Examination of Three Attentional Strategies on Pain Coping and Recovery From the Cold Pressor

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ABSTRACT

The literature supports the role of attention diversion strategies in the modification of pain perception. Recently it has been suggested that the presence of an overt action is a necessary component of these often multicomponent tasks. Research has also indicated that attention distraction and suppression strategies may carry with them long term cost.

The present study compares the effectiveness of three attentional strategies in an attempt to isolate the necessity of an overt response. It also examines for the presence of a long term cost of these strategies in the form of a rebound effect.

Sixty eight subjects were randomly assigned to one of four strategies: suppression, distraction through visual detection, distraction through visual detection with a response, and control. There were no significant differences between the groups on pain tolerance and pain ratings or on recovery. The recovery from the cold pressor was found to be significantly related to the tolerance time. Subjects who were exposed to the cold water longer recovered more slowly. These results are discussed in terms of pain theory and future research.

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CHAPTER 1

INTRODUCTION

Research both internationally and in New Zealand reveals that pain is one of the most common and costly health care problems faced today. A study by James, Large, Bushnell and Wells (1991) reveals that of the urban New Zealand adult population sampled, 80% reported that they are affected by pain to the extent that it interfered with their life or activities, led to professional consultation, or necessitated the use of drugs. Von Korff, Dworkin, and Le Resche (1990) report that in America 37% of those surveyed reported recurrent pain, of whom 8% had severe and persistent pain. Similarly, Meinhar and McCaffery (1983) estimate that one third of the American population have recurrent pain problems. Bowsher, Rigge, and Sopp (1991) report that, in Britain, 7% of their random sample suffered from chronic pain. Although the prevalence of pain appears somewhat varied, Crombie, Davies, and Macrae (1994) suggest in their review of the epidemiological research that the discrepancy is at least in part due to differences in definitions of pain used. However, they conclude that there is overwhelming evidence that chronic pain represents a major public health care problem.

One of the most prevalent pain problems is back pain. Back pain (BP) is responsible for 25% of all work related injury claims in Australia (WorkCover Corporation, 1992). National statistics in European countries reveal BP has a yearly prevalence in the 25 to 45% range and chronic BP has a prevalence in the 3 to 7% range (Gunnar & Anderson, 1996). In the United States the yearly prevalence for BP is in the 15 to 20% range, and chronic BP is in the 1 to 2 % range (Gunnar & Anderson, 1996). In all industrial countries the life time prevalence of BP exceeds 70%. In New Zealand the Accident Compensation Corporation reports a trend of escalating incidences of back injury and nonspecific chronic back pain (Robinson, 1996).

For those people for whom chronic pain is part of everyday life, the costs in terms of suffering, for both the individual and the family can be incalculable (Turk and Rudy, 1992). Not only can persistent pain have profound physical effects such as impaired sleep and reduced appetite, it can also cause disruption in daily living, ability to work, financial security, and quality of life.

Over and above the human suffering resulting from pain, there is a large financial cost to society. Survey studies in America report that pain costs over US$25 billion in direct health care (Nachemson, 1992), as well as accounting for over 700 million lost working days a year, at a cost of US$60 billion dollars (Meinhart & McCaffery, 1983). The financial costs of pain to New Zealand are equally high. Indeed, approximately one third of the Accident Compensation Corporation (ACC) budget will be spent on low back sufferers. Compensation on new back strain claims increased by $7.3 million from $30.4 million in 1993-94 to $37.7 million in 1994-95 (Robinson, 1996).

Advances in our understanding of pain will lead to more effective and efficient treatments of this vast health care problem. Clearly this would lead to a reduction in suffering as well as decreasing the financial cost.

Over the last 30 years there have been many changes in theories and treatments of pain. One of the most important changes is the move to looking at pain as a multi-dimensional experience. This has opened the door to the study of the psychological aspects of pain perception. Studies in this area have identified many psychological variables which exert an influence on pain and have used them to reduce or change pain perception in both laboratory and field settings. One variable which has been investigated extensively is attention.

Although significant progress has been made in terms of theory and understanding of the way attention effects the perception of pain, there are certain questions which remain unanswered. From the research it remains unclear which characteristics of the

many attentional strategies studied are necessary for the most effective and efficient treatment. Recently, the suggestion has also been raised from thought suppression theory that attentional strategies may, in fact, carry with them a cost in terms of recovery.

The present study will investigate the necessity of a response in a simple distraction task, as well as examining the possibility of a cost arising from the use of attentional strategies. The following chapters will include a description of the history current status of pain theory, a discussion of the role of attention in pain processing with a review of the relevant literature, and an outline of thought suppression theory and how this relates to pain. This will be followed by an outline of the current research, method, results, and discussion.

CHAPTER 2

HISTORY OF PAIN THEORIES

An historical examination of the concept of pain is important as it reveals the way in which the prevailing definition and theories of pain have dictated what is observed and studied in patients and how pain is treated. Although it is generally recognised today that psychological factors play an important role in pain processing, this has not always been the case. Historical writings illustrate how, along with medical and scientific ideas, the role assigned to psychological factors in pain has changed considerably over the years. Psychological factors have held varied positions in pain theory, from being dismissed as irrelevant, to being assigned primary importance (Gamsa, 1994).

Before the nineteenth century pain was understood as an experience of the mind only. Aristotle described it as pure affect, the opposite to pleasure (Price, 1988). At that time there was no effort to understand pain in terms of physical mechanisms or causes. It was the advent of post-Renaissance scientific thinking which viewed the body as a machine that led to pain being explained in terms of anatomical and physiological mechanisms. This view, beginning with Descartes, became firmly entrenched by the beginning of the 20th century (Gamsa, 1994). Pain came to be understood as a direct result of tissue damage or organic disease. This linear perspective described pain intensity as corresponding directly to physical stimulation. In other words, the experience of pain was believed to be directly proportional to the extent of tissue damage or pathology. At that time pain research and pain management was based almost exclusively on sensory models, with little interest shown in psychological factors (Bonica, 1983; Gamsa,1994).

Although current thinking on pain recognises the multi-dimensional nature of this complex phenomena and the role of psychological factors, it is important to review the

neurophysiological observations and theories which grew out of previous eras. From the linear sensory paradigm a number of neural theories of pain perception developed. Price (1988) provides a thorough discussion of these theories and the evidence for each one. The following will include a brief outline of the main theories that developed, and their impact on current theory.

Neurophysiological Theories of Pain

Specificity Theory

The first neurophysiological theory of pain to develop, the specificity theory, evolved from the idea that sensory modalities were served by both a specific type of neural receptor and a central pathway. It was postulated that there were four cutaneous modalities: warm, cold, touch, and pain. In other words, pain was thought of as another sensory system like hearing and sight. Stimulation which is damaging or potentially damaging was believed to activate specific pain receptors and fibres which, in turn, projected pain impulses to a pain centre in the brain. Transmission of pain information was thought to be along a direct pathway, from peripheral neural receptors to the brain (Melzack,1993; Price, 1988; Turk & Rudy, 1992; Weisenberg, 1987).

Although more recently this theory has been shown to be a gross oversimplification, modern explanations have retained two of its main principles (Price, 1988). Firstly, that sensory receptors are indeed specialised to respond to specific types of stimulation and that nociceptors are one type of these receptors. Secondly, that the destination of the ascending pathway is an important variable in differentiating the type of stimulus.

Pattern Theory

The second well known sensory theory, the pattern theory, came from the finding that skin receptors lacked structure and form specialisation. The alternative hypothesis was that, rather than specialised receptors responding to different somatosensory stimulation, the same receptors respond to different types of stimuli with different

patterns of impulses. Although there is no evidence for this type of complex impulse patterning, this line of research has made some contributions to current theory as well (Price, 1988). Impulse frequency was found to be a variable that distinguished nociceptive from nonnociceptive stimulation. Furthermore, most nociceptive receptors will respond to two or more forms of stimulation so that receptor specificity is relative rather than absolute (Melzack & Wall, 1982). Like the specificity theory, pattern theories conceptualised pain as a sensory experience directly and solely related to the physical stimulus. This approach was eventually found to lack the complexity to explain many of the features of pain (Melzack, 1993).

Summation Theory

In an attempt to explain the fact that long duration pain could sometimes be triggered by brief stimulation, the summation theory was proposed by Livingston (1943). Livingston's hypothesis was that reverberating circuits existed within the grey matter of the spinal cord, and pathological activation of sensory nerves initiated activity in these reverberatory circuits. These circuits were self-exciting loops of neurons. This was a popular explanation for pathological pains such as phantom limb pain. Although the neural mechanism proposed in the summation theory has been found to be incorrect, it is likely that certain nociceptive neurons release long duration neurotransmitters (Price, 1988).

Sensory Interaction Theory

Closely related to summation theory is the sensory interaction theory. This theory was originally based on the idea that a rapidly conducting system exists which inhibits transmission in a more slowly conducting nociceptive system. It is und er pathological conditions that the rapidly conducting system loses its inhibitory control over the slow one, resulting in pathological pain. The sensory interaction theory was expanded a great deal by Noordenbos (1959) with more specific types of interactions being defined. Small afferents were seen as carrying the nerve impulse necessary for pain and the large

afferent as inhibiting nociceptive messages. The resulting idea was that pain perception was determined by the balance of large and small afferent input.

Several of the features of Noordenbos's theory have found support, including the concept that there is an interaction between inputs from different afferents which help determine the presence and severity of pain, and the presence of ascending and descending interconnections within the spinal cord (Price, 1988). This was probably the first departure from the concept of a straight through pain pathway which was later followed by the more complex current models of pain perception.

Limitations of the Neurophysiological Theories

Changes in the basic conception of pain arose when the sensory models of pain fell short in explaining clinical observations. The two main observations were that psychological factors affected pain perception and that surgical and chemical attempts to interrupt the pain pathway often failed to reduce pain.

The first evidence of psychological factors affecting pain perception came from the now classic study by Beecher (1959). This study demonstrated a large difference in distress response by people with similar wounds but in different situations. Beecher reported that, of 150 men wounded in battle, only 32% requested pain relief. This is contrasted with civilian patients with similar surgical wounds made under anaesthesia, of these 83% requested pain relief. The sensory model of pain is based on the assumption that pain perception is directly related to extent of damage, and fails to explain this large difference in distress by people in different settings.

Beecher's study illustrated that there was at least one psychological factor involved in pain perception, and opened the door for other psychological factors to be investigated. Subsequent studies have identified a number of variables which can effect perception of pain. These factors include past experience, culture, feelings of control, anxiety, and

cognitive factors such as attention (Price, 1988). The fact that all of these variables are able to affect pain perception argued against a direct correspondence between stimulus intensity and pain intensity. Clearly, a theory which incorporated a variety of psychological factors was needed.

