant to neutral. Contrary to his research hypothesis, pleasant imagery was not superior to neutral imagery in either increasing pain tolerance or reducing self-report of pain. Worthington presented two possible reasons for these results. First, the neutral imagery scenes were not truly neutral, as the subjects rated them as slightly pleasant. The comparison made in the study, then, was that of pleasant imagery to slightly pleasant imager, which may not have varied affect enough to produce differential treatment effects.
Second, the neutral imagery may have been equally effective in reducing pain sensitivity because of its personal relevance and content complexity, which engendered involvement equal to that of pleasant imagery. Were this so, personal relevance and complexity of imagery content may be a more reactive component than affective ratings of imagery content regarding self-control of pain. This second contention has been strongly supported by Winslow & Rimm (unpublished manuscript). Their study found both pleasant and sad imagery superior to an equally credible expectancy treatment, but not significantly different from each other. Self-rated imagery involvement seemed more important for pain control than did the type of effect present. These findings raise questions regarding Melzack and Wall's (1965) motivational-affective component of pain. Consequently, pleasant imagery has been thought to moderate pain by minimizing the negative affect accompanying pain. It seems possible that imagery effects pain control through a more indirect process. The role of affect in imagery may be more appropriately viewed as a corollary to cognitive-attentional factors which, regarding pain control, function in a redirective manner. Cognitive processes fostering coping rather than pain behavior may be engendered when subjects attempt to immerse themselves in some form of emotive imagery.
One major purpose of this study is to further investigate the role of affect in imagery based pain control procedures. Specifically, pleasant imagery will be compared to angry imagery as a pain control cognitive strategy. Westcott and Horan (1977) found that for females anger emotive imagery was superior to no-treatment control in increasing cold pressor tolerance. This relationship did not exist for males, although the authors pointed out that high mean pretest tolerance scores for the male subjects left little room for improvement, given the imposed ceiling of 300 seconds for cold pressor hand immersion.

Unfortunately, this study did not include a documented equally credible control group and therefore provides only suggestive evidence of angry imagery's potential as a pain control strategy. Nevertheless, this study, along with Winslow and Rimm's (unpublished manuscript) results, suggests that imagery, whether it be rated by subjects as pleasant, sad, or angry is effective for pain control. By comparing angry imagery to pleasant imagery as well as to an equally credible control group, this study intends to further test this contention. Despite consistent positive effects of imagery on cold pressor tolerance, large variations of response to treatment is reported in the literature (Avia & Kanfer, 1980; Hackett & Horan, 1980; Westcott & Horan, 1977; Worthington, 1978;
Worthington & Shumate, 1981). This considerable subject variability in treatment groups implies that imagery based cognitive pain control strategies currently in use, while demonstrably effective for many, are of little benefit to others. This study intends to modify an already established imagery based cognitive strategy in an attempt to potentiate its effectiveness. Pleasant imagery has frequently been found effective in increasing cold pressor tolerance (Avia & Kanfer, 1980; Chaves & Barber, 1974; Grimm & Kanfer, 1976; Scott & Barber, 1977; Winslow & Rimm (unpublished manuscript); Worthington, 1978; Worthington & Shumate, 1981). Subjects in the pleasant imagery groups of Winslow and Rimm (unpublished manuscript) individually generated two of their own imagery scenes and then wrote them down in some detail prior to receiving the cold pressor posttest. As a result a myriad of pleasant scenes coupled with the tolerance scores of subjects using the scenes were available. This study empirically selects attributes of these scenes which correlate most highly with increased pain tolerance. These attributes were incorporated in two new imagery scenes written by the author, and presented to subjects as strategies previously demonstrated as especially effective for pain control. The imagery group using these scenes were then receiving prescribed imagery rather than generating their own.
This prescribed imagery group was compared to the original self-generated pleasant imagery strategy used in Winslow and Rimm (unpublished manuscript).

In an effort to further differentiate subjects' responsiveness to prescribed versus self-generated imagery, locus of control measures were recorded for all groups in this research. In a previous study, Worthington (1978) found that with the cold pressor task subjects tolerated pain better when allowed to choose their own imagery content rather than when provided with imagery scenes. No locus of control measures were obtained in this study. It seems possible that subjects with a more internal locus of control orientation may respond better to treatment encouraging their own active participation in creating imagery scenes, while subjects with a more external locus of control orientation may respond better to an externally prescribed set of scenes. Consequently, locus of control scores were obtained for all subjects in this study.

In summary there were six major hypotheses tested by this research. There were formulated as follows.

1. All four imagery groups would significantly increase pain tolerance and threshold when compared to the expectancy control group.

2. Prescribed pleasant imagery would be superior to self-generated pleasant imagery with respect to pain tolerance and threshold.
3. Prescribed angry imagery would be superior to self-generated angry imagery with respect to pain tolerance and threshold.

4. Prescribed pleasant imagery would be superior to prescribed angry imagery with respect to pain tolerance and threshold.

5. Self-generated pleasant imagery would be superior to self-generated angry imagery with respect to pain tolerance and threshold.

6. Subjects with high external locus of control scores would exhibit superior pain control with prescribed versus self-generated imagery, while subjects with low external locus of control scores would demonstrate the opposite.

Method

Subjects

Subjects were 100 North Texas State University undergraduate student volunteers obtained from classes in general psychology in return for class credit for their participation. They were divided into five experimental groups: a) prescribed pleasant imagery, b) prescribed angry imagery, c) self-generated pleasant imagery, d) self-generated angry imagery, and e) expectancy control. Each group consisted of 20 subjects, 10 with locus of control scores above the median for all 100 subjects, and 10 below. An equal proportion of males, 30%, was included in each cell.
**Apparatus**

Cold pressor pain was produced by a technique similar to one used by Worthington (1978). A styrofoam ice chest was filled 7 inches deep with a mixture of rock salt, ice, and water. The water was stirred prior to each use and maintained at a temperature of 1 to 3 degrees Centigrade by adding ice as needed. A metal screen was used to prevent ice from contacting the subject's hand while allowing free circulation of the water. The time each subject's hand was immersed in the water was measured by a stopwatch. No subject was allowed to keep his or her hand in the ice water for longer than 300 seconds. A Lafayette heart rate monitor was connected to the index finger of the subject's nondominant hand, although in reality it was not used for data collection.

**Procedures**

Subjects read a brief rationale of the experiment (see Appendix A) and were asked to sign an informed consent form (see Appendix B). Following the experimental rationale the heart rate monitor was attached to the index finger of the subject's nondominant hand. The unit was intended to further credibility of the experiment rationale and was not used to record data.

After heart rate monitor attachments were completed, each subject filled out a brief medical history inventory
(see Appendix C) designed to screen out any subjects with cardiovascular or circulatory disorders. Once screened, all subjects received a pretest of ice water tolerance. Subjects heard the following instructions for the pretest on an audio cassette recorder while reading the same instructions in the text.

In a moment I will ask you to place your hand in the ice water. Use your right hand if you are right handed and your left hand if you are left handed. This is a pretest to get baseline levels of your physiological reactions. While your hand is in the ice water, there is one thing I want you to do for me. I want to know when the ice water starts to become painful for you. The moment you decide that the sensation is painful, let me know by saying, out loud, "pain." That's all you need to say, just the word pain the moment you first experience it. It's important that you not forget to say it out loud. You are free to decide when to remove your hand from the water. Now, would you please place your hand in the water, making sure your hand is on the X marked at the bottom of the tank.

Pain threshold, the time from hand immersion to the word pain, and pain tolerance, the total time of hand
immersion were recorded by the experimenter with a stopwatch. Subjects who tolerated the ice water longer than 3 minutes were excluded from the study in order to minimize possible ceiling effects during posttest.

Following pretest each subject completed Levenson's (1974) locus of control scale. In order to obtain a single, unitary measure, the external items of the scale, powerful others and chance, were summed. Each item had six possible responses, ranging from strongly disagree to strongly agree. These responses were numerically scored on a 0 to 5 point scale, with 0 points scored for a response of strongly disagree, 1 for disagree somewhat, 2 for slightly disagree, 3 for slightly agree, 4 for agree somewhat, and 5 for strongly agree. The sum of the internal items was then obtained in the same manner, and subtracted from the sum of the external items. Finally, a constant of 40 was added to the result to prevent negative scores. This scoring system resulted in a composite locus of control score for each subject ranging from 0 to 100, with 100 representing the highest possible external score, and 0 representing the lowest.

