Distraction and the Processing of Pain

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ABSTRACT

Distraction is useful for increasing pain thresholds and tolerances and reducing ratings of acute pain and is often incorporated in pain management programmes for chronic pain. However, its usefulness for chronic pain management is questionable. Rosenstiel and Keefe (1983) and Turner and Clancy (1986) both found that chronic pain patients who scored high on the Diverting Attention and Praying factor of the Coping Strategies Questionnaire also had high average pain.

The aim of the present study was to evaluate the utility of distraction for 8 male and 12 female chronic low back pain subjects in acute and chronic pain conditions. It was hypothesised that for the chronic pain condition distraction would not be effective in reducing pain ratings or increasing pain tolerances as the chronic pain perception has over time, come to be automatically processed. Under such circumstances distraction would not be effective as there would be no competition with pain processing for the limited attentional resources. Distraction however, would be effective in reducing acute pain as acute pain is of short duration and likely to be a controlled process. By implication, the third hypothesis proposed that chronic pain and acute pain are processed differently by chronic pain sufferers with the utility of distraction differing accordingly.

Subjects did the cold pressor test for the acute pain conditions, and a step-up exercise for the chronic pain conditions. These conditions were done with and without a shadowing distraction task. A post-test questionnaire was completed at the end of the study. Pain measures were pain ratings, pain tolerances, and also the number of step-ups for the chronic pain conditions.

Results showed that no effect of distraction on pain tolerances and post-test pain ratings. Not only was distraction found ineffective for chronic pain as hypothesised, but it was also ineffective for acute pain management. There was no interaction effect of distraction with acute/chronic pain to support the third hypothesis. Pain ratings and pain tolerances were significantly different between pain conditions.

Automatic processes are generally not effected by simultaneous controlled processes. The results from this study suggest that chronic pain may have developed over time into an automatic process as the distraction task had no effect on the pain measures, and there was no loss in accuracy on the distraction task across the chronic pain condition. Acute pain however should not have developed into an automatic process as it is of short duration and variably mapped. The ineffectiveness of distraction in dealing with acute pain suggests that maybe the subjects have become hypervigilant to all pain sensations, or that distraction loses its effectiveness over time.

The outcome of this study highlights the need to both determine the active components of cognitive strategies for chronic pain management and to investigate further the processing of chronic pain.

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CHAPTER ONE

Pain

Models of Pain

Pain has been defined as,

> "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." (International Association for the Study of Pain (ISAP), 1986, p. S217).

This definition incorporates the idea of both a physical, and a psychological or affective dimension to pain. The pain consists of two factors, the initial sensation and the reaction to the sensation (Beecher, 1959). The IASP definition sees the pain as independent of the stimulus - although it is viewed in terms of tissue damage it is not dependant upon actual tissue damage. Most relevant for the psychologist are the supplementary notes on usage of the term,

> "Activity induced in the nociceptor and nociceptive pathways by a noxious stimulus is not pain, which is always a psychological state, even though we may well appreciate that pain most often has a proximate physical cause" (ISAP, 1986, p. S217).

The recognition of other than solely sensory components to pain results from observations in practice and is a relatively recent innovation in our perspective on pain (Melzack & Wall, 1965). Pain then is viewed as a psychological experience and not synonymous with the physiological activity occurring within a neuron (Weisenberg, 1987).

Historically, pain tended to be viewed as either a psychological phenomenon or a purely sensory phenomenon (Turk & Rudy, 1986). Early writers such as Aristotle viewed pain as an emotion. In contrast in Descartes's classical dualistic approach pain was conceptualised as a purely sensory phenomenon determined exclusively by noxious sensory input. The Cartesian perspective conceived the pain system as a direct channel from the skin to the brain (Melzack & Wall, 1982). Models such as this, which held sway until fairly recently posited a direct correspondence between sensory stimulation and pain representations (McCaul & Malott, 1984). This relationship suggests that the intensity of pain is proportional to the severity of the physical damage. However, according to Weisenberg (1977), such sensory models although making a major contribution to the scientific analysis of pain have limitations in practice.

Firstly, sensory models fail to explain large differences in distress responses by people with similar wounds who are in different situations. The classical study of Beecher (1959) demonstrated that the setting and interpretation of the pain situation can effect the pain reaction more than the actual tissue destruction. He reported of 150 men seriously wounded in battle, only 32% requested a narcotic for pain relief. In comparison, in civilian life, with similar surgical wounds made under anaesthesia, 83% of the group requested pain relief.

Other variables identified as effecting the perception of pain include culture (Sternbach & Tursky, 1965), past experience (Melzack & Scott, 1957), cognitive factors such as attention (Blitz & Dinnerstein, 1971; McCaul & Haugtvedt, 1982; Rybstein-Blinchik, 1979), anxiety (Spear, 1967), and feelings of control (Kanfer & Goldfoot, 1966). The effect of these variables on pain report argues against the simplistic stimulus-response concept of pain.

Secondly, in cases such as chronic low-back pain, given the number of potential causal factors, the diagnosis of back pain from medical factors alone is difficult and uncertain in accuracy. Additional complicating factors in diagnosis include: (1) the relative inaccessibility of the spine for examination, and (2) the low correlation of pathological changes in the spine with symptoms of low-back pain (Feuerstein, Papciak & Hoon, 1987). Nachemson (1983) estimated that only 20-30% of patients with low back pain are found to have "objective" signs of disease. The majority of patients have subjective symptoms with pathophysiological processes insufficient to explain the pain and disability associated with the back disorder. It appears that environmental, psychological, and psychobiological factors overlay the purely physical components and help to account for the apparent discrepancy among pathology, report of pain, and functional ability (Feuerstein et al., 1987).

Thirdly, despite major advances in the understanding of the nervous system and the development of potent analgesic preparations, amelioration of pain is often not achieved (Turk & Rudy, 1986). A sensory approach implies that all that is needed, is to interrupt the pain pathway. Unfortunately pain persists for many in spite of the best efforts of the medical profession to interrupt the sensory pathway. Indeed most chronic pain patients may be characterised as failures of extensive therapy aimed at elimination of pain (Urban, 1982).

These inconsistencies in pain responding demonstrate the complexity of examining and defining the pain response. Unidimensional models of pain are clinically inadequate. It is apparent that both emotional and psychological factors can effect pain. Pain then must be viewed as a complex phenomenon (Weisenberg, 1977). Melzack and Wall (1965, 1982) introduced their Gate Control Theory of Pain to account for the psychological influences on pain. They rejected both popular sensory theories to date; the specificity theory that is based upon a specific set of peripheral nerve fibres that are nociceptive in function (Weisenberg, 1977), and the pattern theory that suggests pain perception is based upon stimulus intensity and central summation (Goldscheider, 1894, cited in Melzack & Wall, 1982).

Gate Control Theory of Pain

Conceptually gate control theory proposes a gating mechanism in the substantia gelatinosa which modulates sensory input by the balance of activity of small and large diameter fibres. Activity of large fibres closes the gate and prevents synaptic transmission to centrally projecting cells, whereas small diameter fibres open the gate and facilitate activity to the central cells once a critical level is reached. A central control trigger can also influence the gate. Thus, cognitive processes can either open or close the gate. The gate theory with its emphasis on parallel processing systems, provides the conceptual framework for integration of the sensory, affective and cognitive dimensions of pain (Melzack & Wall, 1982). More than other theories it emphasises the different aspects of pain perception. Pain has a sensory component that is similar to other sensory processes. It is discriminable in time, space, and intensity (Weisenberg, 1977). However pain also has an essential aversive cognitive-motivational and emotional component that leads to behaviour designed to escape or avoid the stimulus.

With pain which persists over time and becomes chronic, successful pain control often involves changing the motivational component while the sensory component remains intact. While specific neural components of the gate control theory have required modification over time, the conceptual basis of the model is now generally accepted as best explaining the complexity of pain perception (Weisenberg, 1987).

Classifications of Pain

The time and course of the pain are the arbitrary dimensions that distinguish the different categories of pain. Transient pain is of brief duration having little consequence and generates not more that fleeting attention. Little or no damage has been done. If the pain persists, or was initially more severe, the pain is known as acute pain and is the transitional period between coping with the cause of the injury and preparing for recovery (Melzack & Wall, 1982). It has a recent onset, short duration and is generally well understood and managed (Sternbach, 1987).

Pain that has persisted for a period of at least six months be it recurrent or continual is known as chronic pain (Feuerstein et al., 1987). Turk, Meichenbaum, and Genest (1983) identified three types of chronic pain. Chronic, periodic pain where the pain is acute but intermittent for example with migraine headaches; chronic, intractable, benign pain which is present most of the time with intensity varying, as for low back pain; and chronic, progressive pain often associated with malignancies. Chronic benign pain is the pain of interest in this study.

With chronic benign pain the underlying cause has often been identified or treated but the pain persists. Thus the pain is no longer a warning sign for an underlying disorder that needs to be treated, but rather a false alarm that serves no purpose and has a destructive, debilitating effect (Sternbach, 1987). Conventional treatments for acute pain are usually ineffective for chronic pain (Keefe, 1982).

Chronic pain effects a surprisingly large proportion of the population. Sternbach (1987) reported that 12.8% of American adults reported chronic pain, with associated interruptions to their daily routines, their ability to concentrate and their ability to enjoy leisure activities. The average individual surveyed lost 23 days a year due to a pain problem. Those with chronic pain frequently complain of sleep disturbance, exhaustion, irritability, loss of appetite, social withdrawal and depression (Sternbach, 1987). They typically also tend to exhibit behaviours specifically related to their pain (Fordyce, 1976). These effects can have a crushing impact on family life (Linton, 1987). Flor, Turk and Scholz (1987) reported that pain patients and their spouses experienced change in marital and sexual satisfaction due to the effect of the chronic illness.

Chronic low-back pain is one form of chronic pain that has received a lot of attention due to the severely debilitating physical and psychological consequences for the sufferer (McArthur, Cohen, Gottlieb, Naliboff & Schandler, 1987).

Chronic Low-Back Pain

Musculoskeletal problems, particularly of the lower back, commonly become chronic pain problems (Webb, 1983). Benign chronic low-back pain (CLBP) has been characterised by Vazuka (1962) as,

> "varying degrees of low-back discomfort or back stiffness with difficulty bending, decreased back mobility, skeletal muscle spasm and tenderness, concern or preoccupation with the back and with general concomitant disability" (cited in Hoon, Feuerstein & Papciak, 1985, p. 379)

In its most severe form the chronic low back pain sufferer is minimally able to accomplish the most ordinary of tasks, let alone partake in exercise or hold gainful employment. They frequently have a history of twisting, lifting, bending or falling that can be associated with the pathogenesis of the chronic pain (Spengler, 1983). Psychological distress tends to be very high, exacerbated by repeated failures at obtaining relief from pain by medication or surgery (McArthur et al., 1987).

Society is also hit hard by the high incidence of low back pain. Chronic back pain is one of the most costly ailments in terms of medical expenses and lost work time (Kelsey & White, 1980). It affects up to 18% of the general population (Feuerstein et al., 1987). Twenty five percent of New Zealanders can expect to sustain back injuries in their lifetime (Hickey, 1978). Accident Compensation Corporation (ACC) back injury claims with a 1981 accident date showed that half of all compensation for New Zealand men aged 20-59 was paid to claimants where incapacity exceeded six months (ACC, 1984). 50 million dollars compensation was paid out by ACC for back injuries in 1989 (ACC, 1990). The socioeconomic impact of chronic back pain is heightened by the fact that most sufferers are employees in their prime productive working years (Spengler, 1983). The implications of chronic back pain both to the individual and society highlights the need for the development of a better understanding of the etiology, treatment and prevention of the pain.

Behavioural Model of Pain

Behaviours can indicate the level of pain a sufferer is perceiving. With chronic pain these behaviours can become established over time. Fordyce (1976) developed a behavioural model of pain which attempts to understand chronic pain by the integrating available physiological and psychological data on chronic pain. The behavioural model of pain is similar to the Gate Control Theory in that it acknowledges the psychological components of pain, however it ignores the affective, cognitive and to some extent sensory components of the pain experience (Turk & Rudy, 1986).

The behavioural view is based on the notion that when we observe a pain patient, it is behaviour that we are observing. In chronic pain, pain behaviours such as winces, guarded movements, verbal reports, and avoidance behaviours, may originate initially as a consequence of body injury stemming from reflex reactions. These pain behaviours may be followed by reinforcing contingencies, such as increased attention from others or release from strenuous work, which can potentially maintain or increase the initial pain behaviour. In this environment productive of conditioning effects, the pain behaviours may continue long past healing time for reasons quite different than those eliciting them at the time of injury (Fordyce, 1976). Thus respondent pain behaviours may become operant in nature through the process of learning and may occur even in the absence of nociceptive stimulation (Turk & Rudy, 1986).

In situations then, the antecedents and consequences of pain and pain behaviour can act to perpetuate the chronic pain condition. The impact of the consequences of pain behaviour on responding are demonstrated by Cairns and Pacino (1977) who systematically varied physical therapist feedback response in a series of nine chronic pain patients exercising to tolerance. Patient performance was shown to improve markedly and systematically when the therapist was delivering praise. In this study environmental factors, in this case social feedback, can exert influence on exercise performance under the constant instruction to exercise to tolerance.

Environmental differences and verbal/nonverbal discrepancies in pain responding can be evidenced in everyday situations where the antecedents and consequences vary. A back pain patient may complain about the discomfort experienced from an activity such as sitting at a desk and yet may experience minimal discomfort when sitting fishing. This highlights the fact that behaviours, verbal and nonverbal, can receive different consequences. Equally it demonstrates that we are capable of focusing our attention on certain incoming sensory information to the exclusion of other inputs. The person who enjoys fishing may become engrossed in that activity to the extent that their pain is secondary to their involvement in catching fish. Working however may not be as enjoyable with attention being allowed to waver to the tension or aching in their back. The process of attention can exert considerable influence on the perception of pain stimuli as well as on the ensuing responses or pain behaviours.

The degree that attention can be directed away from a pain sensation and the perception of pain consequently be reduced, is a component of pain management which has recently received much interest within clinical and cognitive psychology. Attention, in particular pain focused attention, is a central issue both in formulating a model of pain and in the management of pain.

CHAPTER TWO

Attention and Pain

Selective Attention

The concept of attention refers to,

> "the taking possession of the mind in clear and vivid form, of one of what seems several simultaneously possible objects or trains of thought. Focalization, or concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal more effectively with others ." (James 1890, cited in Reason & Mycielska, 1982, p.220)

Within this definition attention is seen to be selective, conscious to some degree, and limited. The individual can determine where they direct their focus and they can alter that focus, but need to withdraw attention from one stimuli to give it to another. There is a limit on the number of stimuli that can be processed at any one time and so allocation strategies both automatic and voluntary exist to direct the processing of relevant stimulus information. Traditionally the exclusion from processing of stimuli other than an identified stimulus, has been referred to as selective attention.

Selective attention has gained a foothold in the mainstream of psychology. The concept presupposes that there is some "bottleneck" or capacity limitation in the processing system and that subjects have the ability to give preference to certain stimuli so they pass through the bottleneck easily at the expense of other stimuli.

This limited capacity or mechanism can be associated with consciousness and processing which requires effort or attentional resources (Kahneman, 1973). The limitation of the mechanism implies that at some stage or stages in the information flow, the information arising from some objects must be momentarily excluded from processing. LaBerge and Brown (1989) see this exclusion from processing occurring due to operations that either enhance the information from a target stimuli or by operations that suppress the information from the distracter objects, or by operations that do both.