The second body of evidence resulted from clinical observations of the failure of medical attempts to interrupt the pain pathway. Based on the sensory theory of pain all that was needed to cure pain symptoms was the interruption or blocking of the pain messages along the neural pathway. With the increased understanding of the nervous system, the development of potent analgesic preparations, and the newly available surgical procedures, the eradication of pain should have been possible (Turk & Rudy, 1986). The clinical observations were not supportive, in fact many patients continued to report pain after the disruption, blocking and severing of pain pathways, and patients reported widely varying benefits from identical medical treatments (Price, 1988).

Thus, although the sensory theories have contributed through advances in the understanding of the nervous system and the sensory aspect of pain, they left no room for psychological factors to be considered. This paradigm lead to a dualistic understanding of pain, either there was an organic cause to pain in the body, or it did not exist and was all in the mind. If patients complained of pain without organic evidence they were labelled as malingerers and/or sent to a psychiatrist (Melzack, 1993).

Current Theories of Pain Processing

A multi-dimensional view which incorporated neurophysiological knowledge, psychological factors, and accounted for the clinical observations of pain was needed. The main theory of pain which developed to synthesise these elements was The Gate Control Theory. It was proposed by Melzack and Wall in 1965 and, although it has

been modified and other models proposed since then, it remains influential in current thinking.

The Gate Control Theory

The Gate Control Theory (GCT) combined the available facts from the clinical literature and from neurophysiology to produce a unified model of pain. The main proposal of the GCT is that the flow of nociceptive impulses from peripheral nerves to the CNS can be modulated by a gating mechanism (Melzack, 1993). This mechanism is located in the substantia gelatinosa of the dorsal horns in the spinal cord. The gating mechanism is controlled by the balance in the amount of activity in the small and large diameter fibres (Melzack, 1993). Activity of large fibres tends to inhibit transmissions or close the gate, while activity by small diameter fibres tends to facilitate transmission or open the gate. This idea appears very similar to the one proposed in the sensory interaction theory described previously (Noordenbos, 1959).

The GCT proposed that the gating mechanism is also influenced by impulses descending from the brain. This component of the theory was based on the clinical research showing a variety of psychological factors which were known to influence pain and on the anatomical knowledge that the dorsal horn was influenced by several descending pathways from the brain (Melzack, 1993). In this way the theory incorporated psychological variables effecting pain perception. It views the brain as not a passive receiver of information from the peripheral nervous system but as an active participant in the pain experience. In other words, there is no simple one to one relay from stimulus to pain perception in the brain. Transmission can be inhibited or enhanced by a variety of factors either originating locally or originating from descending control systems in the brain (Price, 1988).

There have been some modifications over time to specific neural components of the GCT. However, rather than being incorrect, the tenets of the original theory are seen as too general to incorporate the detailed neurophysiological knowledge currently available

on the interaction in the dorsal horns, and the diversity of endogenous pain modulating systems (Price, 1988).

In spite of these limitations however, the qualitative conceptual basis of the GCT has remained inherently accurate and serves as an approximation of the neural processes underlying the transmission of nociceptive information (Price, 1988). The GCT is now generally accepted as the best model for explaining the complexity of pain perception (Weisenberg, 1987). Particularly as this model also recognises the potential of many psychological factors which may impact on the pain experience, and provides a framework for the integration of the sensory, affective, and cognitive dimensions of pain. Since the development of the GCT, behavioural and cognitive theories have been advanced to explain the role of psychological factors.

Current Definition

These changes are reflected in the International Association for the study of Pain's current definition of pain 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 [IASP], 1994, p.210). The definition accepts the idea of multiple dimensions to the pain experience and identifies two components, an affective and a sensory component. Also relevant are the notes on term usage. "Activity induced in the nociceptor and nociceptive pathways by 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" (IASP, 1994, p.210). Thus pain is defined as independent of both the stimulus and actual tissue damage.

Conclusion

The study of pain and pain control has shown extensive progress over the past 25 years (Price, 1988; Weisenberg, 1989). Through attempts to understand pain and how to treat it effectively our understanding of the concept of pain has changed dramatically. It has evolved from a simple neurophysiological signal to a complex psychophysiological

experience. All of the theories reviewed here have added important dimensions to research and thinking on pain. Most importantly is the recognition that pain is a complex multi-dimensional experience.

CHAPTER 3

PSYCHOLOGICAL THEORIES OF PAIN

The treatment of pain over the past 30 years has changed considerably. The development of a multi-dimensional view of the pain experience has opened the door to new avenues for pain control. Treatment approaches for both chronic and acute pain now include, not only pharmacological and surgical approaches, but also physiotherapy, acupuncture, TENS, relaxation, biofeedback, and various other psychological interventions such as cognitive and behavioural strategies. This chapter will include a brief description of the psychological theories of pain underlying these strategies, with an emphasis on the rapidly growing area of cognitive theory in pain perception. This will be followed by a more in depth review of the literature concerned with the cognitive coping strategies and the criticisms of the research.

Psychoanalytic Theory

The psychological theories and treatments which developed prior to the GCT reflected the belief of a mind-body split which reigned at the time. From about 1940 to the mid 1960s it was the psychoanalytic theory which dominated explanations of pain that defied organic diagnosis and treatment (Price, 1988). From this perspective, pain was seen as a defence against unconscious psychic conflict (Gamsa, 1994). Accordingly emotional pain or disturbance finds its expression in physical pain symptoms. Several psychoanalytical theorists offered models to explain how these disturbances were changed into bodily pain.

Psychoanalytic Research

A large body of literature examines a broad range of problems such as: repressed hostility and aggression, rigid superego, guilt, resentment, defence against loss or

threatened loss, early childhood deprivation or trauma, masked depression, neuroticism, and a number of personality disorders (Gamsa, 1994; Swanson, 1984). Psychoanalytic theory also led to a body of research investigating psychosocial variables as possible aetiological factors in chronic pain. Those factors investigated include number of siblings and birth order, problems in early family relationships, marital maladjustment, personality disorders, and depression. Recently Gamsa (1994) reviewed the research on psychoanalytic models and concluded that, although there are some positive results in investigations of psychosocial variables, in general the ideas have not been confirmed.

However the work in this area did call attention to the important influence of a variety of psychological factors. This was at a time when the sensory models of pain were the rule, but it was becoming progressively obvious that these models were lacking in the complexity necessary to explain the clinical and research findings available.

Behavioural Theory of Pain

During the late 1960s behavioural theories in psychology became popular. Following the inception of the GCT, an explanation of the role of psychological factors in pain from a behavioural perspective developed. From this perspective, pain is defined as the overt behaviours associated with it. Accordingly then pain is operationalized as overt "pain behaviours" such as facial expressions, verbal reports, avoiding activities, etc. (Turk & Rudy, 1986).

Fordyce (1976; 1982) developed a behavioural model of pain which describes the progression of pain behaviours from respondent to operant. Respondent pain behaviour is the reflexive response to a stimulus (body injury). The respondent pain behaviours may in time become operant in nature through the process of learning. This may occur even in the absence of nociceptive stimulation (Turk & Rudy, 1986). Secondary gain, or environmental reinforcement of pain behaviours such as: avoiding undesirable activities or increased attention from family members, results in the pain behaviours

persisting and/or increasing. The operant pain behaviours can also be learned by observing pain behaviour "models" in others and therefore can occur in the absence of any initial tissue damage (Craig, 1978). In some ways the behavioural model of pain continued the tradition of a split between mind and body in models of pain. As respondent pain is very similar to sensory pain (physical) and operant pain does not refer back to nociception (Gamsa, 1994).

Behavioural Research

Evidence for the behavioural view of pain can be found in laboratory studies which show that pain behaviours can be increased through positive reinforcement, decreased if they are ignored, and well behaviours reinforced (Craig, 1987; Turk & Rudy, 1987). Also, Craig (1987) reviewed numerous studies in which participants observed models showing high and low pain tolerance. The results demonstrated the important role of observational learning in response to painful stimuli. The high prevalence of pain and illness in family members of pain patients, and studies which show that members of a family often share similar types and/or sites of pain, have also been cited as evidence for observational learning (Turk & Rudy, 1987).

A number of clinical studies provide evidence for the efficacy of behavioural based pain management (Fordyce, Roberts, & Sternbach, 1985, Turk & Rudy, 1987). Management of pain from this perspective is aimed at abolishing "pain behaviours" such as avoiding activities, bed rest, and taking medication, while simultaneously increasing "well behaviours" such as increased activity and returning to work. These operant programs use changes in contingent reinforcement to accomplish the goal of eliminating pain behaviours.

Criticism of Behavioural Theory and Research

While the operant programs may improve the quality of life in some patients as

indicated by studies reporting their efficacy, they have been criticised for ignoring the patient's experience of suffering (Gamsa, 1994). Clearly the criteria for success do not include any consideration for decreasing individuals' perception of pain, only their overt reaction to it. Also questions have been raised at the long term efficacy of these programs; as the patients return to their own homes will the gains be maintained? This is an area which requires further investigation.

The behavioural theory of pain appears to be somewhat too simplistic and linear in its explanation of pain. It disregards the cognitive and affective components which are clearly identified in the current definition. However, it has contributed to pain theory, not only by identifying the role of environmental reinforcers in maintaining pain, but also in the introduction of carefully designed controlled procedures and laboratory methods (Gamsa, 1994).

Cognitive Theory of Pain

Since the 1970s the cognitive approach has increasingly been applied to both theoretical and clinical pain issues. This is consistent with the current trend in many fields of psychology to look to cognitive factors for explanations of experiences (Weisenberg, 1987). According to the cognitive perspective, individuals are viewed as active processors of information (Turk & Rudy,1992). From this perspective the perception of an event is influenced by an individual's interpretation of it, as well as the characteristics of the event itself.

People bring to the pain experience their own beliefs and expectations which, according to the cognitive approach, will influence their perception of the pain. For example, two individuals who experience equivalent nociceptive input may experience considerably different suffering depending on the meaning or interpretation. If one views the nociception as signalling life-threatening illness and the other as minor injury, their

cognitions, not the stimulus, lead to the difference in pain experience (Turk & Rudy, 1992).

According to the cognitive theory, peoples' interpretations of nociception can not only affect their perception of pain but also directly and indirectly effect physiological processes which in turn effect nociception and may maintain or aggravate pain (Turk & Rudy, 1992). The direct effect of interpretations on physiology may occur by increasing autonomic and sympathetic nervous system arousal. In turn, this may lead to physiological changes such as increases in muscle spasm. The indirect effect could occur through reducing physical activity, leading to reduced muscle flexibility and strength. Both would result in a subsequent increase in the nociception experience. Therefore a circular relationship between cognitive interpretations, physiology and nociception is proposed. If it is accepted that pain is a complex experience involving sensory, affective, and evaluative components, as outlined in the current definition of pain and theGCT, then an understanding of the cognitive variables becomes critical.

Cognitive Research

Researchers have examined a number of specific types of cognitive experiences relevant to pain perception such as; focus of attention, beliefs, attributions, expectations, coping self-statements, images, problem solving cognitions (Turk & Rudy, 1992), self efficacy and personal control (Gamsa, 1994). Cognitive coping strategies have been developed which are intended to influence pain through one or several of these cognitive variables. This is in contrast to behavioural techniques which modify overt behaviour or physical interventions which attempt to impact on the sensory path (Fernandez & Turk, 1989).

