The Effect of Purposeful Activity on Pain Tolerance

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Purposeful and nonpurposeful tasks were performed by 30 normal college-age students (15 male, 15 female) in a study examining the effectiveness of the two types of activity in prolonging tolerance to electrically induced pain. The subjects acted as their own controls, indicated their own threshold for stimulation, and were monitored for peripheral skin temperature and heart rate. Duration of tolerance was measured in seconds from attainment of threshold until the request by the subject that stimulation be stopped. Results indicated that the subjects tolerated pain significantly longer (p = .02) while performing the activity designated as purposeful. No significant differences in peripheral skin temperature or heart rate were found under the two conditions.

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Pain has been described as a multisystem disorder affecting physical and psychological processes and a learned maladaptive behavior reinforced by conditions, responses, ineffectual therapy, poor physical condition, the abuse and misuse of medication, emotional stress, anxiety, and poor nutrition. (Smoller & Schulman, 1982, p. 11)

In addition to the physical discomfort experienced by the individual, pain can also cause emotional, social, and financial damage (Matsutsuyu, 1984). Depression, role loss, inability to cope with stressors and inability to carry out activities of daily living may also result (Mannheimer & Lampe, 1984). Society too suffers from the disruption of family life by pain, while the economy is negatively affected by lost production. The effect of pain on human performance is the legitimate concern of occupational therapy.

Occupational therapy has often used purposeful activity in treating physical and psychological dysfunction (Hinojosa, Sabari, & Rosenfeld, 1983; Lyons, 1983). The purposefulness of an activity, be it a task or a process, can have a significant effect on human performance (Steinbeck, 1986). Affleck et al. (1984) have described distraction as one of four principal occupational interventions for pain. Types of distraction include concentration during activities that range from games and crafts to imaging exercises. Both common sense and clinical experience dictate that purposeful activity can be an effective means of distraction for the patient in chronic pain. Such activities result in decreased perception of noxious stimulation and increased involvement with the external environment. Kielhofner (1982) wrote that the quality of life for people in chronic pain can be improved considerably by helping them find some degree of relief from pain, however transient.

Although occupational therapists have long been aware of the effectiveness of distraction in the form of purposeful activity, there have been few reports of its clinical use in pain management compared with the number of reports on treatment modalities using education, behavioral modification, or rehabilitation. In fact, the literature offers little empirical research to support the use of distraction in any type of occupational therapy, even though its use has long been one of the basic tenets of occupational therapy. Kielhofner (1982) has cautioned therapists to remember that the uses of occupation, activities, and play are continually being rediscovered as valid treatment modalities. Controlled studies are needed to examine the effectiveness and desirability of managing pain with purposeful activity. The current study attempts to determine whether the distraction provided by purposeful activity increases the tolerance of pain in test subjects.
Review of Literature

Most of the medical literature examines the control of pain through surgery or drugs, although noting a growing acceptance of both education and operant conditioning (Bonica, Procacci, & Pagni, 1974; Bresler & Katz, 1980; Mannheimer & Lampe, 1984; Melzack & Wall, 1982). Specific references to pain management by occupational therapists are sparse. Available sources emphasize behavioral modification, biofeedback stress reduction techniques, body mechanics, work modification, adaptive aids, and distraction (Johnson, 1984; Rybstein-Blinchik, 1979; Sakamoto & Warner, 1975).

Distraction is most often achieved through an activity like performing mental calculations, or through the use of guided imagery or meditation (Affleck et al., 1984; Bonica et al., 1974; McCaul & Malott, 1984). In a later study, McCaul and Malott (1984) determined that distraction works best when a task demands attention, involves the challenge of increased attentional capacity, and is used for mild rather than intense pain. McCaul and Haugtvedt (1982) postulated the basic principles for effectiveness of distraction in treating pain. They did so after reviewing a variety of studies that used strategies ranging from imagery to video games. These interventions were tested against pain from various sources, including ischemia, pressure, postoperative pain, chronic pain, dental work, and electric shock.