Although there has been disagreements over the notion of limited capacity there appears no disagreement over the view that processing is selective. This selectivity has given rise to a host of theories concerned with locating the bottleneck in human information processing. That is, when the parallel system capable of processing separate channels concurrently 'narrows' to a serial system that must handle only one channel at a time (Wickens, 1984).

Models of Attention

Theories of attention have been organised into two classes - structural theories and capacity theories. Some structural theorists (Broadbent, 1958, cited in Broadbent, 1971; Treisman, 1969) placed the bottleneck early in the information processing sequence, prior to perceptual analysis. This means that when two stimuli are presented at once, one of them is perceived immediately while the sensory information corresponding to the other is held briefly until the analysis of the first message is completed. Others (Deutsch & Deutsch, 1963) placed the bottleneck later in the flow of information sequence, just prior to the stage of response selection. According to this model, the meanings of all concurrent stimuli are extracted in parallel and without interference until the point where a response is made.

Kahneman's (1973) capacity model of attention was intended to complement rather than supersede structural models of information processing. The capacity model assumes there is a general limit on man's capacity to perform mental work, the capacity limit varies with the level of arousal, and the capacity is controlled by feedback from ongoing activities. Conceptually a "pool" of limited capacity resources are available. As a primary task demands more of these resources fewer are available for a concurrent "secondary" task, and performance on the latter task deteriorates. Thus there is a general limit on the resources available for performing mental operations. However according to Kahneman (1973), this limit does not apply to any specific stage of information processing. Rather capacity can be allocated flexibly to different stages of processing.

Whereas structures in the structural theories were assumed to be dedicated to one task at a time, the capacity view holds that capacity can be allocated in graded quantity between separate activities (Wickens, 1984). The source of interference for the capacity theory depends merely on the capacity demands at the particular processing stage, with mental operations differing in the amount of attentional capacity required.

Capacity theories have branched out to incorporate the idea that there is more than one commodity within the human processing system that may be assigned resource like properties (Navon & Gopher, 1979). There are not major differences between this multiple resource model and Kahneman's model which assumes an undifferentiated resource - both predict that time sharing will be less efficient if two tasks share common structures (Wickens, 1984). According to a multiple resources conception, inefficiency results from competition for the resources that enable the structures to function. According to Kahneman this results from direct competition for the structures.

Under some circumstances, tasks can be efficiently performed simultaneously. It has been demonstrated that some complex operations can occur with only minimal attentional capacity being allocated to them (Logan, 1978; Shiffrin & Schneider, 1977). This typically happens after extended practice when the stimuli and responses are consistently mapped (CM) - that is, across training trials the subject makes the same overt or covert response each time the stimulus occurs. If the responses are variably mapped (VM) across trials - the responses change across trials - performance should change little with practice.

Navon (1985) suggests that because some processing does not demand resources it is conceivable that all processing is resource free. In such a light the cost on performance of attention sharing is not due to limited resources, but due to the negative effects or interference of events that take place at the same time. This conflict, outcome conflict, is qualitatively different from a case of competition for resources in which the events are unlikely to co-occur, or properly proceed, because they rely on the same enabling commodity and compete for it. Interference depends on both the modality of the input and the output and processing, rather than on the total amount of information to be processed (Wickens, 1984).

In recent years, theories have been proposed to account for the quantitative and qualitative changes in performance that occur with extensive practice (Shiffrin & Schneider, 1977).

Controlled Processing

It is generally agreed that the acquisition of almost any cognitive or motor skill involves profound changes with practice (Schneider, 1985). Researchers have interpreted these qualitative differences in performance to occur as a result of two qualitatively different forms of information processing. Shiffrin and Schneider (1977) formulated a theory of information processing based on two fundamental processing modes: controlled and automatic. These processing modes can be illustrated in many everyday learning situations, as initial performance on a task changes with practice. At first, effort and attention are often required for every movement or minor decision, but over time and with extended practice long sequences of responses can be carried out with little attention, and performance is quite rapid and accurate.

Controlled processing is,

> "highly demanding of attentional capacity, is usually serial in nature..., is easily established, altered, and even reversed by the subject, and is strongly dependant on load." (Shiffrin & Schneider, 1977, p. 127)

This is the processing mode that is used to deal with novel or inconsistent information as when a person's response to a stimulus varies from trial to trial. An example of controlled processing is when a person first learns to drive a car and all attention needs to be focused on each individual step of changing gears. Such processes are heavily capacity limited so only one sequence at a time may be controlled without interference unless the extra sequences are slow and can be interwoven serially (Shiffrin & Schneider, 1977). The cost of this limitation is counter-balanced however by the fact that controlled processes are able to manage novel situations.

Controlled processing then rests heavily on the assumption of limited resources. The reason that many novel tasks can not be responded to satisfactorily in a controlled task is due to the fact that each task requires a large allocation of the resources. There are not enough resources to facilitate this requirement and so performance on some tasks suffer.

Automatic Processing

Alternatively automatic processing,

> "is a fast, parallel, fairly effortless process that is not limited by short-term memory capacity, is not under direct subject control, and is responsible for the performance of well-developed skilled behaviors." (Schneider, Dumais & Shiffrin, 1984, p. 1)

Automatic processing typically requires an appreciable amount of training and appears to utilise a relatively permanent set of connections in the long-term store. The processing does not require awareness or initiation and as a consequence they will often be difficult to suppress. Minimal amounts of attentional capacity are used allowing the organism to continue to operate even when very high demands are made, as in moments of high stress or injury (Hasher & Zacks, 1979).

Schneider et al. (1984) developed a two-part rule to account for the attentional requirements of automatic processing. Part One relates to the ability of people to successfully time-share two tasks after extensive practice. Yantis and Jonides (1990) refer to this as the load insensitivity criteria. Dual task studies using an automatic task and a resource consumptive task, have been used to demonstrate the assertion that automatic processing is resource insensitive. If performance in the two tasks remains at or close to single task levels then it is assumed that automatic processing places few if any demands on the limited supply of attentional resources. Logan (1978) showed that subjects were able to simultaneously perform consistently mapped (CM) tasks and variably mapped (VM) detection tasks, without any cost in sensitivity, if subjects allocated attention to the VM task. However when two VM tasks were time-shared, performance on one task prospered at the expense of the other. The results support the idea that under some conditions automatic processing does not require attentional resources.

Part Two relates to the notion of mandatory activation of attention with the presentation of a well-trained target. Here Shiffrin and Schneider (1977) showed that when VM targets appeared in a to-be-ignored diagonal, subjects were able to successfully focus attention on the attended diagonal and ignore the irrelevant diagonal. However, if a CM target was presented in the to-be-ignored diagonal, it interfered with the detection of VM stimuli in the attended locations. Thus the automatic attention response is not under the control of the subject and will occur whenever the stimulus is present. Attempts by a subject to prevent an automatic process from proceeding are not successful. This is known as the intentionality criteria (Yantis & Jonides, 1990).

A hypothesis that contrasts with the automatic-control processing framework is the "attention-is-a-skill" hypothesis (Hirst, Spelke, Reaves, Caharack & Neisser, 1980). This proposes that extended time-sharing training is sufficient to eliminate dual-task interference. The reasoning behind this is that only "simple" tasks and processes can be automatized. Schneider et al. (1984) argue against this suggesting that automatic processes can be very complex.

Theories of Automaticity

A recent approach views automaticity as a memory phenomenon (Logan, 1988; Schneider, 1985). According to memory based theories, automaticity involves retrieving information from a knowledge base established through practice. Initial performance is limited by a lack of knowledge, and the development of automaticity is the result of an increasing knowledge base which facilitates memory retrieval (Strayer & Kramer, 1990). Logan (1988) interprets this model of automaticity as operating on the strengthening of connections between a stimulus and a response (Logan, 1988). Automaticity is viewed as a continuum, reflecting the relative involvement of direct memory access in performance - performance becoming more automatic as the direct memory access plays a greater role.

The memory-based approach to automaticity can be contrasted with process-based theories of automaticity based on resource models of attention which assume that an automatic process is composed of the same operations as a non-automatic process but is carried out more rapidly without attention (eg. LaBerge & Samuels, 1974). According to this perspective, cognitive operations still operate on the information in working memory after consistent practice. Strayer and Kramer (1990) report that process-based theories assume that the memory set must be retrieved from long term memory in both consistently mapped and variably mapped conditions. Attentional capacity is thought to energise performance and the amount of capacity allocated to a process determines the amount or rate of processing. Automatic processes are assumed to require no capacity. Practice somehow strengthens the connections or allows sequential processes to be executed in parallel, so that attention progressively becomes less necessary and finally is not required at all. A serious weakness of the modal or process-based view is that it does not specify how the reduction in demand for attention comes about (Logan, 1988).

Based on the research evidence Strayer & Kramer (1990) suggest that memory-based theories provide a better account of the data than do process-based theories of automaticity.

Model of Controlled - Automatic Transition

Schneider (1985) proposed a four phase model of the transition from controlled to automatic processing. The transition between phases occurs in a continuous manner depending on subjects' strategies, workload, and skill acquisition. Phase One represents controlled processing and is characterised by an effect of memory load on performance. Phase Two occurs shortly after the introduction of consistent practice and is characterised by the co-occurrence of controlled and automatic processing. In Phase Three the controlled sequential operations are no longer necessary. Attention is still allocated to the task but the attention serves to assist automatic processing. Phase Four represents pure automatic processing and is typified by perfect time sharing between a task employing automatic processing and another which demands attentional resources. Therefore allocating attention away from the task employing automatic processing or changing the difficulty of a concurrent task should produce no decrement in performance in the automatic task. Controlled and automatic processing are not independent processes but can coexist.

Automaticity and Attention

This automatic-control processing approach makes several predictions about attentional performances (Schneider et al., 1984). First, performance in a given task can be very different depending on the type of processing involved. Second performance should change due to the development of automatic processes when subjects are given consistent, extensive practice. Third, as performance becomes more automatic, subjects should have more difficulty controlling and modifying their ongoing processing. Fourth, because control processes are capacity limited, reductions in capacity, through drugs, fatigue, motivation, and other attentional demands should much more severely harm control processes than automatic processes. These predictions can to some extent be applied to pain processing and responding. How pain is processed, how the pain processing may alter with consistent mapping, how sufferers can attempt to modify that processing, and the effect of their pain on their overall attention are important issues, particularly for those interested in chronic pain

Attention has been incorporated into the literature on pain through models of pain that allow for a cognitive-motivational component to the pain experience. The Gate Control Theory of Pain (Melzack & Wall, 1965) with its emphasis on parallel processing, provides a conceptual framework for integration of the sensory, affective and cognitive dimensions of pain. It proposes that cognitive activities such as attention and suggestion can influence pain by acting at the earliest levels of sensory transmission. Cognitions, and the perception and attention to pain have as a consequence been an increasingly important domain of research.

The interaction between cognitive processes, affect and behaviour change are complex, with changes in one of these areas having the potential to promote positive changes in the other areas (Turk, Meichenbaum & Genest, 1983). Cognitions are one area where change can readily be effectively accomplished. With cognitive variables found to be important in pain exacerbation and maintenance (Turk & Rudy, 1986), the ability of cognitive strategies to influence patients who live with unremitting pain is now being realised. Pain is a subjective experience, so it seems appropriate to approach treatment from such a cognitive level (Kongstvedt, 1987). As a consequence cognitive strategies have developed for pain management and have been shown to have considerable power in relieving pain.

CHAPTER THREE

Cognitive Strategies for Pain Management

Cognitive coping strategies are those techniques that influence pain through the medium of one's thoughts as opposed to either behavioural techniques which modify overt behaviour or physical intervention (Fernandez & Turk, 1989). Cognitive strategies are intended to influence aspects of an individual such as their attentional processes, beliefs, images and/or self statements. The underlying rationale behind such approaches is that a person's "cognitions" or appraisals of their environment are critical determinants of their experiences and emotions. That is, our expectations and ideas can alter what we see or feel (Tan, 1982). Therefore,

> "faulty "cognitions" lead to negative experiences including exacerbation of anxiety, depression and pain. By altering such "cognitions" to more adaptive ones, negative experiences may be attenuated." (Tan, 1982, p. 202).

The recognition of psychological components to pain have caused the introduction of cognitive and behavioural treatment programmes into pain management. These programmes are typically multifaceted and tend to incorporate to a greater or lesser extent distraction, suggestion, anxiety reduction, and procedures intended to produce an increased sense of self control. The emphasis is on the active participation of the patient. This multidisciplinary approach to pain is designed to enable sufferers to cope more adequately with their pain rather than get rid of it (Turk, Meichenbaum & Genest, 1983).

Turk, Meichenbaum and Genest (1983) suggested that cognitive strategies for coping with pain can be divided into those in which the focus is on altering the appraisal of pain (suggestion), and those in which the primary focus is on diverting attention away from the pain (distraction). Alternatively Rosenstiel and Keefe (1983) in developing the Coping Strategies Questionnaire (CSQ), came up with three clusterings of techniques used by chronic lower back pain sufferers.

The CSQ lists 42 ways of coping with pain, which can be collapsed into six different types of cognitive strategies (diverting attention, reinterpreting pain sensations, coping self statements, ignoring pain sensations, praying or hoping and catastrophizing) and a behavioural strategy (increasing activity level). Subjects indicate on a seven point scale how often they use each way of coping when they experience pain. Ratings are also made of the effectiveness of the strategies in terms of how much control they feel they have over the pain, and how much they are able to decrease the pain. The three factors derived by Rosenstiel and Keefe (1983) were:

1. Cognitive Coping and Suppression - which included methods used to actively suppress pain such as reinterpreting the pain sensations, using coping self statements and ignoring the pain sensations.

2. Helplessness - which was typified by the use of passive techniques such as catastrophizing. Patients high in this factor tend to have a poor ability to deal with pain.

3. Diverting Attention and Praying - which involved focusing on things perceived to be external to the pain such as hoping.

Rosenstiel and Keefe (1983) found that while chronic low back patients reported using some coping strategies more often than others, the overall effectiveness of the strategies for controlling and decreasing the pain, was rated low. The type of strategy employed was not related to the duration of pain, disability status, or history of multiple lumbar surgeries.

Coping strategies were highly predictive of behavioural and emotional adjustment to a chronic pain problem. Patients who scored high on the cognitive coping and suppression factor were more impaired functionally while patients who scored high on the helplessness factor seemed to be suffering more depression and anxiety. Patients high on diverting attention and praying reported more pain and functional impairment. These factors were found to be predictive of adjustment over and above what may be predicted from patient history variables and patient's tendency to somaticise (Rosenstiel & Keefe, 1983).

Turner and Clancy (1986) also using chronic low back pain subjects endorsed Rosenstiel and Keefe's (1983) study. Coping styles were found to be associated with average pain, downtime, functional impairment, and depression. Important similarities between results of the two studies include the significant positive relationship between catastrophizing/feeling unable to control pain and depression, and between diverting attention and pain intensity. Decreased endorsement of catastrophizing strategies related significantly to decreases in pain intensity ratings while increased use of praying and hoping strategies was significantly related to decreases in reported pain intensity (Turner & Clancy, 1986). Of particular interest is the fact that both studies showed positive associations between high levels of pain and the use of the third factor, diverting attention and praying. In relation to this, Rosenstiel and Keefe (1983) and Turner and Clancy (1986) questioned the feasibility of using attention diversion techniques for chronic pain problems.

Reviews

Reviews of studies utilising cognitive pain management strategies have further investigated the efficacy of such techniques, (Fernandez & Turk, 1989; McCaul & Malott, 1984; Tan, 1982).