The general consensus of a number of recent reviews is that cognitive coping strategies can positively effect the perception of pain. Fernandez and Turk (1989) used a meta-analysis to examine 52 studies of cognitive strategies to control pain. In terms of overall efficacy they 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 can be compared with 50% reported by Tan (1982) in his narrative review. Fernandez and Turk (1989) also reported on a comparison of cognitive techniques to expectancy (placebo): 83% of the studies showed cognitive strategies to be superior. They conclude that cognitive strategies significantly reduce pain, over and above the effect of placebo. Turk and Rudy (1992) concur with this conclusion in their summary of the research. They conclude that there is an abundance of studies demonstrating the importance of cognitive activity in pain perception.

Criticism of Cognitive Research

In fact, although there is a wealth of research demonstrating the efficacy of the many cognitive coping strategies for pain, this research has been criticised for two reasons. Firstly, studies have been based largely on perceptions of induced pain in laboratory settings (Eccleston, 1995a). A lack of studies investigating the effects on clinical pain have been identified by several writers (Cioffi, 1993; Eccleston, 1995b; Gamsa, 1994; Turk & Rudy, 1992). Also, reviews of the clinical research by Turk, Meichenbaum, and Genest (1983) and Weisenberg (1989) have reported far less consistent results. However they explain these inconsistencies in terms of the use of different research designs and procedures across studies.

The other main criticism pointed out by Turk & Rudy (1992) is that research of cognitive strategies is based on the assumption that cognitive strategies are relatively independent. Therefore little attention has been focused on investigating the overlap between them. Without comprehensive definitions of the various strategies it is difficult to ascertain in many studies what is actually being investigated. Fernandez and Turk (1989) also emphasised the difficulties which arise from terminological inconsistencies. They use the example of three studies which used the same cognitive strategy but labelled it as; "selective attention" , "incompatible imagery", and "a strategy inconsistent with pain" (Beers & Karoly, 1979; Spano, Horton & Chaves, 1975; Thelen & Fry, 1981 all cited in Fernandez & Turk, 1989). The difference being only in the experimenter's understanding of the mechanisms at work.

More recently Eccleston (1995a) has suggested that often when experimenters intend to use the same strategy or procedure, the instructions given to participants vary widely. This is a potential source of variance when comparing studies.

Classification of Cognitive Strategies

Several writers have attempted to design a classification system which adequately covers and distinguishes between the large number of cognitive variables. The difficulty in doing this is that many of the strategies involve overlapping aspects and there is often no understood definition of terms (Eccleston, 1995a; Turk & Rudy, 1992). Some of the possible classifications are outlined in Table 1. This clearly illustrates the need for comprehensive definition of the various cognitive strategies, as several strategies could be allocated into contrasting categories depending on the classification system used.

In general, the research shows that many of the cognitive coping strategies have been successful in reducing pain perception. However, it remains unclear which strategies are most effective and which components are necessary for success. A major problem with the research to date is the lack of an accepted classification system for the cognitive strategies reported on. The strategies of interest to this study are attention based strategies. The following chapter will review the relevant theories of attention and the literature in this area.

TABLE 1: PROPOSED CLASSIFICATION SYSTEMS FOR COGNITIVE COPING STRATEGIES

SOURCE	NATURE	DIVISIONS
Rosenteil & Keefe, 1983.	Empirically derived, three clusters used by chronic low back pain sufferers.	1. Cognitive coping and suppression (reinterpreting and ignoring pain). 2.Helplessness (passive strategies like catastrophising). 3.Diverting attention and praying (focusing on things external to pain).
Turk, Meichenbaum, & Genest, 1983	2 Arbitrary categories	1.Altering appraisal (suggestion) 2.Diverting attention (distraction)
Fernandez & Turk, 1989	Empirically derived, multi-dimensional scaling. Six categories along three dimensions of: 1.Sensation acknowledgment 2.Coping relevance 3.Cognitive behavioural focus	1.External focus of attention 2.Neutral imagery 3.Pleasant imagery 4.Pain acknowledging 5.Rhythmic cognitive activity 6.Dramatised coping or reconstruction
Turk & Rudy, 1992	Based on theory of three cognitive constructs	1.Cognitive schema 2.Cognitive processes 3.Cognitive content

CHAPTER 4

THE ROLE OF ATTENTION

While research has demonstrated the importance of cognitive strategies in the perception of pain, the previous chapter illustrates the need to isolate clearly defined components of these strategies and their relative effectiveness. Attention, the variable of interest in this study, is one element which is included either explicitly or implicitly in many cognitive strategies for pain management. Both common sense suggests, and cognitive theorists recognise, the potential for attention diversion or distraction to reduce pain (Leventhal, 1992).

There are a large number of studies reported in the literature which illustrate such a positive effect (eg. Anderson, Baron, & Logan, 1991; Devine & Spanos, 1990; McCaul & Haugtvedt, 1982). However there are also a number of studies which found that distraction failed to reduce pain (eg. Cioffi & Holloway, 1993; McCaul, Monson & Maki, 1992). In order to untangle the meaning of these equivocal results, the next section will briefly outline the relevant theories of attention, and their relationship to pain perception. This will be followed by a discussion of the research to date and an outline of the criticisms raised in recent reviews.

Attention Theories

Capacity or Resources Theory

The theory of attention which has had the biggest impact on pain research is the capacity theory (Kahneman, 1973). According to this theory, attention has a finite capacity and in cases of competing stimuli, people must filter out part of the incoming stimuli selectively (Fernandez & Turk, 1989). William James (1890, cited in Fernandez

& Turk, 1989) was the early proponent of the idea of the voluntary control of attention. James saw attentional control as an effort similar to physical effort. He compared moving the mind with moving the muscles. Just as the muscles might operate on reflex, similarly attention could be moved in various directions involuntarily as well.

The capacity theory assumes a general purpose information processing system of limited capacity (Kahneman, 1973). In terms of the analgesic qualities of attention distraction, complying with a distraction task requires the utilization of this information processing system, which will then reduce resources available to process pain (Farthing, Venturino, & Brown, 1984). According to the capacity theory, the awareness of pain is reduced to the extent that attention (information processing resources) is directed to other stimuli (Kahneman, 1973).

Multiple Resources Theory

The more recent special or multiple resources theory of attention assumes that the performance of different cognitive tasks requires the use of different specialised resource pools, rather than the utilization of a single general purpose processing system (Farthing et al, 1984). Accordingly, two tasks interfere with one another only to the degree that they compete for the same limited capacity specialised resource pools. Furthermore, some of the specialised resource systems operate with conscious awareness and use more resources, while others operate without awareness requiring little attention or processing resources. These modes of information processing have come to be known as controlled and automatic processing.

Controlled Processing.

Shiffrin and Schneider (1977) describe their theory of information processing based on two processing modes: controlled and automatic. Controlled processing requires effort and attention. It is highly demanding of attention capacity; is easily altered by the person; and so is useful in dealing with novel or changing information. An example of

controlled processing is when a person first learns to drive a car. All attention needs to be focused on the individual steps of changing gears, operating the clutch and steering.

Automatic Processing.

Alternatively, automatic processing is a fast fairly effortless process which is not under direct subject control, and requires few information processing resources. It is common in well developed skilled behaviours. Automatic processing requires little awareness or initiation and is often difficult to suppress. An example of automatic processing is a skilled driver who can talk, read the street signs, and change gears while driving yet will have difficulty suppressing the movements to change gears when driving an automatic car.

Summary

To summarise, the application of the attention theory to pain research is based on the assumption that pain perception requires attentional resources. The capacity theory of attention suggests that attentional strategies will be effective due to their capacity to limit the processing of pain stimuli by consuming part of the finite amount of information processing resources. Furthermore the specialised resources theory suggests that the effectiveness of an attentional strategy to influence pain perception will be determined by the degree to which they compete for the same specialised resource pools. Additionally, in order to continue to require information processing resources, the attentional strategy must remain a controlled processing task.

Research on Attentional Strategies and Pain

As stated earlier, many studies report that attention based cognitive coping strategies have positive effects on pain. They have been found to be effective in reducing the reported intensity of experimenter induced pain (eg. Arntz, Dressen & Merckelback 1991; Devine & Spanos, 1990; and McCaul & Haugtvedt, 1982) and increasing threshold and/or tolerance to induced pain (eg. Hodes, Howland, Lightfoot & Cleeland,

1990). However, despite the strength of these and a large number of other studies, the overall results are less conclusive. Some studies have failed to find a positive effect on either pain tolerance or pain reports (eg Cioffi & Holloway, 1993; Dubreuil, Endler & Spanos, 1987; and McCaul, et al., 1992).

Recently several reviews have been published which provide a good overview of the research in the area (Tan, 1982; Fernandez & Turk, 1989; McCaul & Mallot, 1984; Eccleston, 1995a). Tan's narrative review (1982) reports overall equivocal results and he emphasises the need for more studies of clinical pain. McCaul and Mallot (1984) also narratively reviewed studies of distraction and coping with pain and found that distraction produced greater reductions in reported pain and pain tolerance than control and placebo conditions. Fernandez and Turk (1989) report that attention distraction strategies were among the most effective of the cognitive strategies they examined. Based on this and more recent evidence, Eccleston (1995a), acknowledges that attention based cognitive coping strategies can be effective in reducing pain tolerance or pain reports.

In addition to the laboratory induced pain studies, some research has been completed using both acute and chronic clinical pain. The studies concerned with acute clinical pain generally support the pain controlling role of attention diversion (eg. Gonzalez, Routh, & Armstrong 1993; Routh & Sanfilipp 1991).

In the area of chronic pain the results are not as consistent. In most studies on chronic pain, researchers have investigated patients use of different coping strategies (Keefe, Dunsmore, & Burnett, 1992). The three main measures used are; the Coping Strategies Questionnaire (Rosentiel & Keefe, 1983), Vanderbilt Pain Management Inventory (Brown & Nicassio, 1987) and the Ways of Coping Checklist (Folkman & Lazarus, (1980). For example Rosenstiel and Keefe (1983) found that chronic low back pain sufferers who scored highly on a attention diversion factor tended to report more pain and functional impairment. Turner (1991) presents a comprehensive review of the

literature on coping and chronic pain with two main conclusions. The first is that chronic pain patients who remain passive or who use catastrophizing, ignoring and reinterpreting, attention diversion, and praying and hoping as coping strategies typically have high levels of physical and psychological disability. The second is that patients who rate their perceived control as high, or rely on active or attentional coping, function much more effectively.

It would seem from this research therefore, that distraction from chronic pain is associated with increased functional impairment and pain reports. However as noted by Turner (1991) this relationship is correlational, making it difficult to determine whether coping strategy alters pain and disability or vice versa. Furthermore, the concept of coping strategy used in these studies is not clearly defined. The concept covers not only patients reactions to pain, but also their beliefs about pain and their own ability to cope (Keefe, Dunsmore, & Burnett, 1992).