Responses to pain are complex and varied, depending on the state of mind or attitude of the individual (Johnson, 1984; Lukin & Ray, 1982; Melzack & Wall, 1982; Smoller & Schulman, 1982). To standardize responses, researchers suggest that subject's self-reported sensation be recorded and compared in repeated testing to confirm the perception of pain thresholds and the effectiveness of experimental control conditions (Blitz & Dinnerstein, 1971; Lukin & Ray, 1982). A means of easily controlled pain induction, such as electrical stimulation, can provide replicable procedures for both testing and recording.

Electrical stimulation has been used routinely in pain experimentation for several reasons. First, the intensity of stimulation can be accurately measured. Second, the intensity can be controlled to prevent permanent damage, as the use of chemicals and some pressure methods cannot. Electrical stimulation can be applied to specific and various body parts, thus minimizing restriction of the subject's mobility. Third, as long as care is taken to avoid the buildup of lactic acid at the application point and provided that safe levels of current are administered, no residual damage to tissue occurs (Notermans, 1975).

Electrical stimulation, when used as a noxious stimulus to induce pain, must have parameters different from those used for transcutaneous electrical nerve stimulation (TENS), which has long been used to block pain (Bresler & Katz, 1980; Mannheimer & Lampe, 1984; Melzack & Wall, 1982). The parameters of an acupuncture-like TENS that can result in delayed onset of analgesia are pulse widths between 200–300 microseconds, amplitudes that are at the early range of muscle fasciculation and within subjects' levels of tolerance. These are administered at one to four pulses per second (single impulse) or seven pulses each at two to four bursts per second (pulse burst/chain) for no longer than 45 minutes (Mannheimer & Lampe, 1984).

Purpose of Study

In the past, the role of occupational therapy in pain management has included the application of a wide variety of treatments including, but not limited to, assessment techniques, desensitization, positioning, work hardening, biofeedback, splinting, behavior modification, and stress management (Giles & Allen, 1987; Matsusuyu, 1984; Sakamoto & Warner, 1975). The present study examined the premise that activity designated as purposeful enables subjects to prolong their tolerance of pain. For this research, purposeful activity was defined as activity involving a response that is goal directed, that is, an activity whose goal the subject finds "has captured his or her attention and interest" (Kleinman & Bulkley, 1982, p. 16). Pain was defined as the level of electrical stimulation registered by the subject as very unpleasant.

Method

Subjects

Thirty college age students (15 male, 15 female) with a mean age of 20.2 years participated in the study. Subjects were selected on the basis of the results of a seven-item assessment of health and history. Volunteers were considered for selection only if they were not studying occupational therapy or physical therapy and if they had no physical conditions that might be aggravated by electrical stimulation or influence their nociperception. Subjects who had been given TENS therapy were excluded. Each subject completed and signed a consent form before participating in the research and was given permission to end participation at any time.

Test Conditions

The purposeful activity involved the use of a clipboard mounted with a sheet of graph paper through which a bold abstract pattern could be seen. Subjects marked an X in any square appearing over the design.
The objective was to duplicate the pattern by covering as many squares as possible in the time between being told to begin and being told to stop. This was the experimental condition. The nonpurposeful activity involved using a blunt stylus to trace an X repeatedly within a single designated square at the center of a sheet of graph paper within an allotted period of time. This was the control condition.

**Apparatus**

A Cyborg Biolab was used to monitor physiological responses with continuous recording by means of a sensor attached to the third and fifth digits of the hand. The subject was not using for manipulating the stylus. As is required by equipment specifications, a draft-free room with a steady temperature between 75 °F and 80 °F was used. Random visual and aural distractions were minimized by using a small room with window blinds and bare walls. The sessions were scheduled to avoid predictable noise. Electrical stimulation was administered by means of a Bircher Model 135 Myosynchron Electro Muscle Stimulator. Parameters for this research were pulse widths between 1 and 333 microseconds, amplitudes that were at or slightly above the tolerance level established by the subject. Stimulation was administered at two pulses per second.

**Procedure**

Subjects served as their own controls. The effect of sequence in testing was controlled for by random assignment of the two possible sequences.

Project descriptions used to solicit volunteers were prepared carefully to avoid mention of pain per se. Volunteers were given a preliminary briefing. It was explained that the research involved monitoring physiological responses to the performance of activities. The task threshold for each participant was determined by administering increasing amounts of electrical stimulation to the lower extremity of the subject who then indicated the level at which discomfort was felt—this was the level that was very unpleasant. Subjects were told that the use of the stimulus was a necessary function of the equipment being used to monitor their physiological responses to activity. Information concerning the purpose of the study, equipment, and procedures was read aloud to the subjects from a prepared narrative. Subjects were informed that the electrical stimulation would be discontinued immediately and completely at their request.