Fernandez and Turk (1989) utilised the meta-analysis procedure to try and overcome some of the subjectivity that had been involved in previous reviews. Cognitive strategies were organised according to a taxonomy developed by Wack and Turk (1984, cited in Fernandez & Turk, 1989) which categorises cognitive strategies along three dimensions of sensation acknowledgment, coping relevance, and cognitive-behavioural focus. The categories identified are 1) external focus of attention, for example watching slides (Kanfer & Goldfoot, 1966; McCaul & Haugtvedt, 1982), 2) neutral imagery, for example imagining classroom activity (Spanos, Horton & Chaves, 1975) 3) pleasant imagery, such as relaxing on a beach, listening to music, or dining out (Chaves & Barber, 1974), 4) pain acknowledging, such as focusing on the sensations of coldness and wetness in the cold pressor test (Blitz & Dinnerstein, 1971), 5) rhythmic cognitive activity, such as counting backwards (Beers & Karoly, 1979) or adding aloud (Barber & Cooper, 1972), and 6) dramatised coping or reconstruction, such as imagining a desert scene while participating in the cold pressor test with the cold water being interpreted as pleasant and refreshing (Spanos et al., 1975).

In terms of overall efficacy, Fernandez and Turk (1989) found that 85% of the investigations showed cognitive strategies to have a positive effect in enhancing pain tolerance/threshold or attenuating pain ratings, as compared with no treatment. This compares with the figure of 50% reported by Tan (1982) in his narrative review of the literature.

In addition to their overall analysis of the efficacy of cognitive strategies, Fernandez and Turk (1989) reported that each individual category of strategy attenuated pain significantly. The most effective categories were the imagery strategies and external focus of attention. The strategies involving repetitive cognitions or acknowledgement of sensations associated with pain were among the least effective.

Fernandez and Turk (1989) also looked at the advantage of cognitive strategies over expectancy (placebo) manipulations. 83% of the studies showed cognitive strategies to be superior. They concluded that cognitive strategies significantly reduce pain. Tan (1982) in contrast concluded that the efficacy of cognitive and cognitive-behavioural methods for clinical pain attenuation although encouraging, is somewhat meager. Tan's (1982) review unlike Fernandez and Turk (1989) and McCaul and Malott (1984) incorporates both studies designed to control clinical pain and those studies that evaluate the efficacy of cognitive methods for experimental pain control. The other reviews have not concentrated on clinical pain studies and this could well lie behind the difference in reports on the utility of cognitive strategies. The critical test of the utility of any strategy lies with clinical pain management. Tan (1982) concluded that it was imperative that further clinical studies be undertaken to determine the value of interventions already useful with experimental pain. This is necessary before any generalisable conclusions can be made.

Distraction

The strategies which require an external focus of attention or distraction, are the strategies of interest here. Distraction can be broadly defined as,

> "directing one's attention away from the sensations or emotional reactions produced by a noxious stimulus." (McCaul & Malott, 1984, p. 517).

It is apparent from Fernandez and Turk's (1989) meta-analysis and other studies (Blitz & Dinnerstein, 1971; Chaves & Barber, 1974; McCaul & Haugtvedt, 1982) that when people are required to attend to something else while receiving a painful stimulus, they will rate the pain lower. Not only is this of interest to researchers but it is frequently used in everyday circumstances by people unaware of its foundations or its real efficacy. Four theoretical assumptions form the basis for predictions regarding the effectiveness of distraction. The assumptions are,

1. cognitions are an important determinant of the pain experience,

2. attentional capacity is limited,

3. pain perception is a controlled, rather than an automatic process, and

4. the distraction task also is controlled, rather than automatic.

The hypothesis that distraction will reduce pain is clearly based on models which incorporate cognitions into pain. The rationale sees the pain experience emerging from information processing; distress and emotions are a product of attending to sensory inputs and processing them in an emotional way (McCaul & Malott, 1984). Distraction can interrupt this chain of events if the assumption of a limited attentional capacity, is invoked. This assumption implies that if task requirements of the distraction task or pain perception exceed the capacity limit then performance on one or both of these tasks will suffer.

Distraction for pain management then utilises similar principles to those relating to dual-task performance of variably mapped tasks - when two variably mapped tasks are time-shared, performance on one task prospers at the expense of the other (Logan, 1978). Employing distraction strategies for pain control assumes that performance on the distraction task will prosper while producing a detrimental effect to the processing of, and responding to pain. Both tasks are considered to be variably mapped or controlled processes. If either of the tasks are, or become, automatic processes due to ease of the task, consistent mapping or extended practice the effectiveness of distraction as a pain management strategy is lost.

The effectiveness of distraction has been assessed extensively in research designs using changes in acute pain tolerance as a measure of outcome. When using attention as a central component of a cognitive strategy one has to accept that focused attention is never complete. Therefore there are situations where distraction is more or less effective.

Review of Distraction Literature

McCaul and Malott (1984) narratively reviewed distraction and coping with pain. Although they have been criticised for basing their conclusions on a non-uniform pool of studies (Fernandez & Turk, 1989) they nevertheless provide a general overview of distraction in predominantly experimental pain management. They looked at recent studies from Psychological Abstracts and pain literature reviews and based their own paper around providing evidence to support or refute four principles.

The first principle examined by McCaul and Malott (1984) was that subjects who are asked to perform an attention demanding task will exhibit less distress when exposed to a painful stimuli than subjects provided with either no instructions or placebo instructions. Of the eight cold pressor studies which compared treatment with no instructions, threshold and tolerance measures were uniformly increased with a variety of distraction tasks. Self reported pain and discomfort measures compared with threshold and tolerance measures, but were weaker. With stimuli other than cold pressor stimulation, the studies once again showed consistently positive, though not overwhelmingly powerful effects for distraction over no instructions.

One's expectancy regarding coping efficacy of distraction tasks was similarly reviewed by McCaul and Malott (1984). There was evidence that distraction was beneficial relative to various types of expectancy instructions (eg. Beers & Karoly, 1979), but the expectancy groups did not differ from no treatment controls on pain measures and it is unclear whether the expectancy instructions did indeed raise subject's expectancy levels. One study did suggest that distraction was superior to expectancy alone. Chaves and Barber (1974) demonstrated that cognitive strategies produce a reduction in pain which is over and above that due to expectancy; groups provided with cognitive strategies showed significantly less pain than subjects expecting less pain but not provided with cognitive strategies. Experimenter modelling was also largely ineffective in reducing pain (Chaves & Barber, 1974).

McCaul and Haugtvedt (1982) explored whether a "commonsense belief" in the benefits of distraction as a coping strategy was the reason behind distraction being a better coping strategy than attention to sensations when subjects were asked to report pain threshold and tolerance. The evidence for this was mixed; however if subjects were not encouraged to think about, or allowed to choose among alternative strategies, they viewed distraction as beneficial. Further when given a choice of strategy, there was a strong tendency for them to prefer distraction.

In a more recent study than McCaul and Malott's (1984) review, Marino, Gwynn and Spanos (1989) varied expectancy instructions for a shadowing distraction task, and an imagery task on the cold pressor test. Subjects received positive expectancy information about one of the strategies and negative expectancy information about the other. Negative information reduced expectancy ratings and decreased the magnitude of reported pain reductions. This is consistent with the hypothesis that expectancy exerts much of its effect by influencing the extent to which subjects implement and maintain the strategies they are given.

In addition Stevens (1985) found that 64% of subjects involved in a study aimed at determining the effectiveness of covert positive reinforcement in modifying responses to cold pressor pain, supplemented the conditional strategies with their self generated strategies. Other studies have also found that subjects would have preferred to use their own methods for pain reduction rather than those they were instructed to use (Barber & Cooper, 1972; Chaves & Barber, 1974). This demonstrates the everyday utility of distraction as well as presenting a potential methodological problem for researchers examining pain management interventions.

McCaul and Malott's (1984) review in conjunction with more recent studies point to the conclusions that for experimental pain management, distraction provides encouraging outcomes when compared with placebo and expectation instructions. In addition subjects both viewed distraction favourably and reported using their own or spontaneously generated strategies.

The second principle that McCaul and Malott (1984) explored, based on the concept of limited attentional capacity, was that distraction tasks which involve a greater use of attentional capacity will be more powerful reducers of pain related distress. Unfortunately research to date makes it hard to determine which strategies require more capacity. Beers and Karoly (1979) for example measured cold pressor pain threshold, tolerance and reported discomfort after asking subjects to engage either in pleasant imagery, or counting backwards. These two conditions did not differ on any of the measures, nor did they differ on the perceived percentage of time the subjects used the strategy. Kanfer and Goldfoot (1966) in their experiment on self control and pain tolerance, showed that subjects who had control over viewing slides had higher cold pressor pain tolerance than those subjects who watched a clock. Based on the notion that tasks which are more effective pain reducers, when used as distracters, will require more attentional resources, McCaul and Malott (1984) suggest that results like Kanfer and Goldfoot's (1966) indicate that control over slide onset and timing is more attention demanding than simply observing a clock. As there are no measures of task involvement such a suggestion is speculative.

From their review McCaul and Malott (1984) summarise that the studies reported were consistent with the idea that distraction strategies higher in the use of attentional resources will better reduce pain responses. The evidence however was weak due to the comparison of strategies not differentiated on the capacity dimension and due to the confounding of possible affective responses to the instructions.

Later studies than McCaul and Malott's (1984) review have further explored the issue of attentional demand on the effectiveness of distraction. In a study assessing the effectiveness of distraction demands on exercise symptoms, Fillingim, Roth and Haley

(1989) asked subjects to cycle on a cycle ergometer. Although the study does not focus directly on pain it is associated with an individual's awareness of their body sensations.

Subjects assigned by Fillingim et al. (1989) to the experimental conditions were required to do either a low or high demand distraction task. No significant differences were observed across groups on the symptom report measures. The results do not support the hypothesis that distracters requiring more attention will reduce exercise-induced symptoms more effectively than less demanding distracters and is counter to the tentative conclusion of McCaul and Malott (1984). Fillingim et al. (1989) also suggested that other components of distraction such as emotional quality of the distracter or the source of information to be attended to, may mediate the reduction of physical sensations rather than the attentional demands of the distracter. This suggestion equates with the identification by McCaul and Malott (1984) of the confounding affective component that was a weakness in their review.

Estimates of the use of a strategy in relation to pain reports is another method for assessing the importance of attentional demand. Stevens (1985) showed that correlations between tolerance difference scores and discomfort difference scores with estimates of the use of pleasant and adaptive imagery were not significant. This contrasts with other studies (Chaves & Barber, 1974; Spanos et al., 1975) which found that subjects who reported greater use of the strategies also reported greater pain reductions. Marino et al. (1989) showed that absorption in imagery strategies corresponded to reductions in rated pain. Evidence then is contradictory regarding the extent to which attentional requirements influence the effectiveness of distraction in managing pain.

In addition to task variables, individual differences have been related to the efficacy of cognitive pain management. Hypnotic susceptibility is one variable that has been looked at in association with distraction and attention. Studies (eg. Spanos, McNeil, Gwynn & Stam, 1984) have shown significant correlations between degree of suggestion-induced pain reduction and pretested levels of hypnotic susceptibility in both hypnotic and non-hypnotic subjects.

Spanos et al. (1984) assigned subjects, preselected for high or low hypnotic susceptibility, to three treatment groups - shadowing, suggestion or control. The shadowers listened to a list of monosyllabic words and were instructed to repeat each word verbatim, while the suggestion group were administered a 45 second analgesia suggestion inviting them to imagine their arm as numb and insensitive like rubber. Suggestion induced greater reductions in rated pain for those classed high in hypnotic susceptibility compared with those low in hypnotic susceptibility. With the shadowing task however, low and high susceptibles did not differ significantly in degree of pain reduction despite reporting significantly larger pain reductions than controls. Low susceptible shadowers reduced rated pain to the same degree as high susceptibles given the suggestion. Spanos, Perlini and Robertson (1989) also showed that subjects low in hypnotic susceptibility given hypnotic suggestions reported much less analgesia than hypnotic highs, but lows given suggestions in various nonhypnotic contexts reported as much analgesia as hypnotic high hypnotizables.

Spanos et al. (1984) interpreted their findings as supporting the notion that reductions in reported pain result from attention diversion and other actively employed cognitive strategies. This position recognises that high susceptibles may be particularly proficient at employing imaginal strategies as a way of not attending to noxious events, but a variety of non-imaginal strategies may be equally effective in reducing reported pain. For this reason, low susceptibles may be as proficient as high susceptibles in reducing rated pain when they are encouraged to employ the cognitive strategies that suit their abilities.

Locus of control is another individual variable that is accepted as a basic mediating factor in cognitive pain management. Individuals who have an internal locus of control believe that a positive cause/effect relationship exists between their own behaviour and the outcomes they experience. People having an external locus of control, on the other hand, perceive little relationship between their activities and the consequent outcomes. Applied to the chronic pain experience, sufferers who have an internal locus of control believe that their own efforts are likely to effect the future course of their pain, and have been shown to use active coping strategies to minimize, tolerate and reduce their pain (Copp 1974, cited in Crisson & Keefe, 1988). Those with an external locus of control may employ a different set of coping strategies in the belief that the future course of their pain is dependant on interventions by powerful others or chance. Crisson and Keefe (1988) showed that locus of control was significantly related to pain coping strategies and psychological distress. Patients who perceived outcomes as controlled by chance factors received high scores on the Helplessness factor of the Coping Strategy

Questionnaire and were also more likely to endorse items measured by the Diverting Attention and Praying/Hoping factor of the CSQ. There was no significant relationship between internal locus of control orientation and pain coping strategies.

It is evident then that individual coping styles or personality variables are important in influencing both pain reactions as well as responses to particular interventions such as distraction. Distraction may be more effective therefore if it is tailored more to individual needs and preferences.

The third principle that McCaul and Malott (1984) examined was the notion that distraction may be more effective for reducing distress with mild as opposed to intense pain. The rationale for this was that at greater levels of intensity, noxious stimuli can no longer be easily excluded from attention and at that point distraction will become less effective. This was tested by looking at the extreme measures of both threshold and tolerance. Beers and Karoly (1979) found that counting backwards increased threshold judgments compared with a no-instruction condition but did not reliably increase tolerance times. This supported the third principle. Blitz and Dinnerstein (1971) also found that the distraction strategy reliably increased pain threshold but not pain tolerance. This was attributed to the greater attentional salience of pain at quit point levels of noxious stimulation.

Further studies have found distraction to lose its effectiveness over time. These studies have collected frequent pain or distress reports as subjects respond to continually escalating levels of stimulation. Barber and Cooper (1972) found that the distracters of Listening to a Story and Adding Aloud reduced pain ratings over the first minute of the Forgione-Barber pain stimulator, but by the end of the second minute their effectiveness in reducing pain was no longer evident. After the one minute mark the pain was found to be intolerable and unable to be managed by distraction. McCaul and Haugtvedt (1982) with their series of experiments also discovered that compared to subjects asked to attend to sensations, distraction subjects reported less distress for the first minute of the painful experience, but the distress ratings were exactly reversed for the final two minutes of the cold pressor test. These studies generally support the idea that compared with no instructions, distraction will be more effective for mild versus strong intensity stimulation.