A floating median of locus of control scores was maintained while the experiment was being conducted in order to assign subjects evenly to each of the five groups: prescribed pleasant imagery, prescribed angry imagery,
self-generated pleasant imagery, self-generated angry imagery, and expectancy control. Each subject received the appropriate treatment description and rationale based on their locus of control score. At the conclusion of the experimental period, each treatment group consisted of 20 subjects, 10 with locus of control scores above the median for all 100 subjects, and 10 with scores below.

Prescribed Pleasant Imagery (group 1). Subjects in this group heard instructions on an audio cassette recorder while reading the same instructions in the text. In addition to providing treatment rationale, these instructions presented two preconstructed fantasy imagery scenarios. The instruction and imagery scenes are found in Appendix D. Once the imagery scenes were provided, subjects were directed to fill out a credibility questionnaire (Appendix E). Finally, the instructions directed the subject in the posttest using the same procedures as the pretest. After completion of the posttest, each subject filled out a posttest imagery questionnaire (see Appendix F) assessing compliance, clarity of imagery, perceived involvement in imagery, and pleasantness of imagery. The two preconstructed scenarios were developed from the pleasant imagery group of a study by Winslow and Rimm (unpublished manuscript), which demonstrated superior pain tolerance and threshold when compared to an equally
credible control group. These pleasant imagery scenes were created and recorded individually by each of 16 subjects. They were rated by two independent raters on the presence or absence of the following six different content classifications, selected because of their noted frequent occurrence in the imagery scenes: 1) Social involvement (friends, family, or romance), 2) Stimulus relevance (water or thermal reference), 3) Sensory content (tactile, olfactory, auditory, or visual color), 4) Relaxation theme, 5) Coping skills theme, and 6) Food or drink references. The raters obtained a 97% agreement across categories. In order to examine the relationship between these imagery content classifications and pain control, a composite rating score based on the total of all six classifications was computed for each subject. The following analysis was computed to establish the potential utility of imagery scenes with these content classifications. A Pearson product-moment correlation was computed for the composite imagery content rating scores and their concordant pain tolerance scores. The correlation was significant \((r = .47, p < .05)\). Table 1 shows the percentage of subjects utilizing each of the six content classifications. This analysis, based on a small subject population of sixteen, is exploratory in nature, and primarily oriented toward construction of an empirical investigation of potentially efficacious imagery content
themes and their prescriptive utilization in cognitive pain control strategies. The combination of the two prescribed imagery scenes were designed to incorporate these six classificatory themes.

Table 1

<table>
<thead>
<tr>
<th>Theme</th>
<th>Social Involvement</th>
<th>Stimulus Senses</th>
<th>Relaxation</th>
<th>Coping Skills</th>
<th>Food or Drink</th>
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<tbody>
<tr>
<td></td>
<td>56%</td>
<td>65%</td>
<td>56%</td>
<td>15%</td>
<td>19%</td>
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Prescribed Angry Imagery (group 2). Subjects in this group followed the same procedure as group 1. The only difference in treatment instructions are the two preconstructed imagery scenes presented to the subjects. These imagery scenes are intended to induce anger, and, with the exception of relaxation, incorporated the same content classification themes used in the group 1 imagery scenes. The instructions and imagery scenes are found in Appendix G. As with group 1 each subject filled out the imagery questionnaire (see Appendix F) following the posttest.

Self-Generated Pleasant Imagery (group 3). Subjects in this group followed the same general procedure as groups 1 and 2. They heard instructions on an audio
cassette recorder while reading the same instructions in the text (see Appendix H). In addition to providing treatment rationale, these instructions guided subjects in the selection of fantasy scenarios of their own choice. The only restrictions on the imagery scenes chosen were that they be both pleasant and personally relevant. Once imagery scenes were selected, the treatment instructions directed the subjects to fill out the imagery (see Appendix I) and credibility questionnaires (see Appendix E). Finally, the instructions directed the subjects in the posttest using the same procedures as the pretest. As with group 1, once the posttest was completed, each subject filled out the posttest questionnaire (see Appendix F).

**Self-Generated Angry Imagery (group 4).** Subjects in this group followed the same general procedure as group 3. Treatment instructions (see Appendix J) were identical, with the exception of the affective manipulation of imagery content. This manipulation was accomplished by requesting subjects to select imagery scenarios which were personally relevant and anger invoking to them.

**Expectancy Control (group 5).** Subjects in this group followed the same procedure as groups 1, 2, 3, and 4, with the exception of receiving or creating imagery scenes and completing the imagery questionnaires. Treatment instructions (see Appendix K) were intended to engender positive
expectancies for decreasing pain intensity and increasing pain tolerance without the direct suggestion of possibly effective cognitive pain control strategies. Primarily, the instructions provided rationale and physiological evidence for an adaptation response which allows one to increasingly tolerate pain as one becomes more familiar, and therefore less frightened of it.

Results

Experimental results are reported in four phases. The first phase examines the credibility ratings of all groups and the correlations of credibility scores with outcome. The second phase investigates the imagery ratings scores for the four imagery treatment groups. The third phase examines the correlations of locus of control scores with imagery ratings and pain tolerance and threshold. Finally, the fourth phase reports treatment effects on the two dependent variables, pain tolerance and threshold, as well as the effect on imagery affect ratings.

Credibility

A two-way analysis of variance, group-by-locus of control (LC), is computed using credibility scores as the dependent variable. Table 2 summarizes the results. Inspection of the table shows that the five treatment groups do not differ significantly in credibility ratings. In addition there is no significant difference in credibility
ratings for subjects in the high versus low locus of control groups, and no significant interaction effect between treatment and locus of control as well.

Table 2

Summary of Analysis of Variance of Credibility as a Function of Locus of Control and Treatment

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects</td>
<td>140.530</td>
<td>5</td>
<td>28.106</td>
<td>1.133</td>
<td>.349</td>
</tr>
<tr>
<td>Treatment</td>
<td>138.840</td>
<td>4</td>
<td>34.710</td>
<td>1.399</td>
<td>.241</td>
</tr>
<tr>
<td>LC</td>
<td>1.690</td>
<td>1</td>
<td>1.690</td>
<td>.068</td>
<td>.795</td>
</tr>
<tr>
<td>Treatment-by-LC</td>
<td>22.560</td>
<td>4</td>
<td>5.640</td>
<td>.227</td>
<td>.922</td>
</tr>
<tr>
<td>Total</td>
<td>2395.381</td>
<td>99</td>
<td>24.196</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For all subjects a Pearson product-moment correlation is obtained for credibility scores and each of the two dependent variables, pain tolerance and threshold. A significant correlation with credibility is obtained for pain threshold ($r = .17, p < .05$), but not for tolerance. Further correlations for credibility with pain tolerance and threshold are obtained for each of the five treatment groups with locus of control collapsed. For group 2, only the pain threshold correlations with credibility approaches
significance \((r = .34, p = .07)\). For the remaining groups, no significant correlations are obtained. Finally, correlations between credibility and pain tolerance and threshold are obtained for all groups with high external locus of control scores versus those with low external scores. The only correlation obtained which approaches significance is with pain threshold for subjects with high locus of control scores \((r = .22, p = .059)\). All of these credibility correlations are summarized in Tables 3, 4, and 5.

### Table 3

Credibility Scores Correlations with Tolerance and Threshold for Across Groups and Locus of Control

<table>
<thead>
<tr>
<th>Variable</th>
<th>(r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>.13</td>
</tr>
<tr>
<td>Threshold</td>
<td>.17*</td>
</tr>
</tbody>
</table>

Note. *\(p = .042\)

### Table 4

Credibility Scores Correlations with Tolerance and Threshold for All Subjects within Treatment Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>.32</td>
<td>.15</td>
<td>-.16</td>
<td>-.08</td>
<td>.28</td>
</tr>
<tr>
<td>Threshold</td>
<td>.29</td>
<td>.34*</td>
<td>-.25</td>
<td>.07</td>
<td>.24</td>
</tr>
</tbody>
</table>

Note. *\(p = .07\)
Table 5

Credibility Scores Correlations with Tolerance and Threshold for All Subjects within Locus of Control

<table>
<thead>
<tr>
<th>Variable</th>
<th>High External</th>
<th>Low External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>.10</td>
<td>.15</td>
</tr>
<tr>
<td>Threshold</td>
<td>.22*</td>
<td>.14</td>
</tr>
</tbody>
</table>

Note. *p = .059

Imagery

Imagery rating scores are correlated with pain tolerance and threshold both within and across the four imagery groups, with locus of control collapsed. Similar correlations are obtained within the locus of control independent variable, both with and without groups collapsed. Pain tolerance and threshold are expressed as pre-posttest difference scores. All correlations are Pearson product-moments. The results are summarized in Tables 6, 7, and 8.