Duration of tolerance was measured with a stopwatch to record the elapsed time between the initiation of electrical stimulation and the moment at which the subject asked that the stimulation be discontinued. A series of pilot studies determined that a lapse of 2 minutes was well beyond the time at which subjects would ask that the stimulation be discontinued. To approximate clinical conditions, noxious electrical stimulation was initiated 4 seconds prior to the subjects' engaging in each type of activity. Heart rate and peripheral skin temperature were monitored during both control and experimental conditions. Both were used as indicators of the response of the autonomic nervous system to the stress of nociception. The subject's upper extremity was stabilized in a padded, wooden jig to minimize accidental limb motion that might impair function of the sensors.

Although electrical stimulation of the subject's lower extremity was terminated immediately upon request, the time allotted for participating in the test activity continued for the entire 2 minutes to ensure that the subject did not associate the duration of stimulation with the amount of time needed to perform the activity. Monitoring of heart rate and peripheral skin temperature was also continued for the full 2 minutes so that the subject did not identify the application of the pain stimulus as the actual purpose of the research.

**Results**

As a consequence of a ceiling effect in which some subjects tolerated the painful electrical stimulation for the greatest amount of time possible under both conditions of the experiment, nine scores were eliminated from consideration. To facilitate a comparison of the data across individual subjects, logarithm and square root transformations were applied. Kirk (1968) suggested that these operations be performed to achieve homogeneity of error variance whenever an experimental design requires the participation of subjects whose responses vary widely. The square root formula was used to transform telemetric data on heart rate and peripheral skin temperature, whereas a logarithmic transformation was used on the duration of tolerance data. Dependent *t* tests indicated that the mean number of seconds of electrical stimulation the

<table>
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<tr>
<th>Variable</th>
<th>Purposeful Activity</th>
<th>Nonpurposeful Activity</th>
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<tr>
<td></td>
<td>M</td>
<td>SD</td>
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<tr>
<td>Duration*</td>
<td>1.579</td>
<td>.505</td>
</tr>
<tr>
<td>Peripheral skin temp*</td>
<td>3.188</td>
<td>.437</td>
</tr>
<tr>
<td>Heart rate*</td>
<td>7.046</td>
<td>1.032</td>
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subject endured while performing the purposeful activity was significantly greater than the mean number of seconds of electrical stimulation the subject endured while performing the nonpurposeful activity ($p = .02$). For the control variables heart rate and peripheral skin temperature, there was no significant difference between purposeful and nonpurposeful activities (see Table 1 and Figure 1).

Discussion

This study provided empirical support for the hypothesis that purposeful activity has a positive effect on the duration of tolerance of pain measured in seconds. It provides further support for the use of purposeful activity in the management of pain by occupational therapists.

The results support the idea that activities that are intrinsically motivating engage one's attention and thereby provide distraction from noxious experiences. It follows that persons in pain may be more distracted from their pain by activities chosen for their interest-sustaining properties than by purposeless activities. Work-hardening programs could provide tasks that not only replicate job requirements but also are intrinsically purposeful for the client. Indeed, some subjects volunteered that they created their own distractions when none were provided and that such distractions may consist of internal imagery and fantasy rather than interaction with the external stimuli. Inasmuch as many pain therapy programs maintain goals that emphasize increasing the client's interaction with the external environment, further research in self-distraction may be warranted.

Although not statistically significant, decreases in maximum peripheral skin temperature observed while the subjects were performing the designated purposeful activity suggest other areas for future research.

Summary

The subjects of this study tolerated discomfort for a significantly longer period of time while performing a purposeful activity than they did while performing a biomechanically similar, nonpurposeful activity. This finding supports the premise that purposeful activity, the use of which is a basic tenet of occupational therapy, is useful as a method of distraction. Further study structured to allow for open-ended continuing monitoring of subject performance is recommended. Physiological telemetry of heart rate and peripheral skin temperature provided data of no statistical significance. These data suggest further research, however.

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