Chaves and Barber (1974) found results inconsistent with this conclusion however, showing that the degree of pain reduction during the post-test was greater during the second minute than the first. They suggested that as the pain resulting from the Forgione-Barber pain stimulator increased, it allowed more room for pain reduction during the second minute than the first. They found that overall the subjects who had high and medium pretest pain levels showed greater pain reduction during the post-test than subjects with low pretest pain levels. Spanos et al. (1975) demonstrated similar results regarding the effectiveness of distraction in relation to pretest pain levels. The distraction strategies were only effective for subjects who showed high pretest thresholds. No effect of cognitive strategies was found for subjects who showed low pretest thresholds.

McCaul and Malott's (1984) third principle has not yet been clarified with conflicting evidence hampering any clear cut conclusions. It is not clear why distraction's effectiveness should depend on time unless an individual eventually becomes bored or fatigued with the distraction task.

The fourth principle investigated by McCaul and Malott (1984) suggested that at some level of intensity attention is likely to shift to the painful stimulus. Thus, compared with redefinitional strategies, distraction will be more effective at low levels of stimulus intensity, with the reverse being true for stimuli of strong intensity. Evidence indicates that attention to symptoms increases the perceived intensity of those symptoms. Pennebaker and Lightner (1980) for example studied the effect of self-attention on symptom and pain reports in response to exercise. Subjects were required to walk a treadmill for eleven minutes. A quarter of the subjects heard street sounds, a quarter heard their own breathing amplified and the other half were a control group who heard nothing over the headphones. Relative to control subjects, paying attention to distracting sounds tended to decrease perceptions of fatigue and accompanying symptoms. Forced attention to body, on the other hand, magnified these perceptions. Presumably, attending to the street sounds reduced the degree to which subjects encoded internal sensations. The failure to find any physiological differences as a function of conditions lends credence to the importance of perceptual factors in the determination of fatigue and physical symptoms. That is, even though the subjects had comparable sensory information, they differed in the degree they encoded it as signs of fatigue.

It is clear then that the eventual effects of attending to sensations are heavily dependent upon the schema or set guiding one's interpretation of those symptoms. Pennebaker (1982) highlighted that attention to a given sensation within the context of a schema or selective search instructions, results in a perceptual change in the sensation. Strategies that facilitate a nonemotional (redefinition) interpretation of attended-to sensations should therefore aid in coping with pain. McCaul and Haugtvedt's (1982) study was one that found lower thresholds for subjects given explicit sensory information as compared with an affectively neutral distracter, viewing neutral slides. Results however are inconclusive with other studies (eg. Blitz & Dinnerstein, 1971) showing no difference between thresholds with distraction or redefinition, and others indicating reverse findings. Spanos et al. (1975) for example asked some subjects to engage in imagery that integrated the coldness of the cold pressor test (distraction and redefinition) and others to simply imagine sitting in a lecture class (distraction only). McCaul and Malott (1984) proposed that the distraction only condition would produce higher thresholds as the redefinition component of the other condition would direct attention to the cold sensations and the accompanying pain. Contrary to this expectation the distraction only subjects exhibited lower thresholds.

McCaul and Malott (1984) were only able to find two studies relevant to their fourth principle that looked at the use of distraction and redefinition for intense pain. The results of the studies were contradictory - one supporting superior tolerance for redefinition versus distraction (Ahles, Blanchard & Leventhal, 1983) and the other finding that the redefinition subjects withdrew much earlier from the cold pressor task (McCaul & Haugtvedt, 1982).

One study involving chronic pain was included by McCaul and Malott (1984) to help investigate their fourth and final principle. Rybstein-Blinchik (1979) investigated the effects of different cognitive strategies on the chronic pain experience. Chronic pain subjects were assigned to either a somatization condition (focusing on the sensations), an irrelevant condition (recalling important events in their lives), a relevant condition (reinterpreting the pain experience), or a control condition. Although both the irrelevant and the relevant conditions served a distracting purpose, the relevant strategy which incorporated some conceptual reformulation of the pain experience was shown to be more effective. The subjects allocated to the relevant condition used milder and fewer sensory, affective, and evaluative words to describe their experience of pain, had lower pain intensity ratings, and manifested fewer behaviours on the pain behaviour index than either distraction only or control subjects. Thus it appears the efficacy of a relevant cognitive strategy procedure in reducing the experience of chronic pain is based both on its ability to generate attention diversion effects and on its unique relationship to this experience generated by a new interpretation.

Summary

Distraction then has been shown to be an useful component in the management of experimental pain but there is a notable deficit in studies which examine distraction's efficacy for clinical or chronic pain. For experimental pain distraction produces greater reductions in reported pain and pain tolerances when compared with controls and placebo instructions. There is debate however on the effectiveness of distraction over time and with pain stimuli that are intense. For distraction to be of relevance in the clinical setting where chronic pain is a presenting problem, these issues are important. Underlying these points are questions that arise about the processing of pain that has become chronic.

CHAPTER FOUR

The Automaticity of Chronic Pain Explored

As mentioned, the use of distraction as a pain management strategy rests on four assumptions that relate to the processing of both nociception and the distraction task, the capacity of attention and the cognitive component of pain. It is the assumption that pain perception is always a controlled process that is of interest in the current study.

Although attention-diversion techniques have been found to be useful in decreasing experimental pain it appears they are not as effective for chronic pain problems. Rosenstiel and Keefe (1983) concluded that their results did not support findings from previous studies that have shown coping self-statements, reinterpreting pain sensations and cognitive distraction to be related to lower ratings of pain. Both Rosenstiel and Keefe (1983) and Turner and Clancy (1986) found that chronic pain patients who scored high on the Diverting Attention and Praying factor identified from the Coping Strategy Questionnaire, tended to have high average pain. Turner and Clancy (1986) suggested that,

> "it is probably not useful to incorporate training in attention diversion techniques in chronic pain treatment programs." (p. 363)

Such a conclusion they realised was based on preliminary data and needed to be substantiated further. 'Attention diversion' techniques as referred to by Turner and Clancy (1986) included only strategies such as counting numbers or mentally reciting poems. They did not include strategies which involved engaging in activities in order to decrease thinking and worrying about the pain. Turner and Clancy (1986) conceded that these latter strategies may still be useful for many patients. They also found that increased use of praying and hoping was associated with decreased pain ratings following treatment, and concluded that the relationship between the Diverting Attention and Praying factor and pain was due to the ineffectiveness of distraction techniques and not to the ineffectiveness of praying and hoping.

Rybstein-Blinchik's (1979) study, although indicating the potential effectiveness of cognitive strategies for the management of chronic pain suggested that distraction away from the pain stimulus was not the most effective coping strategy. The emphasis in chronic pain treatment according to Rybstein-Blinchik (1979) is placed on refocusing and distracting patients' attention away from the pain stimulus rather than on teaching people to deal with the pain directly. It was suggested that rather than methods of distraction directed toward partial reduction of pain, management would be better achieved through the utilization of techniques that both contribute to attention-diversion and deal with the pain stimulus.

Most of the studies investigating the impact of attention diversion for pain management use laboratory encounters with an experimental pain stimulus rather than investigating the impact of distraction on chronic pain. The distinction between experimental acute pain and chronic pain is an important one and could well lie behind the difference in effectiveness of distraction in these different contexts.

Experimental acute pain is time limited, whereas chronic pain is often described as constant (Rosenstiel & Keefe, 1983). This constancy can have a negative effect on the psychological interpretations of the pain, one's perception of their ability to control the pain, and on one's motivation to help themselves. With the knowledge that little can be done to terminate the pain, depression and despair can stop sufferers from utilizing effective management techniques, or lead them to the use of maladaptive techniques such as catastrophising (Turner & Clancy, 1986). Experimental acute pain or indeed acute clinical pain does not pose such a lifestyle threat. In acute clinical pain an end is expected, while in experimental pain the subject is typically in control of the termination of the pain. This control may generalise to the subject believing they can control the pain by the strategies that have been introduced by the experimenter.

Chronic pain and experimental acute pain differ then in more ways than just the source and length of the pain. Chronic pain becomes part of a lifestyle and with this burden comes a psychological overlay which can alter the way sufferers behave and perceive their pain. The utility of distraction may be another difference between acute and chronic pain.

One possible explanation for the apparent lack of effectiveness of distraction in the management of chronic pain is the way the processing of the chronic pain signals may have changed over time.

Automatic - Controlled Processing

Qualitative changes in performances can be seen in activities where there have been a consistent series of signals or responses. Such changes see a transition in a continuous manner from controlled to automatic processing (Schneider, 1985). This transition involves a tapering off of the attentional requirements of processing until finally little to no attention is required as the task has become automatic. Automatic processing typically develops under appreciable training and appears to utilise a relatively permanent set of connections (Shiffrin & Schneider, 1977).

Pain similarly can be envisaged as following a transition from transient pain to acute pain, to chronic pain where the pain has continued longer than six months. Changes can be observed in the behaviour of those whose pain has become chronic. It is conceivable that there are further underlying changes which emerge as a response to the longevity of pain.

It is possible as chronic pain signals have persisted, upward of six months, the way the perceived pain is processed may have become automatic. Due to regular processing of the signals, strong connections between a pain stimulus and the responses to it are likely to develop. This automatic processing may lie behind the emergence of the pain behaviours, referred to by Fordyce (1976), that persist after healing has occurred or for reasons that are different from those that elicited them in the first place.

Schneider, Shiffrin and Dumais's (1984) generalisations about the attentional literature in terms of the automatic and controlled processing appear to apply to the notion of automatic processing of chronic pain well.

Firstly they mentioned that performance in a given paradigm can be very different depending on the type of processing involved. Chronic pain does not respond as well as acute pain to distraction strategies. This may indicate some difference in the way the perception of pain is being processed.

Secondly Schneider et al. (1984) suggested that performance should change due to the development of automatic processing when subjects are given consistent, extensive practice. As noted, chronic pain sufferers have been given this 'practice' through the chronicity of their pain.

As performance becomes more automatic Schneider et al. (1984) suggested that subjects should have more difficulty controlling and modifying their ongoing processing. The processing is difficult to alter, ignore or suppress once learnt (Shiffrin & Schneider, 1977). Chronic pain appears hard to ignore as shown by distraction studies. Chronic pain patients equally have difficulty controlling their pain. Once chronic pain has developed it disappears at best slowly.

Finally Schneider et al. (1984) stated that because control processes are capacity limited, reductions in capacity should much more severely harm control processes than automatic processes. Logically if pain processing is automatic, cognitive strategies which rely on competing for limited resources will be ineffective. That chronic pain is automatically processed could explain its persistence, nature and difficulty in management. It is this idea that forms the basis of exploration in the present study.

The Rationale for the Study

Distraction techniques do not appear successful in helping chronic pain sufferers in managing their pain. Possibly the processing of the pain signals has changed over the time that the pain has persisted through to chronicity. The purpose of the present study is to assess whether chronic pain sufferers do in fact process their chronic pain in an automatic way.

To explore this issue, chronic low back pain sufferers will be recruited. Chronic low back pain was chosen for the study as it is such a prevalent chronic pain complaint and is easily aggravated. The chronic pain sufferers will be required to do an exercise which should temporarily exacerbate their chronic pain. Rybstein-Blinchik's (1979) study while using chronic pain, appears to be quite passive in terms of the chronic pain. While the subjects were all patients in a physical rehabilitation ward, had a range of medical diagnoses, and experienced chronic pain, the cognitive strategies they were instructed to use were used in an interactive way, for example role-playing. By involving our subjects in some form of exercise a more realistic situation can be set up and the effectiveness of distraction can be evaluated when the pain becomes more severe.

One suggestion to be tested in the present study is the idea that distraction will be ineffective in managing chronic pain. As mentioned there have been few studies investigating the effect of distraction on chronic pain. Those that have looked at the effect have not produced favourable results. Rybstein-Blinchik (1979) for example concluded that distraction was not the best strategy for chronic pain while Turner and Clancy (1986) in their study suggested that distraction was not useful in chronic pain treatment programmes. Both Turner and Clancy (1986) and Rosenstiel and Keefe (1983) found the use of the Diverting Attention, and Praying factor to be associated with high average pain. Turner and Clancy's (1986) finding that praying and hoping following treatment was related to decreased pain ratings also points to the ineffectiveness of distraction techniques for chronic pain, and not to the ineffectiveness of praying and hoping.

To summarise, it is predicted that distraction will be no more effective in alleviating chronic pain exacerbated by exercise than a no distraction condition. It is then further suggested that this result will be due to the chronic pain having developed into an automatic process. Over the six or more months the pain has been present the processing no longer requires attention resources, therefore the pain processing no longer needs to compete with the distraction task for resources. The result being that the chronic pain is not alleviated by distraction, and the distraction task can be completed as good as baseline standards as their is no competition with the pain processing.

That acute experimental pain perception is a controlled process is demonstrated by the many studies which show the impact of distraction on acute pain responding (see reviews). For the chronic low back pain sufferer the pain sensations from the cold pressor arise from a different site, have different causation and consequently utilize different neural pathways, than the chronic pain they experience. To sum, the acute pain from the cold pressor is a novel experience when compared with the continuous, more familiar chronic pain these people suffer. The attention literature suggests that stimuli that require responses that change over trials, variably mapped or novel tasks, require a large allocation of attentional resources. Thus it seems fair to assume that acute pain for the chronic pain sufferer will be a controlled process which will demand resources. The second hypothesis then proposes that distraction will be effective for reducing acute pain for those with chronic pain. Distraction being a controlled process occurring simultaneously to the acute pain, should interfere with the pain processing. That acute pain processing is a controlled process for chronic pain sufferers will be shown by reduced pain ratings and increased pain tolerances with distraction compared with no distraction.

From the first two hypotheses, a third is derived. This suggests that different types of pain are responsive to distraction in a different way and are processed differently for the person that experiences chronic pain. If the first two hypotheses prove correct it would appear that distraction is not effective for chronic pain while being effective for acute pain. It also suggests that maybe chronic pain is processed automatically while the acute pain remains a controlled process.

Thus, the hypotheses to be tested in the present study are,

1. That distraction will be ineffective in increasing pain tolerances and reducing pain ratings for CLBP sufferers, as the perception of the chronic pain has become an automatic process and therefore will not interfere with the processing of the distraction task.

2. That distraction will be effective in increasing pain tolerances and reducing pain ratings for chronic low back pain sufferers in an acute pain situation.

3. That there will be a difference in the way pain is processed for the CLBP sufferer dependant on whether the pain is acute or chronic.

CHAPTER FIVE

Method

Subjects

Subjects were 20 volunteers with low back pain who were recruited from either a back support group in Palmerston North, one of three physiotherapists, or those who responded to an advertisement put in the local paper (see Appendix A).

The 20 subjects, 8 males and 12 females, had an average age of 45 (range 18 to 67). The length of time that they had been suffering from their pain varied from 10 months to 20 years with the mean period being 9 years. All subjects reported extensive low back pain, however the etiologies differed.

After recruitment subjects were provided with more information on the research, a medical checklist, and consent form to be filled in and returned (see Appendix B). Their general practitioner's (GP's) were also contacted to get medical clearance (see Appendix C).

Of the 24 subjects who returned consent forms:

i) Two were unsuitable according to their GP,

ii) Two more withdrew due either to inconvenience at the time or particularly debilitating back pain.

Transport was provided for the 5 subjects who required it.