Table 6

Correlation Coefficients of Imagery Ratings with Tolerance and Threshold for All Subjects across Imagery Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rating</th>
<th>Compliance</th>
<th>Clarity</th>
<th>Involvement</th>
<th>Time</th>
<th>Affect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td></td>
<td>-.13</td>
<td>.15</td>
<td>.08</td>
<td>.08</td>
<td>.03</td>
</tr>
<tr>
<td>Threshold</td>
<td></td>
<td>-.07</td>
<td>.09</td>
<td>.07</td>
<td>.04</td>
<td>.10</td>
</tr>
</tbody>
</table>
Table 7

Correlation Coefficients of Imagery Ratings with Tolerance and Threshold for Groups 1, 2, 3, and 4

<table>
<thead>
<tr>
<th>Rating</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>Compliance</td>
<td>.07</td>
<td>.07</td>
<td>-.38**</td>
<td>-.36*</td>
</tr>
<tr>
<td>Clarity</td>
<td>.01</td>
<td>.01</td>
<td>.03</td>
<td>-.28</td>
</tr>
<tr>
<td>Involvement</td>
<td>.09</td>
<td>.07</td>
<td>-.22</td>
<td>-.15</td>
</tr>
<tr>
<td>Time</td>
<td>.13</td>
<td>.10</td>
<td>.02</td>
<td>-.28</td>
</tr>
<tr>
<td>Affect</td>
<td>.20</td>
<td>.20</td>
<td>-.25</td>
<td>-.17</td>
</tr>
</tbody>
</table>

Note: a Tolerance *\(p = .057\); **\(p < .05\)
b Threshold

Table 8

Correlation Coefficients of Imagery Ratings with Tolerance and Threshold within Locus of Control

<table>
<thead>
<tr>
<th>Rating</th>
<th>High External</th>
<th>Low External</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>Compliance</td>
<td>.01</td>
<td>-.03</td>
</tr>
<tr>
<td>Clarity</td>
<td>.19</td>
<td>.14</td>
</tr>
<tr>
<td>Involvement</td>
<td>.29*</td>
<td>.14</td>
</tr>
<tr>
<td>Time</td>
<td>.09</td>
<td>.10</td>
</tr>
<tr>
<td>Affect</td>
<td>.26*</td>
<td>.23</td>
</tr>
</tbody>
</table>

Note: a Tolerance *\(p < .10\); **\(p < .05\)
b Threshold
For pain tolerance across groups, with locus of control collapsed, no significant correlations with imagery ratings are obtained. The within groups analysis, however, with locus of control collapsed, finds some significant imagery ratings correlations with pain tolerance. For Groups 1 and 3 there are no significant correlations. For Group 2 compliance correlates negatively with pain tolerance ($r = -.38, p = .05$). For Group 4 both imagery clarity ($r = .49, p = .014$) and involvement ($r = .46, p = .02$) correlate with tolerance. With groups collapsed significant or near significant correlations with tolerance are obtained for imagery involvement ($r = .29, p = .04$) and affect ($r = .26, p = .056$) for subjects with high external locus of control scores. For low external locus of control scores, with groups collapsed, only compliance with imagery treatment instructions correlates with tolerance ($r = -.26, p = .05$).

There are fewer significant imagery ratings correlations with pain threshold than with pain tolerance. With group and locus of control collapsed, no significant correlations are obtained. Across groups, with locus of control collapsed, significant or near significant correlations are obtained only for Groups 2 and 4. Specifically, for Group 2 compliance correlates with threshold ($r = .36, p = .057$), and for Group 4 clarity correlates
with threshold \((r = .45, p = .025)\), as does time \((r = .38, p = .049)\).

**Locus of Control**

Locus of control scores for all subjects range from 0 to 65, with a median of 35 for each treatment group. Pearson product-moments for locus of control and the two dependent variables, pain tolerance and threshold, are computed across and within groups. The results are summarized in Tables 9 and 10. No significant correlations are obtained across groups. For pain tolerance the within group analysis obtains significant or near significant correlations for Group 2 \((r = -.36, p = .06)\) and Group 5 \((r = -.45, p = .023)\). For pain threshold significant correlations are obtained for Group 4 \((r = -.45, p = .023)\) and Group 5 \((r = -.44, p = .027)\).

**Table 9**

Correlation Coefficients of Locus of Control Scores with Pain Tolerance and Threshold for All Subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>(r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>-.040</td>
</tr>
<tr>
<td>Threshold</td>
<td>.006</td>
</tr>
</tbody>
</table>
Table 10

Correlation Coefficients of Locus of Control Scores with Pain Tolerance and Threshold within Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>-.25</td>
<td>-.36*</td>
<td>.06</td>
<td>-.28</td>
<td>-.45**</td>
</tr>
<tr>
<td>Threshold</td>
<td>-.25</td>
<td>-.04</td>
<td>.12</td>
<td>-.45**</td>
<td>-.44**</td>
</tr>
</tbody>
</table>

Note. *p < .10; **p < .05

Further across and within group Pearson product-moment correlations are computed for locus of control scores and imagery rating scores. In addition high and low locus of control group correlations are computed, with treatment groups collapsed. These correlations are summarized in Tables 11, 12, and 13. No significant correlations are obtained across treatment groups or within locus of control with treatment groups collapsed. Within treatment groups, however, significant correlations of imagery ratings with locus of control scores are obtained for Groups 1, 2, 3, and 4. For Group 1 significant or near significant correlations are obtained for the following imagery ratings: (a) clarity ($r = .51, p = .07$); (b) involvement ($r = .39, p = .04$); and (c) time ($r = .34, p = .07$). For Group 2 significant correlations are obtained for clarity
(r = -.39, p = .04) and time (r = -.53, p = .009). For Group 4 time (r = -.41, p = .038) and affect (r = -.39, p = .046) correlate with locus of control. No significant correlations are obtained for Group 3.

Table 11

Correlation Coefficients of Imagery Ratings with Locus of Control with Groups Collapsed

<table>
<thead>
<tr>
<th>Rating</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance</td>
<td>.09</td>
</tr>
<tr>
<td>Clarity</td>
<td>-.08</td>
</tr>
<tr>
<td>Involvement</td>
<td>-.02</td>
</tr>
<tr>
<td>Time</td>
<td>-.02</td>
</tr>
<tr>
<td>Affect</td>
<td>.02</td>
</tr>
</tbody>
</table>

Table 12

Locus of Control Correlations with Imagery Ratings within High versus Low Locus of Control

<table>
<thead>
<tr>
<th>Rating</th>
<th>Locus of Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High External</td>
</tr>
<tr>
<td>Compliance</td>
<td>.18</td>
</tr>
<tr>
<td>Clarity</td>
<td>-.10</td>
</tr>
<tr>
<td>Involvement</td>
<td>-.06</td>
</tr>
<tr>
<td>Time</td>
<td>.05</td>
</tr>
<tr>
<td>Affect</td>
<td>.07</td>
</tr>
</tbody>
</table>
Table 13

Locus of Control Correlations with Imagery Ratings within Treatment Groups

<table>
<thead>
<tr>
<th>Rating</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance</td>
<td>-.10</td>
<td>-.26</td>
<td>.15</td>
<td>-.10</td>
</tr>
<tr>
<td>Clarity</td>
<td>.51***</td>
<td>-.39**</td>
<td>-.23</td>
<td>-.14</td>
</tr>
<tr>
<td>Involvement</td>
<td>.39**</td>
<td>-.07</td>
<td>-.16</td>
<td>-.08</td>
</tr>
<tr>
<td>Time</td>
<td>.34*</td>
<td>-.53***</td>
<td>-.03</td>
<td>-.41**</td>
</tr>
<tr>
<td>Affect</td>
<td>-.02</td>
<td>.01</td>
<td>-.08</td>
<td>-.39**</td>
</tr>
</tbody>
</table>

Note. *p < .10; **p < .05; ***p < .01.

Treatment Effects

Treatment effects are reported for both the affect manipulation and the two dependent variables, pain tolerance and threshold. Where appropriate, suitable multiple comparisons are computed to investigate specific treatment differences. In addition pretest pain tolerance and threshold times are compared across groups and locus of control to examine for any initial significant differences.