In summary, attention based cognitive coping strategies are found to be effective in reducing pain perception in a large number of laboratory studies. The results using acute clinical pain are also positive but studies of coping with chronic pain are less supportive.

Distraction as an Attentional Strategy

In much of the research focused on attentional strategies the strategies chosen have been multi-component tasks. Labels are often used to describe overlapping strategies (McCaul et al, 1992). One form of attentional strategy frequently investigated is labelled as distraction. Distraction tasks can require attention to be either internally directed, such as imagining a scene (Devine & Spanos, 1990) or performing mental arithmetic (Hodes, Howland, Lightfoot, & Cleeland, 1990), or externally directed, such as watching slides (Maltzman, 1988) or playing video games (Williams & Kinney, 1991). Although all are referred to as distraction tasks they can differ in a number of

ways other than direction of attention. They might differ in the sensory mode used, for example auditory vs. visual; the emotional content of the task, in terms of the content of the imagery or the slides; and the necessity of a response, for example when playing games. At times cognitive strategies involving a component of reinterpretation have been labelled as distraction (Williams & Kinney, 1991). An example might be an imaginal task which involved imagining a hot desert scene with the cold water of the cold pressor to be perceived as refreshing (Devine & Spanos, 1990). It is clear that a variety of multiple component tasks have been investigated under the label of distraction.

Elements of Distraction Tasks

More recently, investigators have begun to examine and identify the elements necessary for distraction to succeed and be most efficient (Leventhal, 1992). Some of the components studied include: demand on attentional capacity (McCaul et al., 1992), similarity to pain task, inclusion of an overt response (Williams & Kinney, 1991), and inherent mood (McCaul & Mallot, 1984). Studies have also investigated variables such as the effect of distraction at different pain levels (McCaul & Haugtvedt, 1982, Dubreuil et al., 1987; Devine & Spanos, 1990) and effectiveness of distraction over time (Cioffi, 1993).

Leventhal (1992) points out the importance of investigations which attempt to isolate a single component of what is often a complex experimental or clinical strategy. By isolating single components researchers will identify additional components which may be necessary for distraction to work. Not only will this enhance our understanding of the pain experience, but also lead to the generation of more efficient interventions for acute and chronic pain (Leventhal, 1992).

Demand on Attention

A study by McCaul et al. (1992) investigated the analgesic affects of neutral distraction tasks which differed in their demand on attention. They found that the tasks with greater attentional demand failed to reduce physiological, self-report, or behavioural responses to the cold pressor task. McCaul et al.'s results call into question one of the basic assumptions of attentional theory (Leventhal, 1992). That is, the greater the demand on information processing resources, the more effective will be the distraction strategy (McCaul & Mallot, 1984). They conclude that distraction alone is insufficient to reduce pain and distress, another variable must be added.

Active Distraction

Another component which has been isolated for study is the need for an overt action in distraction strategies. The literature on coping and chronic pain discussed previously suggests that active coping strategies are associated with better functioning and lowered pain reports, while passive strategies are associated with impaired functioning and increased pain reports. As stated earlier, these studies indicate a correlational rather than causal relationship. However they do indicate that one element of distraction worthy of investigation is the difference in passive versus active strategies. Although, in the coping literature, attention distraction along with ignoring are labelled as passive strategies (Turner, 1991), it would seem from the experimental literature that distraction is not always passive. The literature makes a distinction between simply ignoring or suppressing pain and distracting attention to another stimuli (Cioffi & Holloway, 1993). A wide variety of multi-component tasks have been investigated under the label distraction. As discussed earlier they have differed in a number of ways. Some tasks require action whether it be arithmetic (Hodes, et al., 1990) or playing a video game (Williams & Kinney, 1991), while others only provide an alternative focus for attention such as viewing a video (Williams & Kinney, 1991).

Williams and Kenny (1991) evaluated the effectiveness of an overt performance based task versus non-performance based tasks of verbal-imaginal and relaxation strategies. Their hypothesis was that a distraction task which required subjects to overtly perform or respond would be more attentionally demanding and therefore more effective. In the study the treatment conditions were: (1) overt performance distraction in which participants played a small pocket electronic game called "Popeye", (2) verbal-imaginal distraction in which participants were instructed in three different strategies: refocussing attention by concentrating on engrossing mental activities; imagining pleasant scenarios; or dissociation, imagining the hand in the water does not belong to them, and (3) relaxation in which participants were instructed in relaxing themselves through deep breathing and tensing and untensing of muscle groups. They reported that the overt performance strategy enhanced pain tolerance substantially more than either the verbal-imaginal or relaxation strategies.

Unfortunately the conditions in Williams and Kinney's (1991) study were multi-component. They differed in terms of the demand on attention and emotional content as well as the inclusion of overt performance. The distraction tasks used in the current study are designed to isolate the performance component

Criticism of the Attentional Research

Eccleston's (1995a) review of the literature attempts to explain the equivocal results of studies of attentional control in terms of four possible sources of variance: (1) the pain induction method used, for example cold pain versus pressure pain; (2) the instructions given, for example 'leave your hand in the water as long as you can stand it' versus 'as long as you feel you want to'; (3) method of pain measurement used, for example tolerance versus threshold; (4) complex strategies which may be labelled as distraction but differ in other ways. Eccleston concluded that any comparison between studies may be difficult. He suggests that not only should care be taken to avoid variance in these

areas, but also that, where possible, the researcher should report all parameters of the experiment.

Cioffi (1991) also has identified a weakness in the research in the area of distraction. She suggests that the possible longer term costs of distraction strategies have been ignored due to the focus on immediate tolerance or pain reports. Cioffi hypothesises that attempts to avoid pain through distraction strategies may carry with them negative repercussions similar to those encountered by attempts to avoid unwanted thoughts. The interest in the effect of avoiding unwanted thoughts or thought suppression results from Wegner's extensive work in the area of mental control. Thought suppression and its role in pain perception is discussed in the next chapter.

CHAPTER 5

THOUGHT SUPPRESSION

Cognitive coping strategies have in general been accepted as a valuable component in the treatment of both acute and chronic pain. The most common strategies appear to involve attentional manipulation. However more recently it has been suggested that a dramatically different analysis of attention strategies and particularly distraction be considered. Cioffi and Hollaway (1993) reconsider distraction from pain in terms of the research and theory of mental control and thought suppression. This view suggests that pain can persist, not in spite of mental efforts to avoid thinking about it, but because of them. In other words, physical discomfort may be prolonged precisely because of the attempt to suppress or distract from it.

In Cioffi and Holloway's study (1993) they examined the possible costs of avoidant mental strategies during physical discomfort. The results suggested that attempts to suppress awareness of physical pain may result in subsequent increases in pain. Also avoidant strategies may lead to the negative interpretation of a subsequent somatic experience. The possible long term repercussions of the cognitive strategy of distraction have been neglected, prior to Cioffi and Holloway's study.

This chapter will give a brief background on theory of thought suppression and the research supporting it, followed by a discussion of the implication for distraction and suppression in coping with pain and a critical review of Cioffi and Holloway's study.

Development of Mental Control Theory

Wegner's theory of thought suppression (TS) originates from the literature on mental control. Mental control, although not a new concept, is a relatively new term. It refers to people's attempts to control their own minds or mental states. Mental control is

defined as the mechanism at work when people suppress a thought, concentrate on a sensation, inhibit an emotion, maintain a mood, stir up a desire, or squelch a craving (Wegner & Pennebaker, 1993).

Historically, mental control has been studied under different labels in psychology. Mental control (MC) has been viewed as: the ability to attend, an unconscious defence, a method of self regulation, a personality characteristic (ie. strong and weak willed), a coping technique in response to stressors, and as a means to socially appropriate behaviour (Wegner & Pennebaker, 1993).

From this multi-dimensional beginning the core concept of MC has been generated: people have reasons to want to influence their own mental state and they commonly try to do so (Wegner & Pennebaker, 1993). MC often involves avoidance of an undesired thought or emotional state, referred to as cognitive avoidance. Cognitive avoidance can be thought of as either automatic (unconscious) or strategic (deliberate) and is a term used to include a number of processes such as repression, distraction, dissociation, rationalisation, and emotional numbness (Lavy & van den Hout, 1994). Thought suppression is one method of strategic cognitive avoidance and has become the experimental model for cognitive avoidance research (Lavy & van den Hout, 1994).

Theory of Thought Suppression

The mechanism behind TS was proposed by Wegner (1989). He points out that the task of suppressing a thought contains in it a natural paradox (Wegner, 1992; Wegner & Erber, 1992). The hypothesis is that, in order to suppress a thought, one must first plan to suppress a thought, and then carry out that plan by suppressing all manifestations of the thought, including the original plan (Wegner, Shortt, Blake & Page, 1990). Thus the paradox of knowing and not knowing simultaneously.

As Wegner admits, Freud was the first to recognise this paradox and make it theoretically possible both by his concept of the unconscious and by further specifying that the unconscious was capable of performing the TS for consciousness. Although the unconscious could not remove the thought from itself, and conscious could not remove the thought for itself either, the unconscious could perform this task for the separate conscious part of the mind. This psychoanalytic emphasis on such unconscious repression has gradually receded and more recent research in the area suggests a straight forward cognitive mechanism (Wegner, Schneider, Carter & White, 1987).

Basically the mechanism described by Wegner is that in order to avoid or suppress a thought people often use the strategy of focusing on various aspects of the present environmental context (external distractors), or on items stored in memory (internal distractors) (Kelly & Kahn, 1994; Wegner, 1992; Wegner et al, 1987; Wegner et al., 1990). This strategy has been described as unfocused, self directed distraction. Often people choose a distractor and when it fails, move on to another. Because suppression is difficult, a large number of distractors are sampled (Wegner, Schneider, Krutson, & McMahon, 1991). While suppressing the thought the person is continually checking they are not thinking about it. This continuous checking increases vigilance to the target thought. The many distractors which are also in the persons mind come to be linked to the thought as they are known as something that is not that thought. Therefore the distractors used may actually remind the individual of the thought (Wegner, 1989, 1992). At a later time there are many potential reminders or triggers for the unwanted thought. In this way trying to exclude thoughts from consciousness may actually make the thoughts even more intrusive (Wegner, 1992). Wegner has called this paradoxical resurgence of unwanted thoughts following one's attempts at suppression the "rebound effect".

Wegner's theory is based on three main assumptions:

1. That people have unwanted thoughts and attempt to avoid (suppress) them.

2. That people use external and internal distractors to avoid the thought and this is difficult, at least initially.
3. That the distractors become reminders of the thought and suppression is followed by a rebound effect.

Research Supporting Wegner's Theory

1. People have unwanted thoughts, and attempt to avoid them.

The idea that people have unwanted thoughts and attempt to avoid them through suppression has been recognised as a long serving concept in psychology (Wegner, et al., 1990; Wegner, et al., 1987). Common experiences reported by people and cited in the literature include: trying not to think about an upcoming stressful event, avoiding thoughts of smoking while trying to quit, putting persistent thoughts of lost love out of mind, (Wegner et al, 1987), thoughts of humiliating failure at work, inappropriate sexual impulses, thoughts of food during a diet, memories of traumatic experiences, a secret one must not divulge, and thoughts of a physical symptom which could point to grave illness (Wegner et al, 1990).