Apparatus

Cold Pressor Test

Previous researchers (Benjamin, 1958; Kunkle, 1949; Wolf & Hardy, 1941) have reported that "aching" pain is elicited within 10-60 seconds in normal subjects by water near freezing applied to a limb. If the limb is not removed pain continues for 2-4 minutes before adaptation sets in. This method of acute pain stimulation has become known as the cold pressor test. The typical physiological reactions shown by the use of the cold pressor are elevations in muscle tension, reduction in skin resistance, and heart rate and respiratory irregularities. These reactions are all generally associated with painful stimulation (Barber & Hahn, 1962). The pain threshold to ice water is also highly correlated with other pain producing stimuli (Brown, Fader & Barber, 1973). The cold pressor test is an advancement on previous acute pain producing stimuli such as the pinprick, electric shock or radiant heat applied to a limb as the pain can be elicited over a longer period of time than the brief duration typical of these older methods, and it does not produce tissue damage. The cold pressor test has been successfully used in numerous pain studies (Blitz & Dinnerstein, 1971; Gilligan, Ascher, Wolper & Bochachevsky, 1984; McCaul & Haugtvedt, 1982; Spanos, Horton & Chaves, 1975)

A thermostatically controlled adapting bath measuring 44 cm x 28cm x 17cm deep was set at 37°C(+/-1.0). This provided a standardised hand temperature on entry into the cold water.

The cold pressor test apparatus which consisted of a plastic ice chest measuring approximately 31cm x 36cm x 18cm deep was divided into two sections by a wire screen. The section that was farther from the subject's body contained ice cubes. A bar connected to a timing device to measure pain tolerance was in the near section and was pressed down by the palm of the subject's left hand for the duration of the test. This ensured that the subject's hand was completely immersed and controlled for the amount of skin under stimulation. Spatial summation plays a significant role in the cold pressor experience (Westcott, Huesz, Boswell & Herold, 1977). The apparatus used can be seen in Figure 1.

The water was maintained at a temperature of between 3°C and 5°C and was continuously agitated by a pump.

A seat was situated to the right of this apparatus so that the subjects could easily place their left hand in both containers of water. Investigations of pain threshold and tolerance with hand preference have produced evidence that the left hand is more sensitive to pain than the right hand for both dextral and sinistral subjects (Murray & Hagan, 1973; Murray & Safferstone, 1970).

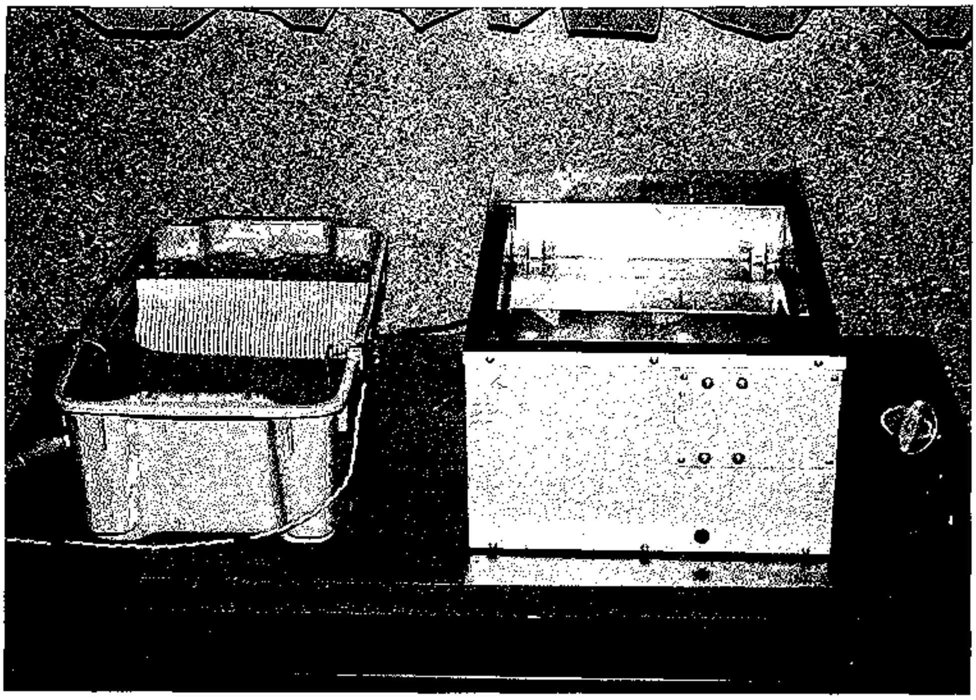

Figure 1

Cold pressor apparatus with the warm adapting bath on the right and the cold pressor bath on the left. A microphone for subject responses is in the bottom right corner.

Step-ups

Step-ups are an exercise which typically cause pain in patients with chronic low back pain and are often used for both assessment and rehabilitation of chronic low back pain. Step-ups were chosen as the exercise because:

i) they can be done by 70-80% of back patients (A. Tankersley, personal communication, May, 1990),

ii) individual capabilities and fitness can be catered for by lowering the steps,

iii)patients typically continue for around three minutes with performance beginning to slow around the one and a half minute mark. This corresponds well with cold pressor pain tolerances,

iv) patients do not appear to be able to judge time while they do the task,

v) step-ups can be done with little attention having to be paid to them.

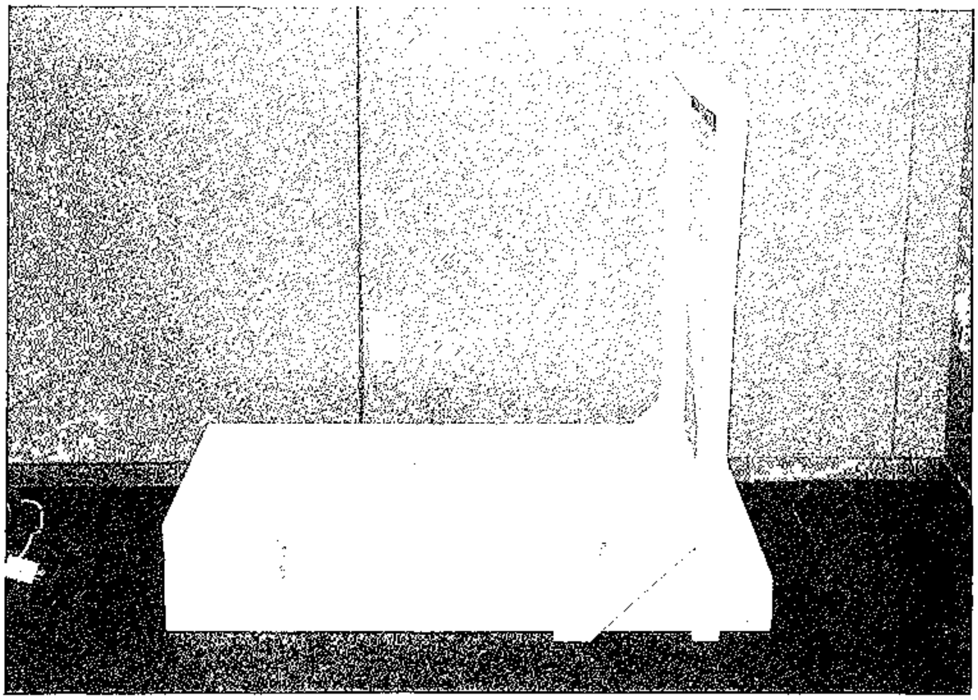

Figure 2

The step-up apparatus with its handrail on the right. The three step heights can be seen at the bottom of the step-ups.

A step of 20cm in height which could be lowered to 15cm or 10cm depending on individual capabilities was used. It was 60cm x 100cm and had a handrail rising 1 metre from its base as seen in Figure 2. Subjects were given the option of which step height they would prefer.

Pain tolerance, which was measured by a stopwatch, was taken as the length of time the subjects did the step-ups. In addition the number of steps the subject took in that time was recorded.

Distraction

Television and video recorder equipment was set up to present the distraction task and a tape recorder with an external microphone recorded subjects' responses on the task.

Shadowing was chosen as the distraction task as it requires sustained attention (Spanos, McNeil, Gwynn & Stam, 1984) and a large number of studies have shown shadowing to make large demands on processing capacity. Subjects were to repeat aloud a series of words said at 30 words per minute. The words were neutral one and two syllable words obtained either from the Rey Auditory Verbal Learning Test (1964, cited in Lezak 1983) or from selecting nouns from everyday situations. Typical examples of the words are, tile, finger, farm, banana and church.

A secondary component of the distraction task designed to increase the processing demands on the subject was incorporated into the shadowing task. Subjects were to view a video monitor on which a pair of words appeared side by side. The word pair was replaced by another pair at minute intervals. The words in the pairs were not related to each other, examples of the word pairs being water/hammer, moon/path, bird/colour (see Appendix D for the distraction task). At some stage over the minute when the pair were showing on the screen, both words of the pair would be mentioned in the shadowing word list. When a word was heard while appearing on the screen the subjects were instructed not to shadow it. The video was six minutes long.

Visual Analogue Scale

A visual analogue pain scale (Huskisson, 1983) was used as a measure of pain before and after the conditions. Most patients with pain understand the concept and can quickly make the measurement (Huskisson, 1974). The scale was a 10 cm line labelled "no pain" at the left and "worst pain ever" on the right, (see Appendix E).

Procedure

A pilot study was run with one subject. Modifications to the procedure made due to this pilot study were:

i) instead of the planned five individual sessions - baseline step-ups and baseline distraction, step-ups, step-ups with distraction, cold pressor and cold pressor with distraction - it was decided to double up the sessions so testing would involve three days rather than five. This was desirable in terms of subject convenience.

ii) a 'before' subjective rating for the step-ups conditions designed to control for daily variations in pain was introduced.

iii)it was decided that pain threshold data would not be recorded as the attention required to decide the threshold point and indicate it to the experimenter could interfere with the distraction task.

Subject involvement in the main study spanned three sessions as shown in Table 1. Before the second session subjects were randomly allocated to one of two groups which differed with respect to the order in which subjects were given the experimental conditions - Group A had the cold pressor task combined with the distraction task, followed by step-ups as tasks for the second session, while Group B had the cold pressor test followed by the step-ups with the distraction tasks. Table 1 shows how this ordering was reversed for the third session. In all conditions the step ups followed the cold pressor task to ensure that any pain resulting from the step-ups did not interfere with subjects' attention to the cold pressor task. The sessions each took 15-20 minutes.

Initially the subjects were given a short subject fact sheet (see Appendix F) which gathered information about their age, sex, handedness, length of time they have experienced their pain and the type of sensations they felt. A pain drawing (Melzack, 1975) was completed showing areas of pain and areas of numbness.

Subjects were instructed how to use a visual analogue scale to record their pain levels. At set points through the study they were asked to mark on the scale the degree of pain they were experiencing. These times were:

i) before the baseline distraction and all step-up conditions. This recorded "pain at the moment", and

ii) following the conclusion of all conditions. The measure focused on the pain in their hand for the cold pressor pain and the pain in their back for the step-ups. The measure was for the pain experienced when they decided to stop the condition (or were stopped).

Conditions

A. Baseline Distraction.

The distraction task was explained and a one minute practice (using the sixth minute of the tape) was undertaken. They then did the task for five minutes.

Subjects were told,

> "On the video here you will hear a series of words said slowly. At the same time there will be two words that appear on the screen for a period of time to be replaced by two more. What you have to do is shadow the words that you hear, that is repeat the words aloud as soon as you hear them. The words that are on the screen will also be heard - when they are heard while also appearing on the screen you are not to say them. So, you are repeating the words that you hear but not the words that you see and hear. Accurate shadowing is your primary concern. If you are uncertain of what the word was try and make a response anyway."

Subjects were made aware that their responses would be tape recorded to gauge their accuracy. The task began when the words appeared on the screen.

Table 1

Procedural format of study

Session	**Procedure**	
1	* Subject Information Sheet * Visual Analogue Introduction * Baseline Distraction * Baseline Step-ups	
	Group A	Group B
2	i) Cold pressor with distraction	i) Cold pressor
	ii) Step-ups	ii) Step-ups with distraction
3	iii) Cold pressor	iii) Cold pressor with distraction
	iv) Step-ups with distraction	iv) Step-ups
	* Questionnaire	
Followup	* Study review sent out	

B. Cold Pressor.

Subjects were requested to remove all jewellery and any watches from their left hand and put their hand in the warm water until asked to remove it. Their hand was in the water for two minutes. While their hand was submerged in the warm water they were given a demonstration of what was required with the cold water and instructed:

> "Put your whole hand in the water with your palm pressing down on the bar until it clicks. This will set a timer off. Continue to hold the bar down until the discomfort gets so that you would rather remove your hand. At this point remove your hand and the timer will automatically stop. If you have not withdrawn your hand after a set period of time I will ask you to remove it."

Subjects were asked to remove their hand if they had not already withdrawn it, after five minutes of being in the cold water. They were also instructed to remember the degree of pain they felt in their hand when they withdrew their hand so they could fill out a subjective pain rating form.

Tolerance was measured by the timing device connected to the equipment. For all conditions pain tolerance was taken as the length of time in seconds that the subject tolerated the pain before they decided to stop what they were doing to produce the pain.

C. Cold Pressor with Distraction.

Subjects did the cold pressor task with the additional requirement of completing the distraction task. They commenced the distraction when they put their hand in the cold water.

D. Baseline Step-ups and Step-ups.

A. Tankersley (personal communication, May, 1990) reported that patients occasionally experienced an afterpain a few hours after completing step-ups. As this might impact on subsequent step-up performance a baseline measure was taken on the first day.

The set of steps were positioned in front of the distraction equipment (see Appendix E) and a demonstration of the step-ups given. Subjects were told,

i) to step up in a regular time bringing both feet up and stepping back down. They could start with either foot.

ii) to keep stepping up until they got to the stage that they would rather stop, at which point they could stop. If they did not stop on their own accord within a certain time they were asked to stop.

iii)to remember the amount of pain they felt in their back when they decided to stop so they could rate it on the visual analogue scale when they were finished.

Before they started the step-ups they had to rate the amount of pain they were experiencing in their back at that moment on the visual analogue scale. As for the cold pressor test the time limit on the step-ups was five minutes.

E. Step-ups with Distraction.

Subjects did the step-ups as for the baseline condition with the additional requirement of the distraction task. They were to start the step-ups when the words were first heard and seen on the television screen and were to stop when they felt that they would rather stop.

F. Questionnaire.

When the experimental conditions were completed subjects were given a questionnaire to take away, fill in and return. This enquired about different aspects of the experimental procedure and their use of coping strategies both in the study and in their everyday lives. (see Appendix G).

A review of the study's aims and its findings was sent out to all subjects after analysis. (see Appendix H).

CHAPTER SIX

Results

To evaluate the effect of distraction under acute and chronic pain conditions on tolerance and subjective pain ratings, two repeated measures multivariate analyses of variance (MANOVA) using SPSS/PC were performed. This type of MANOVA tests each effect while statistically controlling for other effects, thereby avoiding the restrictive assumptions of traditional repeated measures analysis of variance (Tabachnick & Fidell, 1989). Thus all F statistics reported below reflect partial or controlled effects.

Pain Tolerances

The means and standard deviations from the pain tolerance variable can be seen in Table 2. It was predicted that there would be an interaction effect between distraction and the pain condition. Results from the MANOVA on the pain tolerance data indicated that this was not the case, ($F(1,19) = 1.35$, $p > 0.05$). Distraction was ineffective for chronic pain as predicted, but interestingly was also ineffective for the acute pain condition. An insignificant main effect of distraction on pain tolerances was subsequently found for acute and chronic pain conditions, ($F(1,19) = 0.70$, $p > 0.05$). That is, under distraction conditions there was no increase in the time to reach tolerance.

Although not predicted it was not surprising to find a significant effect of type of pain on pain tolerance, ($F(1,19) = 1.35$, $p = 0.001$). It took a significantly longer time to reach tolerance for subjects on the step-up task than it did on the cold pressor task.