Affect. A two-way analysis of variance, group-by-locus of control, is used to investigate the differential effects of the four imagery treatments on subjects' ratings of affect. A significant treatment effect, summarized in Table 14, is obtained ($F = 7.995, p = .001$). Because no significant locus of control or interaction effect is found, locus of
control is collapsed and multiple comparisons between the treatment means are computed using Duncan's Multiple Range test. Treatment means, with and without locus of control collapsed, are summarized in Table 15. Group 2, prescribed angry imagery, produces significantly lower affect ratings ($p < .05$) than Groups 1, 3, 4, and 5, which do not differ significantly from each other.

Table 14

Summary of Analysis of Variance of Affect Ratings as a Function of Locus of Control and Treatment

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>53.100</td>
<td>3</td>
<td>17.700</td>
<td>7.995</td>
<td>.001</td>
</tr>
<tr>
<td>LC</td>
<td>5.000</td>
<td>1</td>
<td>5.000</td>
<td>2.258</td>
<td>.137</td>
</tr>
<tr>
<td>Treatment-by-LC</td>
<td>6.700</td>
<td>3</td>
<td>2.233</td>
<td>1.009</td>
<td>.394</td>
</tr>
</tbody>
</table>

Pretest Scores. A group-by-locus of control analysis of variance is computed with pretest pain tolerance scores as the dependent variable. The same procedure is used to investigate potential differences in pretest pain threshold scores. No significant main effects or interaction effects are obtained for either pain tolerance or threshold, indicating no significant differences in pretest scores of
Table 15

Group Means of Affect Ratings within Imagery Treatment Groups with and without Locus of Control Collapsed

<table>
<thead>
<tr>
<th>Locus of Control</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>High External</td>
<td>5.10</td>
<td>3.60</td>
<td>4.80</td>
<td>4.10</td>
</tr>
<tr>
<td>Low External</td>
<td>5.60</td>
<td>3.20</td>
<td>6.00</td>
<td>4.80</td>
</tr>
<tr>
<td>Combined</td>
<td>5.35</td>
<td>3.40</td>
<td>5.40</td>
<td>4.45</td>
</tr>
</tbody>
</table>

Pain control across groups and locus of control. The results of the analyses of variance for pain tolerance and threshold, along with their respective group means are summarized in Tables 16, 17, and 18.

Table 16

Summary of Analysis of Variance of Pretest Pain Tolerance as a Function of Locus of Control and Treatment

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>3047.540</td>
<td>4</td>
<td>761.885</td>
<td>.798</td>
<td>.530</td>
</tr>
<tr>
<td>LC</td>
<td>121.000</td>
<td>1</td>
<td>121.000</td>
<td>.127</td>
<td>.723</td>
</tr>
<tr>
<td>Treatment-by-LC</td>
<td>2003.100</td>
<td>4</td>
<td>500.775</td>
<td>.524</td>
<td>.718</td>
</tr>
</tbody>
</table>
Table 17

Summary of Analysis of Variance of Pretest Pain Threshold as a Function of Locus of Control and Treatment

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1576.340</td>
<td>4</td>
<td>393.085</td>
<td>.668</td>
<td>.616</td>
</tr>
<tr>
<td>LC</td>
<td>57.760</td>
<td>1</td>
<td>57.760</td>
<td>.098</td>
<td>.755</td>
</tr>
<tr>
<td>Treatment-by LC</td>
<td>2532.340</td>
<td>4</td>
<td>633.085</td>
<td>1.074</td>
<td>.374</td>
</tr>
</tbody>
</table>

Table 18

Group Means of Pretest Pain Tolerance and Threshold within Groups and Locus of Control

<table>
<thead>
<tr>
<th>Group</th>
<th>High External a</th>
<th></th>
<th>Low External a</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>48.70</td>
<td>40.30</td>
<td>36.00</td>
<td>26.30</td>
</tr>
<tr>
<td>Group 2</td>
<td>38.20</td>
<td>32.20</td>
<td>49.50</td>
<td>30.30</td>
</tr>
<tr>
<td>Group 3</td>
<td>44.30</td>
<td>35.20</td>
<td>41.10</td>
<td>31.10</td>
</tr>
<tr>
<td>Group 4</td>
<td>53.80</td>
<td>31.00</td>
<td>60.20</td>
<td>47.80</td>
</tr>
<tr>
<td>Group 5</td>
<td>39.80</td>
<td>29.30</td>
<td>49.00</td>
<td>24.90</td>
</tr>
</tbody>
</table>

Note: aTolerance  
bThreshold

Pain Tolerance. A group-by-locus of control two-way analysis of covariance, with pretest scores as the covariate, is computed with pain tolerance as the dependent variable.
Strong trends for main effects are obtained for treatment ($F = 2.27, p = .068$) and locus of control ($F = 3.09, p = .083$). The interaction of treatment and locus of control is not significant. The results of the analysis of covariance are summarized in Table 19.

**Table 19**

Summary of Analysis of Covariance for Pain Tolerance with Pretest Scores as the Covariate

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>33197.176</td>
<td>4</td>
<td>8312.402</td>
<td>2.268</td>
<td>.068</td>
</tr>
<tr>
<td>LC</td>
<td>11338.902</td>
<td>1</td>
<td>11338.902</td>
<td>3.094</td>
<td>.082</td>
</tr>
<tr>
<td>Treatment-by-LC</td>
<td>24053.362</td>
<td>4</td>
<td>6013.363</td>
<td>1.641</td>
<td>.171</td>
</tr>
</tbody>
</table>

Main effects for treatment and a priori comparisons are investigated by Duncan's Multiple Range test. The adjusted means of Groups 1, 2, and 4 are all significantly greater than Group 5 ($p = .05$), but not significantly different from each other. Group 3 does not differ significantly from Groups 1, 2, 4, or 5. A priori comparisons, investigating prescribed versus self-generated imagery, find Group 1 superior to Group 3 for low external locus of control ($p < .05$). The main effects for locus of control are not investigated with a multiple range test since only
two means, high and low external locus of control scores are involved. The trend for significance noted earlier with the analysis of covariance $F$ test ($F = 3.09, p = .083$) is in the direction of low external locus of control subjects displaying greater pain tolerance than high external scoring subjects. Treatment means are summarized in Table 20.

Table 20

Adjusted Group Means of Pain Tolerance with and without Locus of Control Collapsed

<table>
<thead>
<tr>
<th>Locus of Control</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>High External</td>
<td>86.88</td>
<td>90.85</td>
<td>109.65</td>
<td>91.97</td>
<td>60.21</td>
</tr>
<tr>
<td>Low External</td>
<td>150.74</td>
<td>121.65</td>
<td>79.04</td>
<td>123.60</td>
<td>70.91</td>
</tr>
<tr>
<td>Combined</td>
<td>118.81</td>
<td>106.65</td>
<td>94.34</td>
<td>107.79</td>
<td>65.56</td>
</tr>
</tbody>
</table>

In order to reduce the possible effect of extreme scores and further investigate the near significant main effects for pain tolerance, a natural log transformation is performed on the raw data for pain tolerance. An analysis of covariance (summarized in Table 21) is then computed using the transformed data (Winer, 1971). A significant main effect for treatment ($F = 2.95, p = .025$) and locus of control ($F = 4.66, p = .034$) is obtained.
The treatment-by-locus of control interaction effect is not significant.

Table 21

Summary of Analysis of Covariance with Natural Log Transformations for Pain Tolerance with Pretest Scores as the Covariate

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>3.011</td>
<td>4</td>
<td>0.753</td>
<td>2.95</td>
<td>.025</td>
</tr>
<tr>
<td>LC</td>
<td>1.190</td>
<td>1</td>
<td>1.190</td>
<td>4.66</td>
<td>.033</td>
</tr>
<tr>
<td>Treatment-by-LC</td>
<td>1.675</td>
<td>4</td>
<td>0.419</td>
<td>1.64</td>
<td>.171</td>
</tr>
</tbody>
</table>

Main effects of treatment are investigated with the Duncan Multiple Range test with the adjusted treatment means. The adjusted means are summarized in Table 22. Similar results to those obtained with the raw data are obtained, with the exception that the trend noted for Group 3 becomes significant (p < .05). In addition low external locus of control subjects produce significantly higher gains in pain tolerance than did high external subjects (p < .05). Thus, following the natural log transformation, all imagery treatment groups are superior to expectancy control (p < .05), while none differ significantly from each other.
Table 22

Adjusted Group Means for Pain Tolerance following a Natural Log Transformation

<table>
<thead>
<tr>
<th>Locus of Control</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>High External</td>
<td>4.19</td>
<td>4.10</td>
<td>4.43</td>
<td>4.24</td>
<td>3.81</td>
</tr>
<tr>
<td>Low External</td>
<td>4.73</td>
<td>4.43</td>
<td>4.18</td>
<td>4.46</td>
<td>4.07</td>
</tr>
</tbody>
</table>

Pain Threshold. The analysis of treatment effects on pain threshold follows the same procedure as that for pain tolerance. A two-way group-by-locus of control analysis of covariance, with pretest scores as the covariate, is computed with pain threshold as the dependent variable. The results of the analysis of covariance, along with the adjusted treatment means are summarized in Tables 23 and 24.