Other illustrations reported in the literature include; social interaction when one may desire to suppress thoughts as an aid to deception, self-presentation, or the self-control of prejudicial thinking (Wegner, et al., 1990).

Thought suppression has been found in survey studies to be very common in non-clinical populations. Kelly and Kahn (1994) discuss one study of college students that found 99% of subjects reported having tried on occasion to suppress disturbing thoughts to avoid the emotions associated with them.

2. That people use distractors to suppress their thought and that this is difficult, at least initially.

The main method of research in TS uses a recording of participants' reported stream of consciousness to examine the cognitions or thoughts associated with TS (Wegner et al,

1990; Wegner et al, 1991; Wenzlaff, Wegner, & Roger, 1988). It is commonly reported in these laboratory studies that people engaged in TS report on a number of external and internal distractors but find their mind returning almost constantly to the target thought, until, over time, more effective distractors are found. At this point the thought is reported less frequently and eventually success is achieved. The now classic white bear study by Wegner et al, (1987) illustrates this phenomenon. In this research participants were asked not to think of a white bear but to ring a bell if they did. Over a suppression period of five minutes participants indicated both by mentions of the white bear, and by bell rings, that they were unable to suppress the thought.

In a more recent study by Lavy and van den Hout (1994) using the suppression of thoughts of numbers in a discrimination task, this difficulty was again illustrated. The suppression group attempted to suppress thoughts about numbers and to distract themselves from this subject, but despite this effort they were more distracted by the number words in the test and spent more time thinking of numbers than did the control subjects. This result was a replication of earlier findings by Lavy and van den Hout, (1990).

3. That the distractors become reminders and suppression is followed by a rebound effect.(Wegner, 1989, 1992).

The idea that trying to exclude thoughts from consciousness may actually make the thoughts more intrusive or cause a rebound effect has been investigated extensively in recent literature (Kelly & Kahn, 1994; Wegner et al, 1991; Wenzlaff, Wegner & Klien, 1991). There appears a degree of unanimity in the conclusion that attempts to suppress experimenter provided thoughts (ie white bears) are followed by a period of thought resurgence (Kelly & Kahn, 1994; Wegner et al, 1987; Wegner et al, 1990; Wegner,1992). For example, in Wegner et al's (1987) white bear study, after an initial period of suppression participants were asked to think about the white bear for a five minute period. These participants reported significantly more thoughts of white bears than the control group who were asked to think of the white bear from the beginning.

However, although the rebound effect has been theorised to apply to people's own intrusive thoughts, most of the empirical work demonstrating this phenomenon has involved experimenter provided stimuli (Kelly & Kahn, 1994). People's intrusive thoughts differ from those provided by the experimenter in terms of their emotional content, ease of imagination, complexity, familiarity, and how much practice people have suppressing them (Kelly & Kahn, 1994; Wegner & Zanakos, 1994).

In a study by Wegner and Gold (1992) using thoughts of a previous romantic partner results were mixed. The results showed a rebound only for those subjects who suppressed thoughts of a no longer desired partner.Subjects asked to suppress thoughts of a still desired partner showed no rebound. Kelly and Kahn's (1994) report that, although they did find a rebound with experimenter provided thoughts, when they asked subjects to generate either their own most pleasant or most unpleasant intrusive thought, they found no rebound. Several other studies using participant generated thoughts report that no rebound was found (Rutledge, Hollenberg, & Hancock, 1993).

In a related study, Macrae, Bodenhausen, Milne, and Jetten (1994) investigated the degree to which the rebound effect extended to unwanted stereotypical thoughts about others. Their results provide strong support for the existence of this effect. Also a recent study by Salkovski and Campbell (1994) investigated TS and rebound effects in personally relevant negative intrusive thoughts with positive results. Clearly there is laboratory research both supporting and refuting the applicability of the rebound concept to personally intrusive thoughts.

Research on the Rebound Effect

The negative repercussions of TS have been investigated in a large number of field and laboratory studies. The first (prototypic) study in this area (Janis, 1958) showed that individuals who are personally inclined to avoid thinking about an upcoming surgery

subsequently exhibit more anxious reactions to it, although this finding has been interpreted in a variety of ways.

Wegner (1989) demonstrated that suppression produced altered physiological responding. His study showed that suppressing exciting thoughts or displays of emotion leads to increased skin conductance levels. Cioffi and Holloway (1993) found preliminary evidence showing that suppression of pain leads to a rebound of the pain experience. Pennebaker (1985) linked suppressing disclosure of trauma to a number of psychological and physiological problems. Silver, Boon and Stones (1983) found that suppressing disclosure of trauma may hamper effective coping processes. Relapse reactions which people have in attempts to avoid habitual behaviour have been explained by rebound effect (Wegner, 1992). Finally, the rebound of suppressed thoughts has been implicated as a potential cause for the attentional bias to threatening stimuli of people suffering from anxiety disorders (Lavy & van den Hout, 1994).

Several researchers have accepted the rebound effect as a genuine phenomena and continued on to investigate more specific characteristics of it (Cioffi & Holloway, 1993; Wegner et al, 1991; Wegner & Zanakos, 1994; Wenzlaff, Wegner & Klein, 1991). One area studied has been the relationship of environmental cues to the suppressed thought. In Wegner et al's study (1991) the results show a rebound only when the person remained in the original suppression environment. They conclude that the rebound effect is strongly environmentally dependent and hypothesise this may account for some of the variability in self generated TS. Related to this are investigations of participant's mood and its role in the rebound effect (Wenzlaff et al, 1991). In Wenzlaff, et al., (1991) they investigated the idea that during TS the target thought became linked to the current mood. They investigated two related hypotheses: (1) that later occurrences of the mood would promote the rebound of the thought and (2) that later expressions of the thought would lead to the return of the mood. Their results showed support for both of these hypotheses. These two characteristics can be explained by the idea that people sample a large number of internal (mood related) and

(environmental related) distractors which when re-experienced become reminders of the target thoughts (Wegner, 1994).

More recently the theory of TS has been extended to suggest a role in the production of obsessional thought (Wegner et al, 1990; Kelly & Kahn, 1994; Wegner, et al, 1987). Basically the failure to suppress is believed to lead to feelings of failure (Wegner & Pennebaker, 1993) or to meta-cognitions. Meta-cognitions are thoughts about the thinking process. In these meta-cognitions the individual concludes that she or he is unable to control unwanted thoughts. The theory proposes that it is these meta-cognitions which may lead to even more frantic attempts at suppression, which also fail, until the recurring unwanted thought rebounds into a full-blown obsession (Clark & Purdon, 1993). Studies in this area report supportive results (Wegner & Zanakos, 1994; Smari, Sigurjonsdottir, & Saemundsdottir; 1994, Salkovski & Campbell 1994). For example, Trinder & Salkovskis, (1994) examined suppression of unwanted thoughts over a 4-day period under conditions designed to maximise the similarity to those experienced by obsessional patients. Results indicate that suppression increases thought frequency and discomfort and may be important in the development and maintenance of obsessive compulsive disorder.

Thought Suppression and Pain

As mentioned earlier, the theory of thought suppression has been suggested to extend to pain processing. Some researchers have asserted that the act of suppressing pain will lead to the same rebound effects as suppressing intrusive thoughts (Cioffi, 1993; Cioffi & Holloway, 1993; Wegner, 1994). According to Cioffi's (1993) conceptualisation, the perception of pain is identified as the target thought. She suggests that suppression of pain will result in it getting subjectively worse and will influence the subjective experience of a later somatic stimulation negatively, even if this stimulation is not inherently noxious (Cioffi & Holloway, 1993). They also predict that both suppression

and distraction tasks will lead to a rebound, although suppression, because it samples so many potential reminders, more strongly so.

In Cioffi and Holloway's study (1993) participants were asked to either suppress thoughts of pain, concentrate on a imaginal distraction task, or objectively monitor their physical sensations during a standard cold pressor task. Cioffi and Holloway hypothesised that, although the two avoidant strategies (suppression and distraction) would initially increase tolerance and may decrease initial pain reports, these strategies would lead to a rebound during the recovery period. The recovery period in which pain ratings were taken every twenty seconds can be thought of as the expression period. They also predicted that suppression attempts might negatively influence or contaminate the interpretation of a later somatic event. Therefore, subjects would rate a somatic experience more negatively (painfully) following the two cognitive avoidant strategies. According to suppression theory, this contamination is due to the distractors used during suppression becoming reminders of the thoughts of pain, and therefore rebound more intrusively after attempts at suppression (Cioffi, 1993).

Cioffi and Holloway (1993) found initial support for their hypothesis. Although the pain tolerance for the two avoidant groups were not significantly longer, they did show the expected trend towards increased tolerance. The recovery ratings during the expression period for the two avoidant groups showed a slower recovery rate. Finally, the subjects in the suppression group rated the subsequent stimulus as more unpleasant.

Although this study questions the use of avoidant strategies in coping with pain, there are some basic problems with the theory and the interpretation of the results.

Most importantly, to conceptualise pain as a thought is a step backwards theoretically. It has taken much time and research for the theory of pain to grow to recognise it as a multi-dimensional phenomenon with inter-related sensory, cognitive, and affective components. Cioffi's theory appears to be simplifying this.

Secondly, if the avoidant strategies do tend to increase tolerance to the cold pressor task then longer exposure to the cold water must be considered as an important factor in the significantly slower recovery time. In the statistical analysis that Cioffi and Holloway have done, the researchers appear to have failed to control for this physical phenomenon.

Additionally, Cioffi and Holloway define suppression as inhibiting a thought and distraction as replacing one thought with another. However distraction tasks in the literature have ranged from providing alternative focus for attention (both external and internal), to involving cognitive activity, to overt performance activities. This active element to distraction has important implications for the application of suppression theory to attentional coping strategies. Suppression theory suggests that thoughts used as distractors become reminders of the pain and lead to a rebound. It is unclear from this theory whether activities used as distractors would also become reminders of the pain. If it were in fact the case that activities as well as thoughts become reminders then the possibility of rebound would become inevitable for chronic pain patients. Any activity engaged in while the individual is feeling pain would become linked to painful thoughts and lead to increases in pain reports.

The present study will examine the relationship between tolerance time and the rebound effect found by Cioffi and Holloway (1993) taking into account the limitations discussed. The next chapter will describe the rationale and hypotheses of the study. This will be followed by the method , results, and discussion.

CHAPTER 6

OVERVIEW OF THE CURRENT RESEARCH

The two primary aims of the present study were to:

1. Compare the effects of three attentional strategies on two measures of pain.
2. Test for the presence of a rebound effect following the use of avoidant mental strategies.