Subjective Pain Ratings

A similar pattern of results was found on the MANOVA performed on the pain rating data. No significant interaction effect was found, distraction having a similar effect on the chronic and the acute pain post-test ratings, ($F(1,19) = 0.22$, $p > 0.05$). For both conditions distraction did not reduce the reports of pain once tolerance was reached, with

CHAPTER SIX

Results

To evaluate the effect of the distraction task on acute and chronic pain tolerance and subjective pain ratings, multivariate analyses of variance (MANOVA) were performed on the data. Pain tolerances measured in seconds could range from 0 to 300, while pain ratings were a measure from 0 to 100.

Cold Pressor and Step-ups

Table 2 and 3 give the outcomes from the MANOVA. In terms of the first two hypotheses, it can be seen that distraction had no significant effect on either pain tolerances or post-test subjective pain ratings for either pressor or step-ups conditions. That is, distraction did not increase pain tolerances or reduce pain ratings compared with no distraction. The distraction effect on pain rating was borderline and interestingly tended towards higher pain rating with distraction. A paired t-test revealed no significant difference in the pretest pain ratings before the step-ups, ruling this out as a covariant in the analysis ($t(18) = -0.06$, $p > 0.05$)).

Table 2

Multiple analysis of variance of pain tolerances data from cold pressor (acute pain) and step-ups (chronic pain) conditions, with and without distraction.

Source	df	*Mean of Squares*	*F*
Distraction (D)	1	1272.01	3.74
Acute/Chronic (AC)	1	247664.77	13.95*
D X AC	1	2679.61	1.35

* $p < .05$

Table 2

Means and standard deviations of pain tolerances and post-test pain ratings for the cold pressor and step-up pain conditions, with and without distraction.

Dependent Variables	**With Distraction**		**Without Distraction**	
	Mean	Std Dev	Mean	Std Dev.
<u>Cold Pressor</u>				
pain tolerance	87.20	78.89	90.80	96.12
post-test pain rating	66.30	17.48	60.30	20.16
<u>Step-ups</u>				
pain tolerance	210.05	102.42	190.50	107.65
post-test pain rating	45.50	25.56	42.35	25.42

Table 3

Multiple analysis of variance of post-test pain rating data from cold pressor (acute pain) and step-ups (chronic pain) conditions, with and without distraction.

Source	*df*	*Means of Squares*	*F*
Distraction (D)	1	418.61	3.74
Acute/Chronic (AC)	1	7507.81	9.60*
D X AC	1	40.61	0.22

* $p < .05$

It was found however, as is shown in Tables 2 and 3, that there were significant differences between pain tolerances and surprisingly, pain ratings, across both acute and chronic conditions. These differences were both significant at the .05 alpha level.

To examine the third hypothesis regarding the differential effect of distraction across acute and chronic pain conditions, the interaction between distraction/no distraction and acute pain/chronic pain was investigated. Table 2 and 3 show that there were no interaction effects from distraction on pain tolerances or after pain ratings. Distraction was equally ineffective over both conditions and on both pain measures.

In addition to the MANOVA, paired t-tests were performed on the after pain ratings and pain tolerance data for both the acute pain conditions and the chronic pain. This was to understand better the effect of distraction on the two individual pain conditions. Tables 4 and 5 illustrate the results which showed no significant differences within these conditions on these measures.

Pain ratings were also analyzed as pain ratios (ie. pain after/pain before). Hilgard et al. (1974) demonstrated the pain ratio statistic to be a more valid descriptive statistic than the difference score as it controls for individual differences in the level of baseline pain reports. In this study subjects' pain before experimentation varied from day to day. Due to the variability of the ratio data a Wilcoxon Matched-Pairs Signed Ranks test was used to test for differences between the ratio means. Results showed there was no significant difference between pain ratios across distraction conditions as seen in Table 5.

the distraction and no distraction conditions statistically being equivalent ($F(1,19) = 3.74$, $p > 0.05$). A paired t-test of 19 subjects pretest pain ratings with and without distraction indicated there was no significant difference in pretest pain ratings ruling this out as a covariate in the MANOVA, ($t(18) = -0.06$, $p > 0.05$).

A significant difference was found between acute pain and chronic pain post-test pain ratings ($F(1,19) = 9.60$, $p = 0.006$). Subjects reported less pain at tolerance under chronic pain conditions as compared with the acute pain conditions.

A paired t-test was conducted on the number of step-ups variable with and without distraction. A significant result was obtained, with subjects completing more step-ups under distraction conditions ($t(19) = 2.19$, $p = 0.04$). However there was no significant difference in the rate (tolerance/number of step-ups) that subjects were doing the step-ups ($t(19) = 0.66$, $p > 0.05$).

Table 4

Pain measure means, and t-test results for cold pressor test with and without distraction.

	Cold Pressor Conditions		
Pain Measure	With Distraction	Without Distraction	t
Pain Tolerance (in seconds)	87.20	90.80	0.42 (ns)
Post-test Pain Rating	66.30	60.30	-1.72 (ns)

(ns) Non Significant

Table 5

Pain measure means, and t-test results for the step-ups with and without distraction.

	Step-up Conditions		
Pain Measure	With Distraction	Without Distraction	t
Pain Tolerance (in seconds)	210.05	190.50	-1.12
Number of Step-ups	72.70	64.30	-2.19*
Step-up Rate	3.19	3.31	0.66
Pretest Pain Rating	24.16	23.90	-0.06
Post-test Pain Rating	45.50	42.35	-0.75
Pain Rating Ratio	2.53	3.27	Z -0.78

* $p < .05$

<u>Distraction</u>

The quality of performance of the distraction task was examined by splitting the distraction data into the correct shadowing of the words presented to subjects, and the correct omission of the probe words that were on the screen and in the shadowing list. Data were converted into percent of accurate responses on each of the trials.

Table 6

Mean percentage correct and t-test comparisons for the shadowing and probe omission components of the distraction task across distraction conditions.

	Distraction Conditions		
Accuracy Of Distraction (Mean %)	Baseline	Cold Pressor	Step-ups
Shadowing	99.16	99.06	99.14
Probe Omissions	93.25	82.00	86.83
t	2.42*	2.24*	2.28*

* $p < .05$

It was found however, that subjects completed significantly more step-ups under distraction conditions. Table 5 shows that there was no difference in the rate (tolerance/number of steps) that subjects were doing the step-ups.

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t	2.42*	2.24*	2.28*

* $p < .05$

As can be seen in Table 6 subjects tended to find the probe task harder than the shadowing of words. Significant differences occurred across all distraction conditions - baseline, cold pressor and step-ups. In addition it is of interest to note that both components of the distraction task were done equally well across baseline and experimental conditions. There were no significant differences at the 0.05 significance level, in the accuracy of responding to the shadowing (base cf. cold, $t(19) = 0.17$; base cf. step-up, $t(19) = 0.08$; cold cf. step-up, $t(19) = 0.11$), and the probe words (base cf. cold, $t(19) = 1.31$; base cf. step-up, $t(19) = 1.39$; cold cf. step-up, $t(19) = -0.48$), across the distraction conditions.

There were no significant correlations between the accuracy on the shadowing or probe word tasks and the tolerances for the step-ups or the cold pressor pain. That is, people who responded most accurately on the distraction task did not tolerate the pain for longer or report less pain once they stopped the condition. These correlations are shown in tables 7 and 8.

Table 7

Correlations obtained between both step-up tolerances and pain ratings, with distraction accuracy data.

	Step-up Measures	
Distraction Measures	Pain Tolerance	Pain Ratio Ratings
Shadowing	-0.15	-0.04
Probe Omissions	0.36	0.12

* $p < .01$

Table 8

Correlations obtained between both cold pressor tolerances and pain ratings with distraction accuracy data.

	Cold Pressor Measures	
Distraction Measures	Pain Tolerance	Pain Ratings
Shadowing	0.16	-0.15
Probe Omissions	0.28	0.19

* $p < .01$

Order Effects

There were no significant differences in the way subjects responded dependant on which order they did the experimental conditions. This result was consistent across pain tolerance number of step ups, and subjective pain rating measures.

Subgroup Performance

Performance on the step-ups could be qualitatively separated into two distinct groups. The first group were those who reached their pain tolerance within the five minute time limit, while the second group were those who had not stopped by the end of the five minutes and were asked to stop. Analysis of the two groups was undertaken to determine if these two groups differed further in the way they experienced pain.

Analysis showed no outstanding differences between these two groups. There were no significant differences between the tolerances and pain ratings for the cold pressor task or between the two distraction accuracy measures - shadowing, and omitting the probe words - across baseline, the cold pressor test or step-ups.

For the step-ups without distraction there were significant differences in the before ($t(17) = 3.48$, $p < 0.01$) and after ($t(18) = 2.69$, $p < 0.05$) pain ratings. The group that reached their tolerance within the five minutes experienced greater pre and post-test pain. This tendency did not prove significant for the distraction step-up condition ($t(17) = 0.40$, $p > 0.05$) or the pain ratios both with ($t(16) = -0.36$, $p > 0.05$) and without ($t(15) = -1.25$, $p > 0.05$) distraction.

Questionnaire Results

Concentration on Shadowing Task

The first two questions asked to what extent subjects had to concentrate on the shadowing task and how much the ongoing exposure to the painful stimuli had interfered with their perceived precision on the task. Six of the fourteen who answered these questions found that as the shadowing task continued they began to think more about their pain and this effected their performance on the distraction task. Such a reply was typified by,

> "at first I had to make an effort to concentrate on the words being spoken, then the task seemed easier until the pain just could not be ignored."

> "The pain in my back and leg intrudes and it becomes more difficult to concentrate on the task."

The other eight found that the distraction task did not seem to get any harder to concentrate on as their pain got more severe.

Use of Own Strategies During Testing

Five out of thirteen answering the third question used their own strategies to cope with their pain. Subjects referred to the use of relaxation techniques and abdominal breathing, setting targets from the distraction task, gritting their teeth, thinking about the weekend and future projects, and self statements such as,

> "I kept telling myself that I was not really feeling pain; that it was all in my imagination."

In the later questions where subjects were asked to say what they were thinking when they were involved in the four experimental conditions, there were further references to the use of their own techniques. These were predominantly in the without distraction conditions as they reported having to concentrate on the words in the distraction condition.

In the cold pressor condition there were references to thinking about riding in cold weather (a reinterpretive technique), focusing on the change of feeling (somatisation), thinking about pleasant and everyday things, and counting to 50.

In the step-up condition some subjects mentioned that they ended up counting steps before they changed feet, concentrated on trying to keep a rhythm going, interpreting the exercise as being good for them and concentrating on the steps so they would not jar their backs too much.

Use of Strategies in Everyday Context

Seven out of fifteen answering this question reported using some mechanisms/tricks to cope with their pain in an everyday situation with effectiveness of the technique being heavily dependant on the level of the pain,

> "it all depends on how bad (the pain is) or (the) type of pain"

"Yes, it is possible to use diversion tactics for a time but inevitably, if pain is very bad, it is necessary to resort to pain killers and rest."

"Yes, depending on the degree of pain they can occasionally be effective but not for long."

"Not knowingly, but notice that when the mind's efforts are switched to a particular distracting task, the pain has sometimes disappeared when I next stop to consider how bad it is."

The remaining eight reported not using such techniques.

Attention Directed to Stepping Up

There was a range of answers to the question asking to the amount the subjects had to concentrate on doing the step-ups. Six out of fourteen subjects who responded to this question reported a minimal level of attention focused to the step-ups with the rest reporting levels of concentration from

"20 to 40%"

"Quite a lot...I had to make sure the strain was more on the left side because of the pain down the right side of (my) back which is aggravated if I put too much pressure and strain on the right side"

"About 50% concentration"

"Fairly intense concentration"

"I had to concentrate fully as I suffer with pain from right hip and numbness in leg and foot...watch I didn't lose my balance."

Summary of Results

There was no significant main effect for distraction or for the interaction of distraction and acute/chronic conditions. Significant main effects were found both for acute versus chronic pain tolerances and subjective post-test pain ratings. T-tests reinforced these MANOVA observations showing significant differences on these pain measures within the acute and chronic pain conditions. It was noted that on the number of step-ups pain measure subjects did more step-ups when combined with distraction as compared with no distraction although there was no difference in their rate of stepping up.

The distraction task was done equally well on all conditions with subjects having more difficulty omitting the words that were not to be shadowed than shadowing the words that were presented.

The questionnaires provided further information on the experiment. No consistent trends were shown but there were indications that some subjects had difficulty maintaining concentration on the shadowing task due to their pain levels, some utilised their own cognitive strategies during the testing, and some found that they had to concentrate quite a bit on the step-up task itself.

CHAPTER SEVEN

Discussion

For these subjects the distraction task employed was not an effective pain coping strategy for either their chronic low back pain or acute pain. These results will be discussed in relation with the hypotheses and the relevant literature.

Review of Hypotheses

The literature strongly supports the use of methods such as distraction in the management of experimental acute pain for the general population (see reviews Fernandez & Turk, 1989; McCaul & Malott, 1984). However, the few studies that have looked specifically at chronic pain sufferers and their pain have not produced such conclusive results (eg. Rosenstiel & Keefe, 1983; Rybstein-Blinchik, 1979; Turner & Clancy, 1986). Rybstein-Blinchik (1979) found that distraction was not the most effective strategy for chronic pain management, while Rosenstiel and Keefe (1983) and Turner and Clancy (1986) found the subjects in their studies who used diverting attention reported higher pain.

This study hypothesised that distraction would not be effective in alleviating the perception of pain for chronic low back pain subjects. The rationale for this prediction was that the processing of back pain had become automatic due to the subjects repeated or prolonged exposure to the nociceptive stimulus. As a consequence pain processing could proceed unhindered by the distraction task. As predicted, distraction had no beneficial effect on post-test pain ratings and pain tolerances. Distraction did however increase the number of steps the chronic pain subjects could do although the step-up rates were not different. The first hypothesis was supported.

The second hypothesis examined the effect of distraction on the acute pain experience for those with chronic low back pain. Evidence from studies using the general population indicate that distraction can be effective in increasing pain tolerances and reducing pain ratings for acute experimental pain (eg. Barber & Cooper, 1972; Spanos et al., 1984).

The interference of distraction on acute pain responding suggests that both require attentional resources and are controlled processes. As acute pain is of short duration and of variable frequency, and automatic processing generally develops with extended practice and indicates a relatively permanent set of connections (Shiffrin & Schneider, 1977), it was hypothesised that acute pain processing would be controlled. In such a case there would be an attenuation in the perception of acute pain under the distraction condition as compared with no distraction. This second hypothesis was not supported. Pain tolerances and post-test pain ratings for this group were no different for the distraction or no distraction acute pain conditions.

The third hypothesis was derived from the first two hypotheses. If distraction was to have an effect on acute pain but not chronic pain, then it followed that chronic pain patients processed pain differently depending on the source and type of pain. This was not shown to be the case. There was no significant interaction effect (D X AC). Distraction had no more effect on acute pain than it did on the chronic pain. These subjects did not appear to process chronic pain any differently from the acute pain. Acute pain and chronic pain were equally resistant to the effects of distraction.

Although there were no predictions about the differences between the acute and chronic conditions it is of interest that the only significant results generated by the MANOVA were differences in pain ratings and pain tolerances across pain conditions. The significant difference between pain tolerances is not that surprising when considering the different requirements of the tasks. Although the step-ups were chosen so as to be similar in tolerance times to the cold pressor test, in practice this was not the case with subjects tolerating the step-ups for longer.