Table 23

Summary of Analysis of Covariance for Pain Threshold with Pretest Scores as the Covariate

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>17994.613</td>
<td>4</td>
<td>4498.652</td>
<td>1.360</td>
<td>.254</td>
</tr>
<tr>
<td>LC</td>
<td>7131.313</td>
<td>1</td>
<td>7131.313</td>
<td>2.155</td>
<td>.191</td>
</tr>
<tr>
<td>Treatment-by-LC</td>
<td>45782.988</td>
<td>4</td>
<td>11445.746</td>
<td>3.459</td>
<td>.011</td>
</tr>
</tbody>
</table>
Table 24

Adjusted Group Means of Pain Threshold with and without Locus of Control Collapsed

<table>
<thead>
<tr>
<th>Locus of Control</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>High External</td>
<td>63.03</td>
<td>69.26</td>
<td>94.64</td>
<td>45.82</td>
<td>47.09</td>
</tr>
<tr>
<td>Low External</td>
<td>124.31</td>
<td>64.89</td>
<td>45.64</td>
<td>111.48</td>
<td>57.64</td>
</tr>
<tr>
<td>Combined</td>
<td>93.67</td>
<td>67.07</td>
<td>70.14</td>
<td>78.65</td>
<td>52.37</td>
</tr>
</tbody>
</table>

No significant main effects are obtained. However, the group-by-locus of control interaction is significant (F = 3.459, p = .011). Analysis of the simple main effects obtains the following significant or near significant differences. For low external locus of control, Group 1 is superior to Group 2 (p = .02), Group 3 (p = .003), and Group 5 (p = .01). Group 4 is also superior, but to a lesser degree, to Group 2 (p = .078), Group 3 (p = .01), and Group 5 (p = .04). Groups 1 and 4 do not differ significantly from each other. For high external locus of control, Group 3 is superior to Group 4 (p = .061) and Group 5 (p = .068), but not Groups 1 and 2. Within groups low external locus of control is superior to high external for Group 1 (p = .02) and Group 4 (p = .014). However, the opposite is true in the direction of significance for Group 3, with high external locus of control superior to low external (p = .06).
Thus, regarding pain threshold for low external locus of control subjects, prescribed pleasant imagery and self-generated angry imagery are equally effective, and superior to all other treatments investigated. This superiority is at a significant level for all Groups but Group 2, where it is strongly in the direction of significance. For high external locus of control, however, self-generated pleasant imagery is not significantly different from prescribed imagery, pleasant or angry, but is, at a near significant level, superior to self-generated angry imagery and expectancy control. Furthermore, for prescribed pleasant and self-generated angry imagery, the two highest group means for pain threshold improvement, low external locus of control subjects are superior to high external ones (p < .02). The reverse is true in the direction of significance for self-generated pleasant imagery, with high external locus of control superior to low external (p = .06).

Discussion

The major focus of this study is threefold: 1) to demonstrate the superiority of imagery based pain control strategies over an equally credible placebo; 2) to investigate the role of affect in the use of imagery for pain control; and 3) to examine the effectiveness of prescribed, preconstructed imagery scenes developed from previous research (Winslow & Rimm, unpublished manuscript) versus
that of subject-generated imagery, and the interaction of the two with locus of control. In addition, the relationship between treatment credibility and rated imagery involvement with treatment efficacy are examined. Credibility of Treatment Groups

No significant, or near significant differences between credibility scores are demonstrated for all five treatment groups. The imagery treatment groups, along with the control group, may then be assumed to generate equal expectancies. With expectancies thus controlled, the presence or absence of specific treatment effects can be reported.

The relationship between credibility ratings and treatment response, defined as increases in pain tolerance and threshold, appears weak in this research. A significant correlation between credibility scores and pain threshold is obtained across experimental groups. Within groups, however, only the prescribed angry imagery group produced a near significant correlation. These results are surprising, as they differ somewhat from Winslow and Rimm's (unpublished manuscript) previous findings of consistent, high correlations of treatment credibility with pain tolerance and threshold. The method of credibility assessment used in the previous study is identical to that of this research. The weak, inconsistent relationship of credibility with
treatment response in this research may reflect an inconsistency or inadequacy of the credibility assessment to measure expectancy.

**Imagery Involvement**

The imagery ratings correlations with pain control provide little support for the contention of a strong functional relationship between the two. Worthington's (1978) finding of a significant positive correlation between imagery vividness and pain tolerance is not replicated by the across group correlation obtained in this study for imagery clarity and pain tolerance. The within group analysis of this correlation, however, does obtain a significant correlation for these two variables for the self-generated angry imagery group. Indeed, for this group rated imagery clarity correlates highly with both pain tolerance and threshold. No other imagery treatment groups obtain even near significant correlations with imagery clarity and pain control. This pattern is repeated with imagery involvement ratings correlations with pain tolerance. Jaremko (1978) found increased pain tolerance for subjects reporting high as opposed to low involvement with pleasant imagery. Winslow and Rimm (unpublished manuscript) found similar results with both pleasant and sad imagery. In light of these previous findings, the failure of all imagery treatment groups but self-generated
angry imagery to demonstrate significant correlation of imagery clarity and involvement with pain control is perplexing. Some light is thrown on this issue by the within locus of control analysis of imagery ratings correlations with pain control. Imagery involvement ratings, though not clarity, obtained significant positive correlations with pain tolerance for external locus of control subjects. There exists, then, some evidence that while imagery involvement is a significant factor in pain control for those with an external locus of control, it is not so for more internally oriented persons. Such a conclusion is tenuous at best, however, without more supportive data. The ratings of imagery involvement in this study are subject to potential bias from performance feedback which may interact in an unknown manner with locus of control.

The negative correlations of compliance with pain tolerance and threshold for the prescribed angry imagery group clearly states that subjects in the group who demonstrated the best pain control reported less compliance. The within locus of control correlations, displayed in Table 8, demonstrate that this result is for subjects with internal as opposed to external locus of control. It seems possible that the internal locus of control subjects in Group 2 modified the prescribed imagery scenes to better serve their needs. Group 2 also produced significantly
lower ratings of intensity of affect than Groups 1, 3, or 4. Perhaps the prescribed angry scenes of Group 2 are not as potent as those of Group 1, and some of the more internally oriented subjects of Group 2 substituted other scenes or coping skills. This hypothesis must remain tentative, however, as it is merely inferred, not clearly supported by this research.

**Locus of Control**

The significant negative correlations of locus of control with pain control for the expectancy control group (see Table 9) shows that increased pain tolerance and threshold is associated with more internally oriented locus of control scores. This result is not found in the imagery treatment groups, except for self-generated angry imagery, and then only for pain threshold, not pain tolerance. The strength and consistency of the relationship for the expectancy control group suggests that when a treatment does not instruct in specifically effective coping skills, internals are more likely than externals to develop means for coping with aversive stimulation.

The within group correlations of locus of control scores with imagery ratings (see Table 13) shows that, with prescribed angry imagery, the more internally oriented a person is, the greater imagery clarity and time spent imaging the prescribed scenes he reports. A somewhat
similar pattern exists for the self-generated angry imagery group. The more internal the locus of control score, the more intensity of affect and time spent imaging the self-generated scenes is reported. This pattern is reversed in the prescribed pleasant imagery group. For this group imagery clarity and involvement, and to a lesser extent time spent imaging scenes varies positively with external locus of control. That is, externals report more high ratings than internals. Thus the trend demonstrated in this research is for internals to report generally more time using imagery with angry affect imagery scenes, and externals more imagery involvement and clarity with pleasant affect ones. Perhaps for internals angry affect may be associated with frustration and loss of control, which may in turn be associated with higher stimulus valence than would be the case for externals.