Comparison of Attentional Coping Strategies

It has been suggested in the research discussed in previous chapters that cognitive coping strategies are important in the modification of pain perception, both in clinical and laboratory settings. One aspect of cognitive coping that is present in many treatment strategies involves attention manipulation. Unfortunately, although there is a great deal of research on attention diversion and pain perception, due to the problems of inaccurate terminology and multi component tasks, it is difficult to identify the necessary and most efficient components or to make inferences about the mode of action.

The present study will compare the effectiveness of three attentional strategies: suppression, distraction through visual detection, and distraction through visual detection with a response. In an attempt to isolate the necessity of an overt response, the first suppression task involves a manipulation only of directing attention away from the pain. Participants are asked to avoid any thoughts of the pain or their hand. The next two tasks are both simple neutral visual detection tasks. The visual detection task was chosen as it is one which has previously been found to be effective in increasing tolerance and decreasing pain reports (Breakwell, 1992; Douglas, 1994). Both tasks involve equal cognitive demands differing only on the single component of overt

response. In the distraction task participants are instructed to direct their attention towards a light and detect changes in it. The second distraction task is identical with the addition of the overt response of pushing a button when they detect the change.

Williams and Kinney (1991) found that a task involving overt performance response produced a larger effect. It is predicted that all three attentional strategies will be effective in decreasing pain perception when compared with the control condition. Moreover, it is expected that the visual detection with a response will be more effective than visual detection task followed by the suppression task.

Hypothesis One

The three avoidant attentional conditions will significantly increase participants tolerance time and may also lower pain ratings when compared to the control conditions.

Hypothesis Two

That the distraction task requiring a response would show a more powerful effect.

Test for the Presence of a Rebound

Recently it has been suggested that attentional strategies, particularly distraction be examined for the presence of a rebound effect. This idea comes from thought suppression theory discussed in Chapter 5. Cioffi and Holloway's (1993) study provides initial support for this hypothesis. They used a slowed recovery time and a more negative rating of a subsequent non- noxious stimulus as evidence for the rebound effect.

However one of the weaknesses previously identified with Cioffi and Holloway's study is their failure to control for tolerance time. If attentional strategies do tend to increase

tolerance to the cold pressor task, then this longer exposure to the cold water must be considered as an important factor in the slower recovery time.

The present study will attempt to replicate Cioffi and Holloway's results using a similar procedure, but with a number of modifications. First we will be controlling for the increased tolerance time resulting from the suppression and distraction in the analysis of the recovery times. It is expected that controlling for tolerance time will decrease or eliminate the difference in rate of recovery between the conditions. Second, this study takes into account the active variable in distraction tasks and therefore investigates suppression (passive task), distraction (active task), requiring both attention to a specific external stimulus, a light, and the detection of changes in the light, and performance distraction (active overt action task), requiring signalling the changes detected in the light.

The method of investigation will be similar to that used by Cioffi and Holloway. This study will use a slowed recovery time and a change in rating of a subsequent moderately painful stimuli as evidence for the rebound effect. The vibration stimulus administered in Cioffi & Holloway's study will not be used. Instead a moderately painful stimuli was chosen rather than a non-noxious ambiguous stimuli. It was hypothesised that it would be more likely to show the rebound effect. As the suppression theory discussed in Chapter five explains, it is the increased vigilance towards the target thought which leads to a subsequent increase in occurrences of the thought. For this reason participants should be more vigilant to noxious stimulation after suppressing the experience of a noxious stimulus.

Research on the characteristics of the rebound effect has found the rebound to be dependent on environment and on mood (Wenzlaff et al., 1991). The mood experienced during suppression becomes linked to the suppressed thought, and later becomes a reminder of it. Therefore, according to suppression theory, the participants mood during the cold pressor becomes a reminder of the suppressed pain and later occurrences

of that mood promote the rebound. If it is accepted, as outlined in the current definition, that pain is "a sensory and affective experience" (ISAP, 1994) then the cold pressor and the iontophoresis should invoke similar affective experiences. Based on suppression theory, this should increase susceptibility to contamination by the rebound effect. The repeated measures design was used as a change in participants rating following the attentional task might be sensitive to this contamination.

Hypothesis Three

The recovery ratings for subjects in the suppression and distraction groups will be slower than the control group. However this effect will be more closely related to time in the cold water rather than assigned task.

Hypothesis Four

The subjects in the suppression and distraction groups will rate the second administration of the iontophoresis as more unpleasant.

Hypothesis Five

The rebound effects will be stronger for the suppression group and may not be present in the distraction groups.

CHAPTER 7

METHOD

Participants

The participants were 74 volunteers recruited by word of mouth, and through approaches to laboratory classes at Massey University. There were 50 females, and 24 males, with a mean age of 22.9 years.

Potential participants were asked to read a brief information sheet (see Appendix A), and complete the consent form and medical checklist (see Appendices B and C). The medical checklist was used to screen for any conditions which might be complicated by the procedure or affect the data obtained.

As a further precaution, participants were screened for cases of rare hypersensitivity to cold, using an ice trial. This involved rubbing an ice cube over a small area of the left arm. The skin was then checked for any unusual manifestations, warning of hypersensitivity (Lehmann & Lateur, 1984). No subjects were excluded using this screen.

Apparatus

Potassium Iontophoresis

The Potassium Iontophoresis was controlled by an IBM personal computer. The pain produced by this procedure was caused by a constant current power source designed to deliver selected amount of current ranging from 0 to 25mA. Intensity levels were selected in .5 mA steps. The amount of potassium ion (K^+) was directly proportional to

the applied current. According to Faraday's law one mA per second of current produced 0.405μg of K^+.

The equipment used was similar to that described by Humphries, Long, and Johnson (1994). The electrodes were attached to the subjects right forearm. The cathode consisted of a silver plate measuring 4 by 13 cm. The plate was covered with several layers of saline-saturated medical gauze (4% w/v sodium chloride) placed against the dorsal surface of the arm. The anode was a silver plate suspended in a plastic bowl which was placed against the palmar surface of the arm. The skin acted as a base for the bowl. This allowed the potassium chloride to be in direct contact with the skin. The surface area in contact with the gel measured 12.5 cm^2.

The Cold Pressor

The cold pressor test involved submerging the hand and lower arm in water kept between 3 and 5 degrees Celcius. This produced an aching pain within 10 to 60 seconds which continued until the hand was removed or until adaptation set in at 2 to 4 minutes. The physiological reactions reported are: elevations in muscle tension, reduction in skin resistance, and heart rate and respiratory irregularities. The cold pressor test was chosen for this study as the method of acute pain stimulation because it can be elicited over a longer period of time while producing no tissue damage and is followed by a recovery period after removal.

To provide a standard hand temperature on entry into the cold water an adapting bath measuring 44cm x 28cm x 17cm deep, was used. It was controlled by a thermostat set at 37^o C (+/-1.0). Participants held their hand in the bath for two minutes prior to the cold pressor.

The cold pressor consisted of a 31cm x 36cm x 18cm deep plastic ice chest which was divided into two parts by a screen. In the bottom of the near half, a bar connected to a

timing device was pressed down by the participants left hand, which also ensured a standard immersion. When the hand was lifted off the bar the timer stopped and the tolerance was recorded. The other section of the chest contained the ice cubes. The water was circulated between the two sections by a pump, and the temperature of the water was maintained between 3 and 5 ^{o} C.

Participants were seated on a comfortable chair to the right of the water tanks. They could easily place their left hand in both containers of water, as well as view the distraction. The left hand was used for the cold pressor as previous researchers have reported that the left hand is more sensitive to pain for both left and right handed people (Murray & Hagan, 1973).

The Attentional Coping Strategies

Three forms of attentional coping strategy were used:

1) *a light detection distraction task*

2) *a light detection with a response distraction task*

3) *a thought suppression task*

1) The light detection distraction task.

A darkened tunnel measuring 610mm long, 250mm wide, and 300mm high was used to view the red distraction light. This insured a consistent amount of background light for all participants. The tunnel was on a pivot to adjust to individual participant height. The light was a disk measuring 15mm in diameter and controlled by an IBM personal computer (PC). The baseline light was programmed to an intensity of 3.0 NITS (candellas/m^2 as measured by a Tetronix J523-21 Narrow Angle Luminance Probe). The PC delivered light pulses which varied in intensity from 4 to 10 NITS at intervals ranging from 5 to 15 seconds. While the participant's left hand was submerged in the cold water they rested their head in the tunnel and watched to detect changes in the light.

2) The light detection with a response distraction task.

This procedure was identical to the light detection distraction task except that it included a response button. Participants used their right hand to press a button each time they detected a change in the light. The responses were recorded on the computer.

3) The thought suppression task.

Participants were instructed to exclude any thoughts of their hand and the pain they were experiencing from their mind. The instructions used were similar to those used by Cioffi and Holloway (1993) in their study of thought suppression and pain, and are described in the procedure section.

The Rating Scales

A single visual analogue rating scale (VAS) was used at several points in this study. The scale measured 15cm and was anchored on the left end with the words 'no pain sensation' and the number '0' and at the right end with the words 'very severe pain' and the number '100'. Participants were asked to respond verbally with a number and this was recorded on their score sheet. The VAS was used after each stimulation during the two ionosphoresis trials, and immediately following the cold pressor test. Following the cold pressor test participants made 6 ratings, one every 20 seconds for 2 minutes.

Procedure

This study is a mixed design. The comparison of the effects of different coping strategies is between groups with one of the dependent variables being changes in pain report with Potassium Iontophoresis. Participants were randomly assigned to one of the four conditions which differed with respect to the task allocated during the cold pressor administration.

Group 1 : control group (no task)

Group 2 : suppression task

Group 3 : visual detection with a response task

Group 4 : visual detection task

All participants attended one thirty minute session. This began when the participants read the information sheet, signed the consent form, and filled out the medical checklist (Appendices A, B & C). This was followed by a brief familiarisation period and then the iontophoresis was explained and the baseline trial completed. The ice pretest and then the cold pressor task were completed. For groups 1, 2, and 3 this was combined with the assigned task. Immediately following the cold pressor test participants had two minutes of pain ratings and then approximately 10 minutes recovery time. The second iontophoresis trial was then conducted, and subjects were thanked and debriefed.

Potassium Iontophoresis Baseline Trial

Participants were asked to first prepare their arm by washing with soap and applying an acetone/90% alcohol solution (1:10v/v). This lowered and stabilised the resistance of the skin. The following procedure was explained:

"The electrodes cup will be attached firmly to your arm and filled with a salt water solution which is made in a gel so that it will not leak. Then the computer will send some stimulus pulses through the wires. These pulses will vary in intensity but they will not damage your skin or arm. We will start with approximately 12 practice trials of two seconds each, and then do the baseline 8 trials. The computer will beep before each trial so that you will know when it is coming. After you feel the stimulus would you please rate it using the VAS scale."

At this time the VAS was explained, (see the next section). Then participants were seated with their right arm resting on a towel with the electrodes in place. A cut off

button was within easy reach of their right hand and it was explained that they could stop the trial at any time by pushing the button. The 12 practice trials were performed to establish an intensity level for each individual which was rated close to the 50% mark on the VAS. From this level a range was established for the 8 stimulus pulses during the two trials by + and - 2μm.