The significant differences in pain ratings could be related to the differences in pain tolerances. Although the rating scales were the same, and for both conditions subjects were instructed to withdraw from the conditions at tolerance, subjects reported more pain at tolerance under the cold pressor conditions than with the step-ups. They did the cold pressor test for a shorter length of time than the step-ups and experienced more pain at withdrawal. These differences may well highlight the different meanings of acute and chronic pain. The chronic pain could be a more threatening stimuli for the subjects with them withdrawing before the pain gets too severe. If they do withdraw early they are likely also to rate their pain as lower.

Theoretical Implications

The finding that distraction was not effective for chronic pain, while in accord with the findings of Rosenstiel and Keefe (1983) and Turner and Clancy (1986), challenges the assumptions that underlie its use in chronic pain management. The outcome of this research generates a need for inquiry into possible explanations for the results.

Controlled - Automatic Processing

The literature on attention provides a framework in which pain processing can be conceptualised. Pain has a cognitive component which can be altered and influenced by attentional processes. The mode of information processing assumed to be involved in the perception of pain has been controlled information processing (McCaul & Malott, 1986). Cognitive strategies that require attentional resources have therefore been seen as a viable intervention for pain management. They can compete for the limited resources minimising the attention focused on the perception of pain.

However pain over time may have become so consistently mapped that the pain processing becomes automatic and does not require resources. It therefore would not interfere with the distraction task. Load insensitivity or the ability for people to successfully time share two tasks was demonstrated in a study by Logan (1978). Subjects in his study could simultaneously perform consistently mapped tasks and variably mapped tasks without any cost to sensitivity, if attention was allocated to the variably mapped task. In the current study it was hypothesised that the processing of the perception of the chronic pain may have become so familiar and practised that effort need only be directed at the variably mapped distraction task. The distraction task data supports this suggestion. There was no increased cost in sensitivity on the distraction task as it was performed while the subject was experiencing pain from either the cold pressor or from doing the step-ups. From baseline to both pain conditions there was no decrease in precision of the distraction task, and performance on the task did not appear to falter when the subjects were experiencing pain.

The distraction technique used, shadowing words, proven effective in reducing rated pain on the cold pressor task for low and high hypnotic susceptibility subjects (Spanos, McNeil, Gwynn, & Stam, 1984) was used here. The effectiveness of the task for reducing pain in the Spanos et al. (1984) study suggests that the distraction task processing interferes with pain processing. Although the words were presented at a slower pace in the current study as compared with the Spanos et al. (1984) study, an additional processing component, omitting probe words seen on the video monitor, was introduced. Accuracy rates showed that subjects had more difficulty with the additional task than with the shadowing task. Questionnaire reports from subjects indicated that considerable attention had to be paid to the distraction task. Despite the attention demand required by the distraction task it did not have a beneficial impact on pain tolerances or pain ratings for either pain condition. Pain processing appeared to proceed unhindered.

This finding runs counter to the assumptions underlying distraction. Not only was distraction not effective for the chronic pain as was hypothesised, it was also not effective for the acute pain. There was no decrement in pain tolerances or pain ratings from no-distraction levels for either type of pain when the distraction task was included. The only improvement with distraction was that subjects were able to complete more step-ups under the condition of distraction although the rate of step-ups did not vary across with or without distraction conditions. If either type of pain involved controlled processing there should have been changes in the perception of pain across the distraction and no distraction conditions.

The results from the chronic pain components of the study can be understood in terms of automatic processing but the results showing distraction to be ineffective for acute pain do not fit into this automatic processing model as readily. The cold pressor experience was not administered frequently enough or for long enough for consistent mapping to have developed. According to the literature on controlled and automatic processing there does not seem to be any basis on which it can have become automatically processed and resistant to distraction. Unless all pain is in some way treated the same, automatic processing may not be the whole answer.

Salience and Hypervigilance to Pain

Pain is of high evolutionary significance and in a survival context is a warning signal for an underlying disorder that needs to be treated (Wall, 1979). However in cases of chronic pain, Sternbach (1987) suggests that the pain is no longer a warning sign, but a false alarm which has a destructive, debilitating effect and serves no purpose but remains a highly salient cue. So salient that the extent it can be ignored is limited.

Awareness of pain can be seen to fall on a continuum where at one end people may deny their painful sensations or report little distress, while at the other end people may exaggerate their sensations whether they are painful or not (Chapman, 1986). This exaggeration or hypervigilance to pain is maladaptive. There is an attentional emphasis on being excessively alert and ready to select out and respond to weak and infrequent stimuli from the external or internal environment, as well as to all signals of potential threat. Such unhealthy systems promote positive feedback processes which operate to upset the homeostatic balance and impede proper healing (Jamner & Schwartz, 1986). Vigilance to somatic signals is a common feature of chronic pain patients (Chapman, 1986). Vigilance has also been associated with a slower and more complicated recovery to surgery (Cohen & Lazarus, 1973).

Vigilance may be seen as a cognitive attentional set or schema which in the present context leads the perceiver to search for somatic cues (Pennebaker, 1982); a product of a learning process, reflecting the effects of past experience on present perception (Chapman, 1986). It may result from anxiety, concern about medical conditions, instructions to pay attention, and develop as a perceptual habit because of selective reinforcement for identifying certain stimuli as is proposed by the operant model of pain and pain behaviours (Fordyce, 1976). The operant model for example would suggest that initially pain signals may indicate that the pain sufferer should stop any strenuous activities and rest. Sufferers may be told not to overexert themselves and to stop any exercise as soon as they start feeling some discomfort. Pain sensations under such circumstances may develop as an important cue to focus on with attention to this cue being associated with positive outcomes such as encouragement to relax, increased attention, and support. Attention to pain behaviour may thus develop as a conditioned response to chronic pain.

The stimulus generalisation principle (Fordyce, 1983) proposes that a particular response which is at first linked to only one specific stimulus will after some time generalise to other stimuli which resemble the original stimulus. The idea that chronic pain patients will react with chronic pain behaviour not only in situations which would elicit chronic pain (eg. physical exertion), but also in acute pain situations, can be derived from this principle. Schmidt and Brands (1986) investigated this, hypothesising that when given an acute experimental pain stimulus, chronic low back pain patients will react with poorer persistence behaviour than a control group.

Schmidt and Brands (1986) compared test behaviour on the cold pressor test for 24 control subjects and 24 chronic low back pain (CLBP) patients matched for age and sex. Chronic pain patients showed poorer persistence behaviour and reports of more intense pain. Thus some aspects of CLBP behaviour were also emitted in the experimental acute pain situation. This was interpreted by Schmidt and Brands (1986) as supporting the stimulus generalisation theory. The behaviour associated with chronic pain had generalised to other stimuli resembling the original stimuli. Schmidt and Brands (1986) noted that because CLBP patients react with chronic pain behaviour in an acute pain situation does not logically mean that this type of behaviour is the result of the chronicity. It is possible that such behaviour is a risk factor in the etiology of chronic pain.

This evidence suggests two possibilities to explain the findings of the present study. Firstly as a result of conditioning history all pain has become so salient that distraction has no impact on pain reports. While in theory this is plausible, in the present study there was no decrement in the accuracy on the distraction task when administered in association with either the acute pain or the chronic pain. It is almost certain that the distraction task was a controlled information process. If pain processing is so salient, it would be expected that the performance on the distraction task will suffer. As this was not the case it suggests that other variables, for example automaticity of pain processing may also be involved.

The other possibility is that the process of change which occurs in processing as pain becomes chronic generalises to impact on all pain. All pain comes to be processed automatically, consequently distraction will not interfere with any pain processing or produce reductions in pain reports. In terms of the current study this generalisation can explain the ineffectiveness of distraction in the acute pain conditions which can not be as easily explained in terms of automaticity alone.

To summarise, for those suffering long term pain, the pain is always there at some level and can not easily or effectively be blocked out or ignored. The pain is always a prominent feature in their attention. Strategies like distraction lose their effectiveness for chronic pain management because of the efficient automatic processing that has developed to cater for the everyday processing of chronic pain. It seems that for these chronic pain sufferers, other forms of pain may be processed and responded to in a similar manner as their chronic pain. In such cases these other types of pain are also not amenable to distraction.

Effectiveness Over Time

A possible explanation for the ineffectiveness of distraction at reducing pain is the fact that distraction has been shown in some studies to lose its effectiveness over time (eg. Barber & Cooper, 1972). McCaul and Haugtvedt (1982) found that the effectiveness of distraction deteriorated after one minute. Interestingly an intervention which required subjects to attend to sensations proved more effective than the distraction task over the last two minutes of the trials. This may relate to increases in the salience of pain, which occur as pain becomes more severe. At some point pain increases to the extent that attempts to block it out are fruitless and strategies that combine the pain sensation with management, are more effective (Rybstein-Blinchik, 1979; Turner & Clancy, 1986). Once the sensations can no longer be ignored the value of distraction may vanish (McCaul & Haugtvedt, 1982). As the pain measures for the current study were collected at the end of each condition there is no way of determining how effective distraction was early in the condition and how the effectiveness may have altered during the painful stimulation. The only indicators obtained were responses on the post-test questionnaire.

Reports from the questionnaire suggest that for some subjects the effectiveness of the distraction task tapered off as the length of time enduring the pain increased. When the pain reached a level where it was becoming more unbearable attention was reported to swing from the distraction task to the pain. The questionnaire also highlighted that when distraction was used in the everyday context it was useful up to a point but inevitably the pain would get so severe that the subjects would have to resort to analgesics and rest as the distraction was no longer effective.

In cases of chronic pain, where there is always some level of discomfort, techniques need to maintain their utility over long periods to be totally effective. If the intent of the strategy is only to get the user through a 'rough patch' it still needs to be useful for more than the one minute found by McCaul and Haugtvedt (1982). Techniques that minimise pain for a matter of a few minutes in the context of a day of pain provide little support for the chronic pain sufferer. Studies that have looked at the use of cognitive strategies in an experimental situation can tend to overlook the history of the pain when transferring their findings to the chronic pain experience.

With distraction where the strategy involves moving attention away from the pain the magnitude of the pain experience may require substantial effort to maintain some form of distraction. Trying to distract one's attention away from such a long term difficulty may not be feasible. In the acute pain experience, the knowledge that the pain is discrete may alter the sufferer's ability to use strategies such as distraction. Chronic pain sufferers however may tire of utilising such cognitive strategies knowing that the pain is likely to persist indefinitely.

Behavioural theorists such as Kanfer and Goldfoot (1966) have long maintained that self-control strategies are most effective in the early stages of attempting to deal with a noxious stimulus such as pain. They predict that over time a breakdown in self-control effectiveness occurs and environmental variables eventually control behaviour. Keefe and Brown (1980, cited in Crisson & Keefe, 1988) have argued that as pain patients proceed from the acute to the prechronic and finally the chronic phases of a pain problem, their perceptions of their ability to control pain decreases. This suggests that associated with this decrease in perceived control could be a decrease in the use of effective cognitive strategies.

Methodological Issues

Pain Measures

The pain measures used were pain tolerances, pre and post-test pain ratings, and specifically for the step-up condition, number of step-ups. Many studies have demonstrated these measures to be good indicators of the effect of distraction on pain (eg. Gilligan, Ascher, Wolper & Bochachevsky, 1984; Stevens, 1985).

Pain threshold and interval pain ratings have also often been used as pain measures. Pain thresholds are when an individual first starts feeling the sensation of pain while interval ratings are pain ratings taken at set times throughout the exposure to a painful stimuli. In this study it was decided that these measures would not be used as the monitoring of pain throughout would require attention to pain and interfere with the effect of distraction.

A recent study by Hodes, Howland, Lightfoot, and Cleeland (1990) suggests however, that fixed interval pain ratings may be a better measure of the impact of distraction than pain tolerances. The dimensions of sensory and reactive pain processing were used to define the conditions for the efficacy of distraction. Reactive processing involves the cognitive evaluations of the painful stimulus as well as the individual's affective response. Affectively neutral distracters are assumed to work by providing input that competes with nociception for access to a limited sensory processing mechanism (Kahneman, 1973). In contrast, mood and cognitive manipulations modify pain by their influence on the emotional and evaluative processing of the painful stimulation. Therefore affectively potent distracters, such as pleasant imagery, should attenuate both the sensory and reactive components of pain.

Hodes et al. (1990) viewed tolerances as representing the processing in the reactive pain system as they are sensitive to both motivational (Blitz & Dinnerstein, 1968) and affective variables (Chen, Dworkin, Haug & Gehrig, 1989), while pain ratings represented the processing in the sensory pain system. Performance on an affectively neutral task was found to significantly reduce pain ratings but not pain tolerances to cold pressor stimulation. The distraction task only altered processing in sensory pain systems and not the affective dimension measured by pain tolerances. Hodes et al. (1990) concluded that affectively neutral distraction would be relatively ineffective for making chronic pain more tolerable and for such persistent pain the choice of a particular technique should be guided by attempts to modify the person's affective state or appraisal of their pain.

Relating the Hodes et al. (1990) study back to the current work, it suggests that fixed interval pain ratings may have been a better measure of the impact of distraction. The shadowing task was affectively neutral, which according to Hodes et al. (1990) suggests that the interference produced by the distraction is going to be at the sensory level and best measured by fixed time pain ratings. They would predict that the task would have no impact on pain tolerance as was demonstrated by the present work. Pain interval ratings may also be more beneficial in assessing the utility of distraction in that they may tap the effects of distraction prior to the pain being so intense that it demands attention. Future work in this area would benefit then from incorporating the fixed interval pain rating into the experimental procedure to obtain an accurate measure of sensory perception when using affectively neutral distracters.

Additionally, fixed interval pain rating scales would have given a more accurate measure of distraction's effectiveness over time. The cost in accuracy on the distraction task however was a more important issue in this study.

Use of Own Strategies

Responses on the post-test questionnaire indicated that some subjects used their own coping strategies during the no distraction conditions. Examples of these were self statements, thinking about things unrelated to the pain experience, and reinterpreting the pain. These strategies were mentioned mainly in relation to the acute conditions although there were some indications that they were being used on occasions for the chronic conditions as well. Many subjects reported the use of strategies to cope with their pain in their everyday life which suggests that they could be quite competent at using them. Other reported studies (Barber & Cooper, 1972; Chaves & Barber, 1974; Stevens, 1985) have found that subjects utilised their own strategies to overcome the pain as best they could. Stevens (1985) saw this as a problem for researchers interested in pain management interventions. Effectively, using self generated strategies sets up the problem for the experimenter that some subjects are effectively having two distraction conditions with no 'without distraction' comparison.

Attentional Demand of the Step-ups

Many subjects also reported in the post-test questionnaire of having to concentrate to some extent on the step-ups. It was not so much the process of the step-ups that was the problem, rather the jarring that occurred if they did not concentrate on lowering themselves down gently or starting off on their 'best' foot. Subjects reported concentrating on stepping so as little pressure as possible would be applied to their area of discomfort.

The main criteria for selection of the exercise for the chronic pain condition was that it could be performed easily and would not require too much attention. This was to ensure that it would not act as an additional distracting influence to the pain. In the study if the step-ups were too attention demanding the subjects when doing the 'without distraction' condition would still be distracting some of their attention away from the pain. Alternatively, the need to focus on the stepping up could equally have encouraged the subjects to focus on their pain more as the step-ups were directly associated with the pain. Although the attentional requirements of the step-ups could be a confounding variable in the chronic pain condition, there was no such variable in the acute pain condition and still there was no difference between distraction and no distraction pain measures. Additionally, although these reports of attending to the step-ups were made, there was no corresponding detriment in accuracy rates on the distraction task under step-up conditions which would be expected if too much attention was focused to the step-up exercise. To overcome these uncertainties in the future, alternative exercises such as treadmilling where jarring would be reduced, could replace the step-ups.