Treatment Effects

For pain tolerance, and to a lesser extent pain threshold, the first research hypothesis is strongly supported. Following the log transformation of the raw data, all imagery groups are superior to the equally credible expectant control group in increasing pain tolerance. For threshold, however, an interaction between treatment and locus of control is obtained. Both prescribed pleasant and self-generated angry imagery are superior to
the expectancy control treatment for internally oriented locus of control subjects, while there is a strong trend for self-generated pleasant imagery to be superior to expectancy control for externally oriented ones. Thus only one of the four treatment groups, prescribed angry imagery, fails to meaningfully improve pain threshold over an equally credible expectancy control treatment for a given locus of control orientation.

The second research hypothesis is supported for internal locus of control subjects for both pain tolerance and threshold. Prescribed is superior to self-generated pleasant imagery for internal locus of control subjects. No such effect is obtained for external locus of control subjects. This result shows the utility of the constructed pleasant imagery scenes for internals. However, the superiority of prescribed versus self-generated imagery for internals does not hold for angry imagery, as predicted by the third research hypothesis. Indeed, for pain threshold with internals, there is a strong trend for self-generated angry imagery's superiority over prescribed angry imagery. This pain threshold interaction with affect and prescribed versus self-generated imagery for internal locus of control subjects is further demonstrated by the analysis of the fourth and fifth research hypotheses. The fourth hypothesis is supported by this research for internal locus of control
subjects for pain threshold but not pain tolerance. For internals prescribed pleasant imagery is superior to prescribed angry imagery in increasing pain tolerance. There is no such effect for external locus of control subjects. The fifth research hypothesis, that pleasant imagery is superior to angry imagery for self-generated imagery scenes, is clearly not supported for either pain threshold or tolerance. Indeed, with pain tolerance, a strong trend for self-generated angry imagery's superiority over self-generated pleasant imagery is obtained.

Clearly, the last research hypothesis is only partially supported. Contrary to the hypothesis, for externally oriented locus of control subjects, there is no significant difference between prescribed versus self-generated imagery for pain tolerance. For pain threshold prescribed angry imagery is superior to self-generated angry imagery. For internal locus of control subjects with the pain threshold variable, the hypothesis is not supported for angry imagery: self-generated imagery scenes are superior to prescribed ones. For pleasant imagery, however, the opposite significant difference exists: prescribed is superior to self-generated imagery.

An overview of the treatment effects will be offered in the interest of clarity. First, one may note that the dependent variable pain tolerance is a robust one with
respect to treatment responsivity. For both high and low external locus of control, tolerance improved fairly uniformly for all four imagery treatments. No interactions were obtained. In addition subjects with an internal locus of control demonstrated greater gains in pain tolerance than subjects with a more externally oriented locus of control. The internal locus of control's superiority may be the result of more available coping skills. The reader may recall the evidence presented in the correlational analysis suggesting that internals may have modified the treatment instructions of Group 2. Further evidence showed that externals demonstrate improved pain tolerance in relation to increased imagery involvement ratings. Such is not the case for internals, who may not so often require involvement in imagery for increasing pain tolerance, as they may possess other more readily available coping skills.

Pain threshold is not so robust a variable as is pain tolerance, as is demonstrated by its previously reported sensitivity to locus of control and affect. Internals demonstrate the greatest gains in pain threshold with either prescribed pleasant or self-generated angry imagery. Externals, on the other hand, do better with self-generated pleasant imagery. The sensitivity of pain threshold to the treatment modalities as opposed to the more robust nature of pain tolerance may reflect subtle differences between
the two measures along an interpersonal dimension. The
tolerance measure is essentially a gross behavioral one,
the analog of ceasing an activity to avoid pain. Threshold,
however, is more a communication than an avoidance. Viewed
this way, its inconsistent response to treatment seems more
reasonable, as it may be more subject to subtle subject-
experimenter interactions as well as individual differences
not assessed in this research.

In summary the results of this study provide strong
evidence for the efficacy of cognitive strategies using
imagery in the management of pain. In addition, the results
show that subjects with an internal locus of control
demonstrate greater gains in pain tolerance than subjects
with an external locus of control. Finally, specific
significant differences of treatment strategies' impact on
pain control are reported for external versus internal
locus of control subjects.

One major limitation of this research lies in its
utility for predicting similar treatment effects for
clinical pain. Future research using prescribed versus
self-generated imagery scenes with clinical pain patients
is necessary to establish such a generalization of treatment
effects. One further limitation is inherent in the design.
Specifically, imagery involvement ratings are subjected to
performance feedback bias. In addition, the credibility
measures obtained may not accurately assess subjects' expectancies. Finally, the pain threshold measure is a verbally communicated one, inviting confounding effects from interpersonal subject or experimenter dimensions. Perhaps a better procedure for assessing pain threshold would be a mechanical timing device operated by the subject to indicate when he or she first experiences pain. Such a procedure would avoid the necessity of a verbal, interpersonal communication of pain from subject to experimenter.

Further research is necessary to replicate the superior pain tolerance gains demonstrated by internal locus of control subjects in this research. Since no significant difference in pretest pain tolerance for external versus internal locus of control subjects is found by this research, it is apparent that internals are more able than externals to utilize imagery for increasing pain tolerance. A broader issue emerges regarding the ability to utilize experimenter or therapist presented coping skills. Specifically, if internals indeed more readily benefit from coping skills training, investigations of how they do so may provide methods for increasing externals' ability to utilize similar treatments. Perhaps a simple increase in practice time with provided coping skills may result in improved treatment effects for externals. These are empirical issues, however, best considered in future research.
Appendix A

Description of the Experiment

The present study is an experimental investigation of the physiological components of pain. The specific physiological measure used is skin temperature, a useful indicator of stress. This measure will be taken twice: once in a pretest and again following audiotaped instructions in an established treatment technique used to increase pain tolerance. In both cases, you will be asked to place your hand in ice water, which, as you are probably aware, can be painful. Although the sensations may eventually become unpleasant, you may be assured that no physical damage is done by the procedure. You may, of course, remove your hand at any time during the experiment.

As part of the experiment, you will be asked to fill out several paper-and-pencil questionnaires regarding your use of the cognitive treatment instructions for pain control. There will be no questions concerning private or personal information, with the exception of a short questionnaire concerning your current state of health. Hopefully, participation in this experiment will provide you with a useful understanding of pain and how to control your reactions to it.
Appendix B

USE OF HUMAN SUBJECTS
INFORMED CONSENT

NAME OF SUBJECT: ____________________________

1. I hereby give consent to Douglas Winslow to perform or supervise the following investigational procedure or treatment:

   An investigation of the physiological responses involved in coping with discomfort (hand immersion in ice water).

2. I have (seen, heard) a clear explanation and understand the nature and purpose of the procedure or treatment; possible appropriate alternative procedures that would be advantageous to me (him or her); and the attendant discomforts or risks involved and the possibility of complications which might arise. I have (seen, heard) a clear explanation and understand the benefits to be expected. I understand that the procedure or treatment to be performed is investigational and that I may withdraw my consent for my (his or her) status. With my understanding of this, having received this information and satisfactory answers to the questions I have asked, I voluntarily consent to the procedure or treatment designated in Paragraph 1 above.

   ____________________________
   Date

   SIGNED: ____________________________ SIGNED: ____________________________
   Witness                      Subject

   SIGNED: ____________________________ SIGNED: ____________________________
   Witness                      Subject

Instructions to persons authorized to sign: If the subject is not competent, the person responsible shall be the legal appointed guardian or legally authorized representative.
Appendix C

Medical Screening Questionnaire

1. How would you describe your current state of health?
   (a) poor
   (b) fair
   (c) excellent

2. Are you currently taking any medication?
   If so, what kind?

3. Have you ever been diagnosed as having any of the following?
   Yes  No
   __  __ Cardiovascular disorders
   __  __ Circulatory disorders
   __  __ Raynauld's disease (hand or feet become pale, cold, and anesthetic, at times tingling with only moderate exposure to normal cold weather).
Appendix D

Prescribed Pleasant Imagery

A lot of scientific evidence has shown that people can reduce pain by actively using their own imagination. Experiments have shown that imagining certain kinds of activities can distract a person from a painful sensation so well that the pain can become trivial or even unnoticeable. You have probably noticed this effect yourself. You can scrape, bruise, or otherwise injure yourself while you are involved in some activity or daydream and not even be aware of it until later. Have you ever noticed a bruise on yourself and not remembered where it came from? Research on this effect has shown that the amount of personal involvement in imagery is what determines how distracting, and therefore how pain relieving it is. If you are really involved in an imagined scene, really "into it", it's amazing how easy it is to ignore pain. Something that would be painful becomes merely a minor nuisance. The trick is to learn to use this naturally occurring phenomenon in your daily life whenever you need it. If you can get really involved in an imagined scene, one that means something to you, then your ability to tolerate pain will increase amazingly.