TABLE 2: FORMULA FOR IONTOPHORESIS INTENSITY LEVEL

x = the intensity closest to a rating of 50 on VAS	
trial 1 = x - 2	trial 5 = x - 1
trial 2 = x + 1	trial 6 = x + 1
trial 3 = x	trial 7 = x
trial 4 = x + 2	trial 8 = x -1

The baseline trial was completed with participants rating each stimulus using the VAS.

Visual Analogue Rating Scale

The rating scale was used after each iontophoresis trial. Participants were instructed: "Look at the scale after each stimulus and tell me the number between the two ends, 0 to 100, which best describes the sensation in your arm."

Responses were then recorded for the participants, and the next trial began.

Cold Pressor Test

Participants were asked to first remove all jewellery and watches from their left hand and then they were given a demonstration of the cold pressor and instructed:
"Put your whole hand in the water with your palm pressing down on this bar until it clicks. This will start the timer which will stop when you lift your hand off. Hold your hand in the water for as long as you feel you are able. Then take your hand out and place it on this towel."

Participants were then asked to perform the ice pretest on their left lower arm. They were instructed to take a piece of ice out of the tank and rub it in a small area of the arm to check for any unknown sensitivity or allergy to cold. Following this participants were encouraged to try pressing and releasing the bar.

Participants were then requested to put their hand in the warm water until asked to remove it. The purpose of the adapting bath was explained. The hand was in the water for approximately two minutes. During this time the visual analogue rating scale was explained and demonstrated.

Participants were instructed:
"When you take your hand out of the cold water place it on the towel. Look up at the scale and rate the sensation in your hand. You will be asked to rate the sensation several times over the next two minutes so please leave your arm on the towel."

Just prior to beginning the cold pressor test the participants were read the instructions for the appropriate distraction task.

If participants had not removed their hand after three minutes they were asked to do so. Pain tolerance was recorded from the timing device, as the number of seconds their hand was left in the water before they decided to remove it.

The Attentional Coping Strategies

Light detection task.

The participants were shown how to place their head into the darkened tunnel and the instructions were read.

"This task involves you focusing on the red light in front of you. Right now it is at the baseline brightness. During the cold pressor test this light will brighten and then fade back to it's current brightness several times. You are to concentrate on watching the light and see if you can detect when the light actually does increase. Try and fill your mind with the task of noticing the light. You don't have to keep any record of the changes."

The light detection and response task.

Participants assigned to this group performed the same as the above group; however they were also asked to press a detection button when they did see the light change. These instructions were read:

"This task involves you focusing on the red light in front of you. Right now it is at the baseline brightness. During the cold pressor test this light will brighten and then fade back to the baseline several times. You are to concentrate on watching the light and see if you can detect when the light actually does increase. When it does you are to push this button. Try and fill your mind with the task of noticing the quality of light."

The suppression task.

Participants were instructed as follows:

"This task involves you trying to keep all thoughts of your hand and how it feels out of your mind. Try to eliminate all awareness of your hand sensations. Concentrate on emptying your head of any awareness of your hand and the water."

The Post-Pressor Ratings

After removing their hands from the water and following instructions received earlier, participants placed their hand on a towel and made a rating of their current pain using the VAS. They made six more ratings, one every 20 seconds for two minutes. Participants were then told they had completed the first part of the study and they were invited to wait ten minutes to complete the study by repeating the second iontophoresis trial.

The Potassium Iontophoresis: Trial 2

The procedure for the second trial was identical to the first. Participants were reminded of the baseline trial and told:

"In order to complete the study there will be a repeat of the baseline 8 trials from the beginning. After each stimulus you will once again look at the scale and tell me the number you think best describes the feeling in your arm."

After the trial participants were thanked and debriefed.

CHAPTER 8

RESULTS

Preliminary Analysis

The cold pressor task was used in this study to induce pain. Subjects who reached the three minute tolerance limit and whose initial pain rating was less than 25 on the VAS scale (a rating of 25 is at the one quarter point on the VAS scale), were excluded from analysis. It was assumed that the subjects who met these criteria were experiencing very little pain at the completion of the cold pressor task. Four subjects (2 male and 2 female) met these criteria. Of these subjects two were assigned to the control group, one to the distraction and one to the suppression group. Seventeen other subjects also reached the three minute tolerance limit but their initial rating was above 25 on the VAS scale. Therefore they were not excluded. The criteria for exclusion used were similar to those used by Cioffi and Holloway (1993). Two additional subjects were excluded due to difficulties with the administration of the second iontophoresis trial.

The final analysis therefore included sixty-eight participants (22 males and 46 females) with a mean age of 23 years. Of these participants 17 were assigned to the control group, 15 to the suppression group, 17 to the distraction group and 19 to the distraction with a response group.

Cold Pressor Tolerance

Subjects on average tolerated the cold water for 87.5 seconds (SD=58.5). There was a trend for the suppression and two distraction groups to tolerate the cold pressor procedure longer (Control = 69.6s, SD=54.7; Suppression = 91.7, SD=57.6; Distraction with a response = 92.05, SD=58; Distraction = 96.5, SD=64.5). The

distraction group had the longest tolerance of the four groups. However this trend did not reach significance: $F(3,64)=.7228$, $p=.5421$. These results are consistent with those reported by Cioffi and Holloway (1993), who also found a non-significant trend for suppression and distraction groups to tolerate the cold pressor longer, with the mean tolerance for the distraction group being the longest.

Pain Rating and Recovery

The average pain rating immediately following the cold pressor task was 66.7 on the VAS scale. The group means were: Control = 66.2, SD=23; Suppression = 65.9, SD=20.4; Distraction with response = 66.1, SD=16.4; Distraction = 68.5, SD=20.4. An analysis of variance (ANOVA) on this initial pain rating revealed no significant group differences: $f(3,64)=.0652$, $p=.9781$. A ceiling effect was unlikely as the total distribution of this variable was roughly symmetrical with the maximum rating at 95.

The recovery rate was measured in the two minutes following the cold pressor task during which eight VAS ratings were collected. Figure 1 plots these post pressor ratings by group or coping strategy and illustrates that there was no evidence of a group difference. Multivariate analysis of variance involving the group by the recovery rate revealed there was no significant differences in the slope of recovery across the four groups. This is inconsistent with Cioffi and Holloway's (1993) results as they report a significant difference between groups on the recovery rate. As illustrated in Figure 2, they found both suppression and distraction groups recovered more slowly than the monitoring group.

In the present experiment, the following analysis was performed to examine for an effect of tolerance time on recovery rate independent of group assignment. A visual inspection of the tolerance time data suggested a bimodal distribution. This is consistent with Geisser, Robinson, and Pickren (1992) who report a bimodal

distribution of tolerance time among subjects on the cold pressor task. Therefore the data was collapsed across the four groups and then re-divided into high tolerance group (tolerance time $\geq$ 120 seconds) and low tolerance groups (tolerance time $<$ 120 seconds).

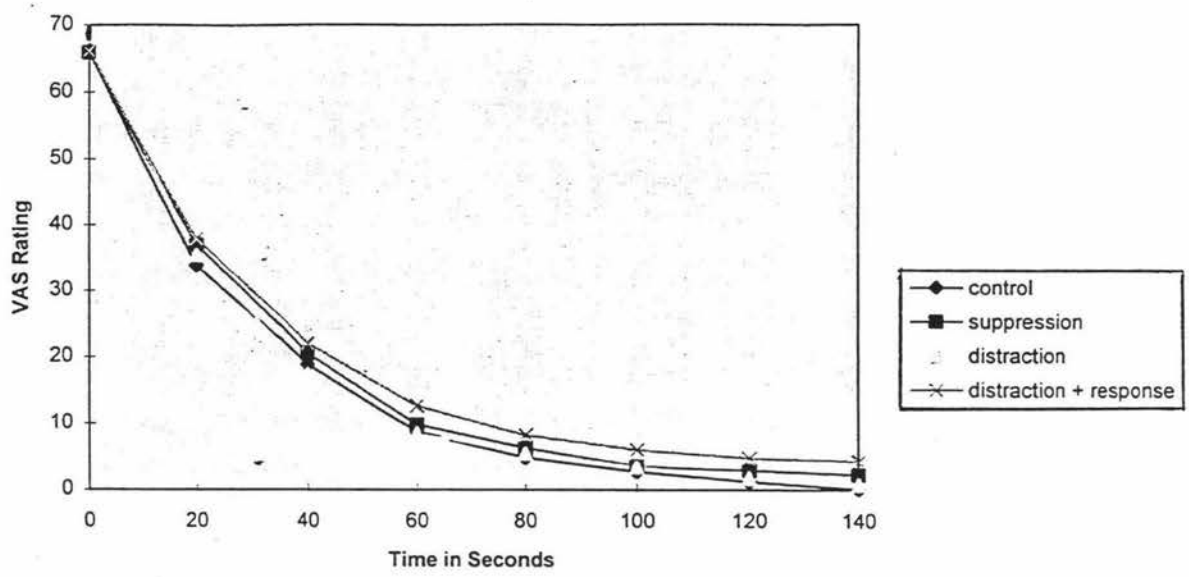

Figure 1: *Rate of recovery by attentional group following cold pressor.*

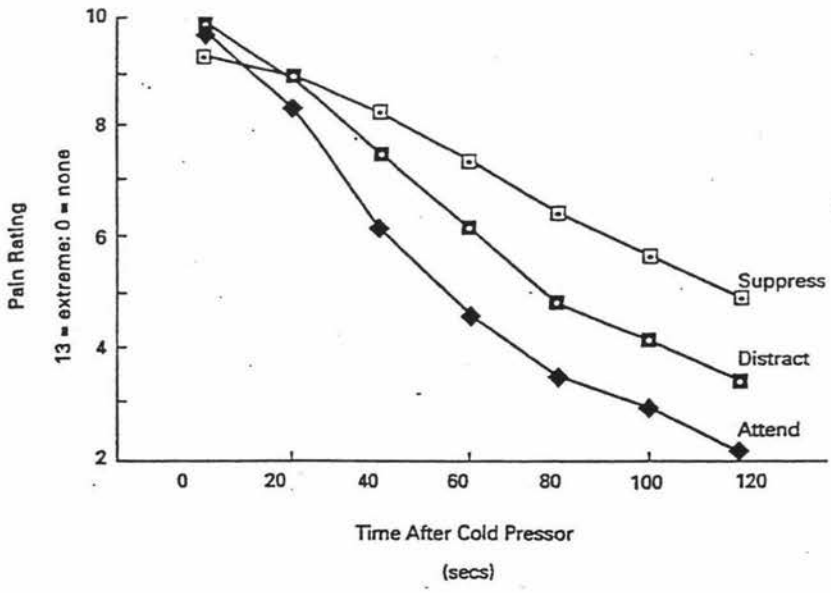

Figure 2. *Cioffi and Holloway (1991) rate of recovery following cold pressor.*

Forty-eight subjects were assigned to the low tolerant group with a mean tolerance of 51.7 seconds (SD=17.3), and 20 subjects were assigned to the high tolerant group with a mean tolerance of 173 seconds (SD=17.8). An ANOVA revealed a significant difference between the two groups ($f(1,66)=684.9513$, $p=.000$). A Multivariate test of significance revealed a significant effect of tolerance group on recovery rate. This difference in the slope of recovery rate is illustrated in Figure 3, below. Although the two groups did not differ significantly on their initial pain rating there is a significant difference by the final rating.