Future Research

The finding that distraction was not effective for the chronic pain group in this study suggests that further investigation is required to determine the place of distraction in the battery of cognitive strategies for chronic pain management. Utilising diversion of attention away from the reality of the pain may still be warranted but within this there has to be some recognition and reframing of the pain experience. Maladaptive techniques like catastrophising which have been associated with low rates of coping efficacy (Rosenstiel & Keefe, 1983) highlight the risk of focusing too much on the pain or not interpreting it in a positive manner.

Behaviours or responses that have become automatic are known to be difficult to modify or suppress (Schneider et al., 1984). Awareness of this reinforces the need to look for coping strategies that do not necessarily aim at suppressing the pain. More consideration in the future also needs to be made about ways that the processing of pain may become more demanding on attentional resources. Paradoxically chronic pain sufferers are aware of their pain but it seems from this study that a lot of processing of pain goes on beyond this awareness.

Research Summary

The study set out to determine whether there was a difference in the way pain was processed in acute and chronic pain situations, and whether distraction was likely to be an effective coping strategy for chronic pain management.

The results obtained suggest that distraction is not effective for either acute pain or chronic pain when its effectiveness was measured by reductions in reported pain tolerances and subjective pain ratings taken at the end of the experimental conditions.

Outcomes have been discussed in relation to hypervigilance to pain sensations, generalisations of pain responses, salience of pain, effectiveness over time, and automaticity of pain processing. Methodological issues such as the pain measures used, the use of subjects' own strategies and the attentional demands of the step-ups have also been considered.

Overall the results are of clinical interest as distraction is often a component of pain management packages. That distraction may not be useful for the chronic pain population suggests that further research needs to be undertaken to determine what are the active components of cognitive strategies, what strategies will be useful for the chronic pain sufferer, and to investigate further the processing of chronic pain.

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APPENDICES

APPENDIX A

Newspaper Advertisement for Subject Recruitment

business hours

DO YOU HAVE CHRONIC LOW BACKPAIN?

We are seeking subjects for study which we hope will increase our understanding of chronic pain. If you have had low back pain which has persisted for 6 months of more, would be prepared to spare a little time and would like further explanation, please telephone Susan Petrie at Psychology Department, Massey University. Ph 69-099 ext 4072 between 9.30-4pm.

CLASSIFIED

APPENDIX B

Information Sheet

We are currently undertaking some research into the processing of pain in people with chronic pain. We require subjects who have had back pain for at least six months to be involved in the study and would appreciate your participation.

As pain persists over a period of time it has been suggested that pain signals may change the way they are processed. In order to clarify this we will be looking at and comparing the processing of chronic pain and an experimental acute pain.

There will be two tasks required of subjects. One involves subjects putting their hand in ice cold water, and the other doing low step-ups. For both tasks you are asked to continue the exercise to the point that discomfort tells you to stop. If you have not stopped after 5 minutes you will be asked to stop. With respect to the step-ups there is the possibility that you may experience some residual pain for a short period once you stop the task.

The time involved should consist of three twenty minute sessions. You will be required to do each of the tasks twice, once with a distraction task (selectively repeating words as soon as you hear them) and once without it.

At the end of the study you will be given more information about the study and when results are available we will send them to you if you provide a mailing address. (These results will be 2-3 months away). Confidentiality will be maintained and your individual results will be known only to us. The results will be grouped for analysis and reporting.

While this study will not be very stressful and you may withdraw at any time for any reason, we are keen to check with your doctor that s/he is happy about your participation. In addition we would like you to fill out the medical checklist at the end of this information sheet, as a further safeguard.

We would greatly appreciate your participation in this study. If there are any queries regarding the study that you would like answered, feel free to ask us. We will be happy to explain aspects of the study to you. If you are prepared to be a subject please fill out the checklist and consent form attached.

Hope to be able to work with you.

Susan Petrie
Malcolm Johnson

Return Address
Psychology Department
Massey University
ph. 69099 extn 4072 or 8356

Medical Checklist

Please answer the following questions:

1) Have you ever had any form of epilepsy? yes/no
2) Are you currently using medication of any type? yes/no
3) Do you have any known heart condition? yes/no
4) Are you in good health? yes/no
5) Do you have reasonable mobility despite your back pain? yes/no
6) Do you suffer from asthma? yes/no
7) Have you ever had an injury or any medical condition that you think may effect your ability to sense pain? yes/no
8) Do you have any skin problems? yes/no
9) Is there a possibility that you may be pregnant? yes/no

Signature:........................ Date:.............

Subject Consent Form

Research into the Processing of Chronic Pain

I have read the Subject Information Sheet for the research to be performed. I agree to participate in this study.

I understand that I may withdraw my permission at any time without giving any reason and that the outcome of my involvement will be kept confidential. In undertaking this study I am aware that I will be exposed to painful stimulation which I can withdraw from at any time. I am also aware that some residual pain may be felt for a short period following the termination of the task.

I agree to contact being made with my general practitioner and have filled out the medical checklist to the best of my knowledge.

Name:	....
Mailing Address:	....
	....
Phone Number:	....
Signature:	....
Date:	....

General Practitioner:	....
Contact Number:	....
Address:	....
	....
	....

APPENDIX C

General Practitioners Information Sheet

We are currently undertaking some research into the processing of pain information in people with chronic pain. As pain persists over a period of time it has been suggested that pain signals may change in the way they are processed. In order to clarify this we will be looking at and comparing the processing of chronic pain and an experimental acute pain. One of your patients .... has agreed to participate as a subject in our study.

As part of the study they will be required to do two tasks that are likely to cause them some discomfort. One of the tasks requires them to put their hand in ice cold water until discomfort causes them to remove it. This is a method of acute pain stimulation that has been used successfully and safely in previous pain research.

The other task requires them to do step-ups, once again to tolerance. As you may well be aware exercise to tolerance is a technique often incorporated in pain management programmes. Exercise is beneficial for chronic pain sufferers as it can lead to improvement of physiological tone, body strength and functional capacity. They are always free to stop at any point at which they feel they do not want to continue. In both tasks there will be a five minute maximum length of participation at which point they will be asked to stop if they have not already found it necessary to stop. It is possible that a residual pain will be felt for a short period following the completion of the step-up task.

They will be required to do each of the tasks twice, once with a distraction task (repeating words as soon as they hear them) and once without it. In addition an initial baseline condition may be required for the step-up condition.

As a precaution I would appreciate the medical clearance of your client as fit for participation in my study. If you consider your client to be physically capable to be involved in the study could you please fill in the slip below.

Thank you for your time.

Susan Petrie
Malcolm Johnson

Return Address
Psychology Department
Massey University
ph. 69099 extn 4072 or 8356

General Practitioners Consent Form

Research into the Processing of Chronic Pain

I have read the General Practitioners Information Sheet for the research to be performed and understand what will be involved for my patient.

I feel that my patient .... is/is not physically capable of participating in this study.

G.P Name: ....

Signature: ....

Date: ....

APPENDIX D

Distraction Task Words

window	home	book	cow
hole	banana	paper	beach
hat	tree	church	room
table	pin	food	card
barn	glass	**bird/red**	roof
ranger	bird	plane	nail
rain/water	farm	turkey	pear
house	jug	hand	brown
nose	mouse	chair	**week/cloud**
pond	**moon/bag**	cat	play
red	plug	watch	drive
letter	river	tin	table
hand	cup	cloud	**pot/leg**
apple	paint	farm	hair
egg	gate	train	bag
pencil	cut	light	car
green	give	garden	tin
talk	happy	mat	mat
bag	bread	turn	help
fence	wheat	**colour/dog**	copy
ear	day	drum	blue
box	**path/pond**	handle	clock
bell/hammer	author	toe	shoe
cat	yellow	top	bottom
ring	wind	truck	bath
dollar	car	candle	fence
finger	lunch	record	book
large	banana	farm	box
window	home	hat	jug
foot	cat	tree	light

Note: Presentation of words ran down the columns from left to right with the first two columns being repeated following the fourth column. Words in bold indicate the probe words that were also presented on the video monitor. For the repeat of the first two columns the second word was presented on the video screen.

APPENDIX E

Distraction Rating Scale

Please indicate on the scale below the degree of pain in your back that you are experiencing at the moment.

Name:............................

----

no pain worst pain ever

Cold Pressor Pain Rating Scale

Please indicate on the scale below the degree of pain you were experiencing in your hand when you removed it from the water.

Name:............................

----

no pain worst pain ever

Step-up Pain Rating Scale

Please indicate on the scale below the degree of pain you are experiencing in your back at the moment.

Name:............................

----

no pain worst pain ever

Step-up Pain Rating Scale

Please indicate on the scale below the degree of pain you were experiencing in your back when you stopped the step-ups (or were requested to stop).

Name:............................

----

no pain worst pain ever

APPENDIX F

Subject Information

Name: ....

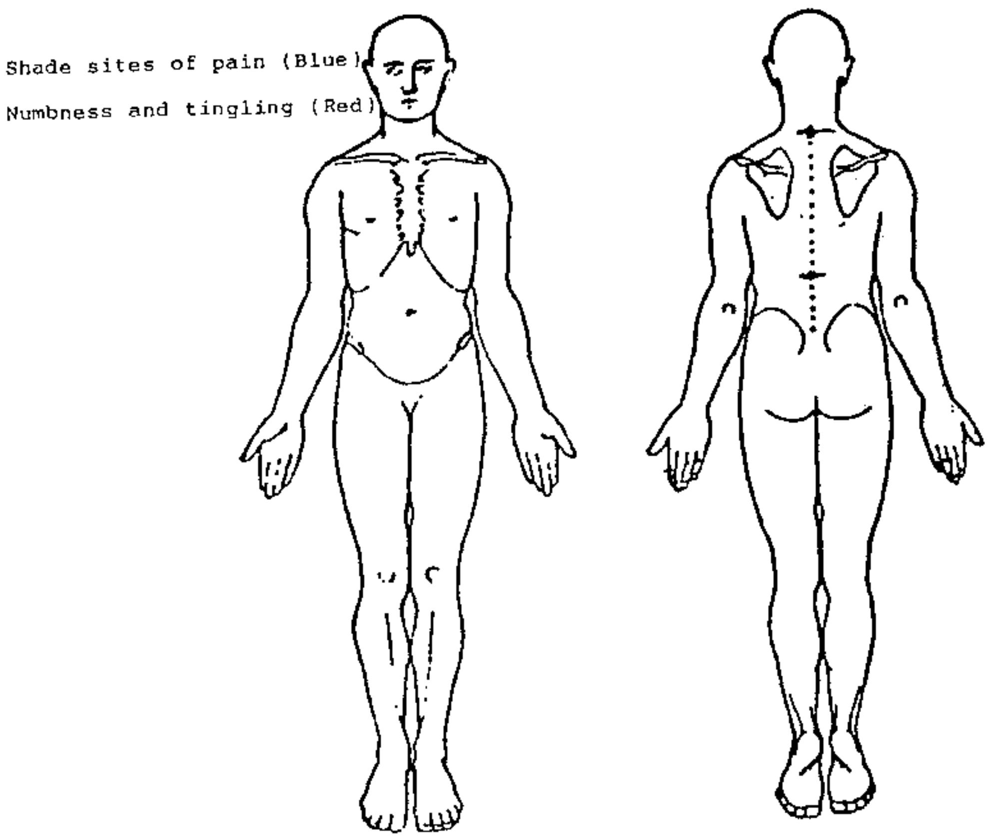
Age: ....

Sex: Male Female

Handedness: Left Right

How long have you experienced your chronic pain?

Pain experienced:(describe in words as best you can the degree and nature of your pain and locate it on the figure below)



APPENDIX G

Questionnaire

Just to provide us with a little more information about how you found the task we would appreciate it if you would fill in this short questionnaire as best as you can. This is optional.

1. In the shadowing task, did the task seem to get harder as you progressed?
   If so, how did it get harder?

2. In the shadowing task did you find that you were thinking about your pain as the shadowing task continued and that this effected your performance on the shadowing task?

3. Did you use any mechanisms/tricks (for example imagery, self statements, distraction) during the conditions other than the shadowing task?
   If so, what were they?

4. Have you ever used these mechanisms before to deal with your back pain?
   If so, have they been effective?

5. What were you thinking about while...

   i. your hand was in the cold water?

   ii. your hand was in the water and you were listening to the words?

   iii.you were doing the step-ups?

   iv. you were doing the step-ups and listening to the words?

6. What made you keep your hand in the water and continue to do the step-ups?

7. To what extent did you have to concentrate on the step-ups?

Thanks you for your help in this research. It has been appreciated.

Susan

APPENDIX H

Study Review sent to Subjects

Dear

Hi, this is just a note to update you on the outcomes of the back pain research you were involved in at Massey. Sorry about the delay but data collection and analysis took longer than I initially intended.

As you will remember we were looking at, and comparing the processing of acute and chronic pain. Literature supports the notion that distraction is effective for decreasing pain perception in acute pain situations such as with the cold water test. It has been shown that subjects will have a higher pain tolerance, that is keep their hand in the water longer, if they are using some distraction strategy as opposed to using no such strategy. However, results have not been as conclusive in studies looking at distraction with chronic pain. The aim of the study you were involved in was to investigate this in respect to ideas relating to attention.

Attention can be likened to an energy store where there is a limit to the amount of resources available. This is seen in everyday situations where people have difficulty doing many things at once, such as reading the paper and carrying out a serious conversation. Both tasks require similar attentional resources and due to the limit on resources one or both tasks will suffer at the expense of the other. Both are attention demanding but there is not enough of the resources for them both to be carried out well simultaneously.

Techniques like distraction work on this attentional rationale - the requirements of the distraction task interferes with the acute pain processing and thus pain is not processed as well. Attention is ideally directed to the distraction task and not the pain being experienced.

As you may be aware some processes over time can become quite automatic in nature - they can be performed with little attention paid to them. In such situations you can often do other tasks at the same time with little to no detriment to the initial task. This taps into the hypothesis we were looking at with respect to the current study - the notion that your chronic pain may have become an automatic process and as a consequence the distraction task can be completed with no interference with the pain processing. The result for you would be no reduction in your perception of pain on the task with distraction as compared with no distraction.

It was interesting to find that our results did not support this hypothesis. Overall subjects responded no differently with or without the distraction in the acute condition or in the chronic pain situation. There was no difference in the tolerance levels between the conditions and in the subjective pain ratings that you completed after the conditions.

These results can suggest a number of things,

1. Distraction is not effective due possibly to:
    a) the development of automatic processing for chronic pain,

    b) the high salience of your pain heightens your awareness to all pain sensations,

    c) distraction's ineffectiveness over time.

2. There were other processes occurring, in addition to the pain processing and distraction, that interfered with the experiment. For example, some of you reported using your own strategies (relaxation techniques, thinking pleasant thoughts) when there was no distraction provided, or having to concentrate too much on stepping up comfortably in the step-up condition.

The results have provided some interesting findings which have increased my knowledge of back pain and cognitive techniques that are used to help manage the pain. These findings could not have been achieved without your participation in the study. Once again I would like to thank you for offering to be part of the study and for being so enthusiastic in sharing your experiences with me. I really appreciate your support.

I hope this has been informative. If there are any further queries regarding the study outcomes, feel free to contact me.
Thanks.

Susan Petrie