As you might guess, one of the best ways to become personally involved in some kind of imagery is to imagine something that is really very pleasant. This way you can
become so captivated, so involved in the scene you are imagining that you can ignore what would otherwise be a painful feeling. The trick is simple: Just hang on to your imagined experience - just stay with it.

Now, I want you to read the following two imagery scenes. These scenes have been chosen from previous research for their positive, involving qualities. They are things that you can really enjoy and care about, so that they will be especially powerful disturbances for you. As you read these scenes I want you to imagine them as vividly as you can. Try to experience them as you do when you daydream about something you want to happen. O.K. - here's the first scene:

Scene 1) I am on the beach at Cozumel, Mexico, a beautiful Caribbean island 12 miles off the mainland. I'm lying on a comfortable lawn chair, on the warm, pure white sand. In front of me is the Caribbean - it's vivid blue color matching the sky, and beautifully outlined by the white beach. The sun feels warm on my skin, and I can smell the suntan oil I've just put on. There is a light breeze blowing which I can occasionally feel against my skin. The breeze is warm from the Caribbean sun, and I close my eyes. My mind and body are at rest, and I feel an inward calm and quiet. In the distance I hear seagulls calling.
Scene 2) I'm on a skiing trip to Denver. Several of my best friends and I are boarding a plane. Take-offs always make me a little nervous, and I can feel my heart beginning to beat a little faster as we find our seats. I just tell myself what the heck, I can handle this - It's not so much, and sit down with my friends. The plane rushes down the runway, gathers speed, and with one smooth movement rotates upward and leaves the ground. Spontaneously, my friends and I let out a cheer - we're on our way and I feel great! The flight is a short one, really, and soon we're there. We rent a car and start driving to the lodge. It's snowing by the time we check into our room -- Big, heavy flakes. It's a small lodge and not many people are there - my friends and I have it mostly to ourselves. We gather around the fireplace for hot chocolate and talk. Tomorrow we'll check out the slopes and rent our skis.

O.K., now you have your two scenes. The next time you imagine them pay attention to detail, the colors, sounds, and smells. Remember, I want you to really get "into" them, as if you are living them. Take a few minutes more and review your two scenes - get familiar with them. (pause)

O.K. - before we go on I have a short questionnaire I want you to fill out. (pause)

All right, in a moment I am going to ask you to place your hand in the ice water again. This time, I want you to imagine both of your imagery scenes, one after another.
Start with either one you wish, close your eyes, and really let yourself go with the scene. If the ice water becomes unpleasant enough to make imagining that scene difficult, simply shift to your other one. Try to imagine each scene as clearly and vividly as you can. As before, say the word pain out loud the moment you first experience it. Please don't forget to say it out loud. Don't say anything more -- you need to keep concentrating on your imagined scenes. Just let a small part of your mind say pain when you first feel it, and then focus everything on your imagined scenes. Again, you are free to decide when to remove your hand from the water. (pause)

O.K., would you please place your hand in the water, making sure your hand is on the X marked on the bottom of the tank.
Appendix E

Credibility Form

Please read the following questions and circle the number which best describes your present beliefs about the pain treatment instructions.

1. How logical does this type of treatment seem to you?
   
   not logical  somewhat  very logical
   1  2  3  4  5  6  7

2. How confident are you that this treatment will help you control the pain of putting your hand in the ice water?
   
   not confident  somewhat  very confident
   1  2  3  4  5  6  7

3. How confident would you be in recommending this treatment to a friend who was to participate in an experiment in which he was asked to place his hand in ice water for an extended period of time?
   
   not confident  somewhat  very confident
   1  2  3  4  5  6  7
Appendix F

Posttest Questionnaire

Please read the following questions and circle the number which best describes your present beliefs about the pain treatment experiment.

1. To what extent did you follow the instructions in dealing with the pain?
   
   not at all somewhat completely
   
   1  2  3  4  5  6  7

2. How clearly were you able to imagine the scenes while dealing with the pain?
   
   not at all somewhat very clearly
   
   1  2  3  4  5  6  7

3. How involved did you feel personally with the imagined scenes?
   
   not at all somewhat very involved
   
   1  2  3  4  5  6  7

4. While your hand was in the ice water, what percentage of the time were you able to imagine the scenes?
   
   0%  20%  50%  100%
   
   1  2  3  4  5  6  7

5. What thoughts, images, words, techniques, etc. could you have used which might have helped you to keep your hand in the ice water longer?

6. Did you add any personally meaningful thoughts, images, techniques, etc. to the instructions? If so, please describe what you used and how well you think it worked on a 1 to 10 point scale (1 = not very effective; 10 = very effective).
Appendix G

Prescribed Angry Imagery Treatment

A lot of scientific evidence has shown that people can reduce pain by actively using their own imagination. Experiments have shown that imagining certain kinds of activities can distract a person from a painful sensation so well that the pain can become trivial or even unnoticeable. You have probably noticed this effect yourself. You can scrape, bruise, or otherwise injure yourself while you are involved in some activity or daydream and not even be aware of it until later. Have you ever noticed a bruise on yourself and not remember where it came from? Research on this effect has shown that the amount of personal involvement in imagery is what determines how distracting, and, therefore how pain relieving it is. If you are really involved in an imagined scene, really "into it", it's amazing how easy it is to ignore pain. Something that would be painful becomes merely a minor nuisance. The trick is to learn to use this naturally occurring phenomenon in your daily life whenever you need it. If you can get really involved in an imagined scene, one that means something to you, then your ability to tolerate pain will increase amazingly.

Research in this area has provided strong evidence that one of the very best ways to become really personally involved in some given imagery is to imagine something that
makes you feel angry. The personal, meaningful nature of this type of imagination will enable you to become so captivated, so involved in the scene you are imagining that you can ignore what would otherwise be a painful feeling. Anger can be a real pain blocker. As you think about something that makes you angry, you become so wrapped up in it that what was previously painful becomes irrelevant. The trick is simple: just hang onto your imagined scene, just stay with it.

Now, I want you to read the following two imagery scenes. These scenes have been chosen from previous research for their anger invoking involving qualities. They are things that you can really understand and get into, so that they will be especially powerful distractors for you. As you read these scenes I want you to imagine them as vividly as you can. Try to experience them as you do when you daydream about something real. O.K. -- here's the first scene. Scene 1) Class is just out and the professor has last week's graded tests spread out on his desk. When I get mine I see I've gotten a high B, which is O.K. But when I look it over I notice an error of 3 points, which would give me an A. The professor is standing up, ready to leave, so I catch his attention and say: "Excuse me sir, but I think there's been a small error made in grading my test. I should have 3 points higher I think." He looks annoyed and says: "There's no sense nit picking--it won't make any
difference in your final grade." And with that he turns and walks out the door. It's only 3 points but it really burns me. I see red, I mean I feel my face burn and my fists clench. My friends look at me open mouthed—they can't believe how rude he was. For a few moments I have to count to 10 and tell myself to cool down, because it really steams me to be treated that way.

Scene 2) I'm driving in Friday afternoon rush hour traffic, on my way to meet a friend. We're going to the lake this afternoon and want to get off as soon as possible. But the traffic is moving slower and slower it seems, and it's getting irritating. It seems like I hit every light wrong, and I'm beginning to hate red lights. The more I stare at them the longer they take to change. In fact, this one's ridiculous -- it seems like I've been here for ten minutes. Suddenly I realized the light is stuck. The guy in front doesn't notice though--he just sits there, he's reading the paper. Suddenly the whole day's hassles just hit me at once. I'm frustrated, hot, tired, and MAD. I lean on the horn with both hands and several other cars join in. It's plenty loud. The guy reading the paper looks up, startled, puts his car in gear, and kills the motor. My car's starting to overheat, and let me tell you, so am I.

O.K., now you have your two scenes. The next time you imagine them pay attention to detail, the colors, sounds, and feelings. Remember, I want you to really get into
them, as if you are living them. Take a few minutes more and review your two scenes -- get familiar with them.

O.K., before we go on I have a short questionnaire I want you to fill out. (pause)

All right, in a moment I am going to ask you to place your hand in the ice water again. This time, I want you to imagine both of your imagery scenes, one after another. Start with either one you wish, close your eyes, and really let yourself go with the scene. If the ice water becomes unpleasant enough to make imagining that scene difficult, simply shift to your other one. Try to imagine each scene as clearly and vividly as you can. As before, say the word pain out loud the moment you first experience it. Please don't forget to say it out loud. Don't say anything more -- you need to keep concentrating on your imagined scenes. Just let a small part of your mind say pain when you first feel it, and then focus everything on your imagined scenes. Again, you are free to decide when to remove your hand from the water. (pause)

O.K., would you please place your hand in the water, making sure your hand is on the X mark at the bottom of the tank.
Appendix H

Self-Generated Pleasant Imagery Treatment

A lot of scientific evidence has shown that people can reduce pain by actively using their own imagination. Experiments have shown that imagining certain kinds of activities can distract a person from a painful sensation so well that the pain can become trivial or even unnoticeable. You have probably noticed this effect yourself. You can scrape, bruise, or otherwise injure yourself while you are involved in some activity or daydream and not even be aware of it until later. Have you ever noticed a bruise on yourself and not remembered where it came from? Research on this effect has shown that the amount of personal involvement in imagery is what determines how distracting and, therefore, how pain-relieving it is. If you are really involved in an imagined scene, really "into it", it's amazing how easy it is to ignore pain. Something that would be painful becomes merely a minor nuisance. The trick is to learn to use this naturally occurring phenomenon in your daily life whenever you need it. If you can get really involved in an imagined scene, one that means something to you, then your ability to tolerate pain will increase amazingly.

As you might guess, one of the best ways to become personally involved in some kind of imagery is to imagine
something that is really very pleasant for you. The personal, meaningful nature of this type of imagination will enable you to become so captivated, so involved in the scene you are imagining that you can ignore what would otherwise be a painful feeling. The trick is simple: Just hang onto your imagined exercise—just stay with it.

Now, I want you to think of two very pleasant things that you can really care about. That way they will be very powerful distractors for you. An example might be, say, a pleasant trip that you have taken or would like to take. Anything you choose is fine, but it's important that both scenes are personally relevant and, most of all, pleasant to you. It's your feelings about them that are important. Take a few minutes to decide what two scenes and events you will enjoy imagining. (pause)

O.K., fine—now write down those two scenes on the form provided (see Appendix C). Pay attention to detail—remember, the next time you imagine these scenes, I want you to really get "into" them, as if you are living them. Go ahead and fill out the questionnaire now, and be sure to include what is going on, how you feel during the scene, what colors, sounds, and smells you will experience, and anything else you think of. (pause)

All right, in a moment I am going to ask you to place your hand in the ice water again. This time, I want you to imagine both of your chosen scenes, one after another.
Start with either one you choose, close your eyes if you want, and really let yourself go with the scene. If the ice water becomes unpleasant enough to make imagining that scene difficult, simply shift to your other one. Try to imagine each scene as clearly and vividly as you can. As before, say the word pain out loud the moment you first experience it. Please don’t forget to say it out loud. Don’t say anything more—you need to keep concentrating on your imagined scenes. Just let a small part of your mind say pain when you first feel it, and then focus everything on your imagined scenes. Again, you are free to decide when to remove your hand from the water. (pause)

O.K., would you please place your hand in the water making sure your hand is one the X mark at the bottom of the tank.
Appendix I

Imagery Questionnaire

Briefly describe the two pleasant/angry scenes you will imagine while your hand is in the ice water. Pay attention to the details of the scene: what is going on, how you feel, color, sound, smell, etc.

Scene 1:

Scene 2:
Appendix J

Self-Generated Angry Imagery Treatment

A lot of scientific evidence has shown that people can reduce pain by actively using their own imagination. Experiments have shown that imagining certain kinds of activities can distract a person from a painful sensation so well that the pain can become trivial or even unnoticeable. You have probably noticed this effect yourself. You can scrape, bruise, or otherwise injure yourself while you are involved in some activity or daydream and not even be aware of it until later. Have you ever noticed a bruise on yourself and not remembered where it came from? Research on this effect has shown that the amount of personal involvement in imagery is what determines how distracting and, therefore, how pain-relieving it is. If you are really involved in an imagined scene, really "into it", it's amazing how easy it is to ignore pain. Something that would be painful becomes merely a minor nuisance. The trick is to learn to use this naturally occurring phenomenon in your daily life whenever you need it. If you can get really involved in an imagined scene, one that means something to you, then your ability to tolerate pain will increase amazingly.

Research in this area has provided strong evidence that one of the very best ways to become really personally involved in some given imagery is to imagine something that makes you
feel angry. The personal, meaningful nature of this type of imagination will enable you to become so captivated, so involved in the scene you are imagining that you can ignore what would otherwise be a painful feeling. Anger can be a real pain blocker. As you think about something that makes you angry, you become so wrapped up in it that what was previously painful becomes irrelevant. The trick is simple: just hang onto your imagined scene, just stay with it.

Now, I want you to think of two things that make you angry, things you can really care about. That way they will be very powerful distractions for you. An example might be, say, being cheated or dealing with someone really annoying. Anything you choose is fine, but it's important that both scenes are personally relevant, and, most of all, things that make you angry. It's your feelings about them that's important. Take a few moments now and decide what two scenes and events you will imagine. (pause)

O.K., fine—now write down those two scenes on the form provided. Pay attention to detail—remember, the next time you imagine these scenes, I want you to really get "into" them, as if you are living them. Go ahead and fill out the questionnaire now, and be sure to include what is going on, how you will feel during the scene, what colors, sounds, and smells you will experience, and anything else you think of. (pause)
All right, in a moment I am going to ask you to place your hand in the ice water again. This time, I want you to imagine both of your chosen scenes, one after another. Start with either one you choose, close your eyes if you want, and really let yourself go with the scene. If the ice water becomes unpleasant enough to make imagining that scene difficult, simply shift to your other one. Try to imagine each scene as clearly and vividly as you can. As before, say the word pain out loud the moment you first experience it. Please don't forget to say it out loud. Don't say anything more—you need to keep concentrating on your imagined scenes. Just let a small part of your mind say pain when you first feel it, and then focus everything on your imagined scenes. Again, you are free to decide when to remove your hand from the water. (pause)

O.K., would you please place your hand in the water, making sure your hand is on the X mark at the bottom of the tank.
Appendix K

Expectancy Control Treatment

A lot of scientific evidence has shown that the more you know about a painful experience, and the more experience you have with it, the less painful that experience will be. If you know exactly how painful something is going to be, and if you've experienced it before, the next time you go through it, it just won't be as bad as the first time.

Pain is really a very subjective experience. By that, I mean that how bad it is is greatly determined by your own attitude. For example, think about the experience you just had with the ice water. Except for the information that it would not be harmful, you knew very little about it. You did not know quite how it would feel, or how you would react to it. You were uncertain about it, and that made it a lot more painful. When you have that kind of uncertainty you can't prepare yourself properly. You're too confused and worried to deal with the situation in the best way. It goes like this: As you become more knowledgeable and experienced with a painful situation like the ice water, you will feel much less pain. You know what to expect, and it's not such a threat.

In case you are interested, the part of the brain which controls pain this way is located in a part of the brain stem called the Reticular Activating System. Its ability to
decrease pain is known as physical adaptation. The trick is to just let physical adaptation take over when you are undergoing a painful experience. If, however, you ignore your past experience with the pain, and become uncertain, physical adaptation cannot work. The reason for this is that uncertainty, as explained earlier, makes your central nervous system (brain?) more sensitive, and pain feels a lot worse. You can, of course, prevent this.

Your experience just now with the ice water has provided you with information regarding its effects, thereby drastically reducing any fear and uncertainty regarding the task. As a result, the next time you place your hand in the water you will notice that it is much less uncomfortable due to physical adaptation, and you will be able to keep your hand in the water longer. (pause)

In a moment I am going to ask you to place your hand in the ice water again. I will continue to record the physiological data while your hand is in the water. The purpose of recording this data is to gain a better understanding of the physiological components of the adaptation process response. As before, say the word pain out loud the moment you first experience it. Please don't forget to say it out loud. Again, you are free to decide when to remove your hand from the water.

O.K., would you please place your hand in the water now, making sure your hand is on the X mark at the bottom of the tank.
References