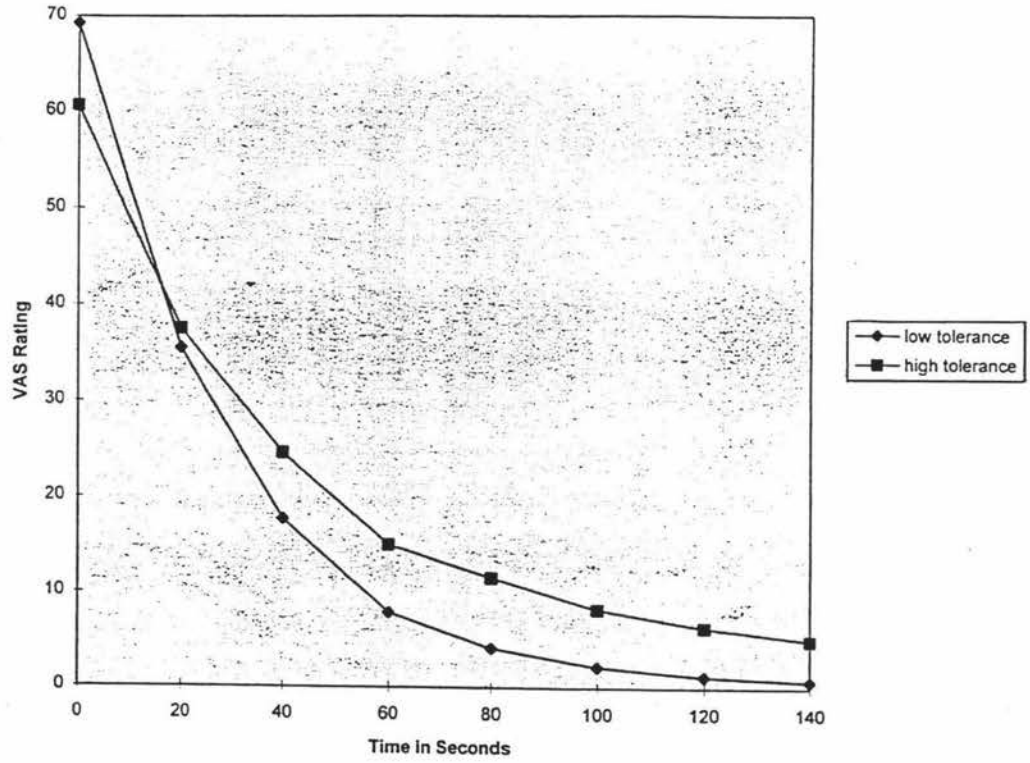

Figure 3: *Rate of recovery by tolerance group following cold pressor.*

Experience of the Potassium Iontophoresis Trials

Subjects experienced two sets of eight Iontophoresis trials, one before and one following the cold pressor task. The mean intensity level was 9 with a standard deviation of 3.9. On average subjects rated the second trial as slightly less painful. The

mean VAS rating for the first trial was 36.2. with a standard deviation of 13.7. The mean VAS rating for the second trial was 34.9 with a standard deviation of 14.6.

Cioffi's rebound hypothesis predicts that a subsequent stimulus will be rated as more painful following a period of pain suppression. In this present study, an ANOVA on the average of the differences between the two trials was used to check for a rebound effect. The results revealed that subjects did not differ significantly as a function of their group membership (Control = .31, SD=4.7; Suppression = -.52, SD=4.7; Distraction with a response = -2.3, SD=7.1; Distraction = .34, SD=6.1; $f(3,66)=.8441$, $p=.4748$).

Also of interest, participants membership in the two tolerance groups on the cold pressor was not related to the iontophoresis level chosen. The low tolerance group mean was 8.7 (SD=3.7); and the high tolerance group mean was 9.9 (SD=4.2). An ANOVA revealed the lack of a significant relationship between these two variables ($f(1,66)=1.2163$, $p=.2741$).

Estimates of Time Concentrating

Subjects in the three mental strategy groups estimated the percentage of time during the cold pressor which they spent concentrating on the assigned task. Subjects on average estimated they concentrated 61% of the time (SD=24). There was a trend for the two distraction groups to report more time concentrating, with the distraction with a response being the highest: Suppression 52.8, SD=26; Distraction = 61.2, SD=21.3; Distraction with a response = 68.9, SD=23.7. However an ANOVA reveals there was no significant difference between the groups on this variable; $f(2,48)=1.8918$, $p=.1621$. There was also no significant difference between the two tolerance groups estimates of time concentrating (Low tolerance = 61.8 (SD=24.9); High tolerance 60.6 (SD=23.2); $f(1,48)=.0264$, $p=.8717$).

CHAPTER 9

DISCUSSION

Hypothesis One

Hypothesis one suggested that the three attentional conditions would lead to longer tolerance times and lowered pain ratings. Although the results show a trend in this direction they fail to reach a significant level.

Hypothesis Two

The second hypothesis suggested that the distraction task requiring a response would show a more powerful effect. This was not supported by the results. In fact the distraction condition without the response led to a slightly longer tolerance time, although this result did not reach significance.

Hypothesis Three

The third hypothesis was that the recovery ratings for subjects in the suppression and distraction groups would be slower than the control group. However, this effect would be more closely related to time in the cold water, rather than assigned task. The current study found no significant difference between the attentional strategies. Examination of the relationship between tolerance time and the recovery rate revealed significant results. Participants who tolerated the water longer, had a slower slope of recovery than the low tolerance group. This provides support for the idea that recovery rate from the cold pressor is more closely related to exposure to the cold water, than the coping strategy employed.

Hypothesis Four

The fourth hypothesis suggested that subjects in the suppression and distraction groups would rate the second iontophoresis trial as more painful. In the current study, subjects

in all of the conditions tended to rate the second iontophoresis trial less painful. There was no significant difference between the four conditions on this variable.

Hypothesis Five

The fifth hypothesis suggested that the rebound effect would be the strongest for the suppression group and might not be present for the distraction groups. In the current study, the recovery rates did not differ significantly between the groups.

Comparison of the Attentional Strategies

The strategies investigated show a trend towards increased tolerance, but fail to result in significantly different pain tolerance times or initial pain ratings. This is consistent with Cioffi and Holloway's (1993) study as well as several other experiments discussed in the reviews by Cioffi (1993), Fernandez and Turk (1989), and McCaul and Mallot (1984). There are a number possible explanations for the results of this study.

One interpretation is the generalisation that distraction does not increase tolerance or reduce suffering. However, this conclusion is unlikely based on the strength of past research supporting the role of attention in pain control (Eccleston, 1995a; Turk & Rudy, 1992).

An alternative interpretation of the results is that the distraction strategy used in this study was ineffective. The distraction strategies used in McCaul et al.'s (1992) study also failed to produce an improvement in pain coping, and they conclude that the strategies may have been lacking in some necessary characteristic. However, this conclusion is also unlikely for the present study as the distraction strategy employed has been demonstrated to significantly increase tolerance and threshold and decrease pain ratings with iontophoretic pain (Breakwell, 1992; Douglas, 1994).

It is possible that participants in the present study failed to engage in their assigned strategy. Although participants were asked to estimate the amount of time they concentrated on the tasks, there was no objective measure of their performance on the respective tasks. Eccleston (1995b) and McCaul et al. (1992) both included measures of performance on the distraction task itself, which may have helped to clarify this issue. However, as stated above, the distraction procedure followed has previously been found to be effective.

It seems more likely that the lack of a significant effect on the tolerance time resulted from a methodological characteristic of the study. There are several possible methodological areas to examine. The subjects were students and the pain stimulus was laboratory induced rather than a real pain experience (Leventhal, 1992). Although these research characteristics may have influenced the results, as discussed in Chapter 4, the research in the area is based very strongly on experimental pain studies, the majority of which report positive results (McCaul & Mallot, 1984).

The lack of significant effect may arise in part as a consequence of the method of pain induction. As Eccleston (1995b) states in his review that the variation in the characteristics of the possible pain induction methods can be the cause of contradictory results. The cold pressor procedure is considered to be valid in terms of the qualitative nature of the pain (Wolff, 1977) and was appropriate to this study as there is a significant recovery period. However one major disadvantage is the high variability between subjects. The measure is dependent on blood flow rates, blood pressure and vasomotor activity (Kreh, Anton, Gilly, & Handwerker, 1984). For example, the numbing of a subject's hand can seriously confound tolerance trials. With prolonged cooling it is possible for the initial painful vasoconstriction to be followed by vasodilation in which the pain levels-off or even reduces in some subjects, thus adding to the unreliability of the stimulus (Kreh, et al., 1984). The results of this study illustrate this high variability in tolerance times and subjects pain ratings. Therefore the distraction strategies may have had an effect on the cold pressor pain similar to the

effect found previously with iontophoretic pain (Breakwell, 1992; Douglas, 1994) but this could have been hidden by the between subject variance on the cold pressor.

Nonetheless, there are examples of positive results from studies using distraction and the cold pressor. The present study failed to replicate these results. Eccleston (1995a) pointed out, in his review that one possible explanation for variance in results between studies using the same pain induction method, is differences in the procedure followed. In this study there is a possible ceiling effect resulting from the three minute cut off. Studies using the cold pressor tend to vary in terms of the cut off time used. Cioffi and Holloway (1993) used a four minute cut off, while Williams and Kinney (1991) did not use data of the subjects who reached the 4 minute cut off. This selection criterion may have been important in achieving the significant results for Williams and Kinney, as the high variance between tolerance times would have been reduced by eliminating these subjects.

Williams and Kinney (1991) suggest that the inclusion of a response will increase the effectiveness of a distraction task. The results of the present study failed to support this suggestion. However, one of the weaknesses of the Williams and Kinney study was that the conditions differed in a variety of ways. The performance based task, an electronic video game involved an overt action as well as continual challenges posed by ever changing stimulus, and the emotional component of winning and losing. Williams and Kinney concede that it is unclear which element of the game is responsible for the superior effectiveness. The present study differed only in terms of overt performance, which suggesting this is not a key element.

Another possibility is that it may be a characteristic of the response task chosen which is responsible for the lack of a significant effect. As discussed in Chapter four, attentional strategies are effective to the extent that they consume the same specialised information processing resources. In order to continue to require information processing resources, the task must remain a controlled processing task. It is possible that the overt response

in the present study became an automatic processing task and therefore did not require any additional resources.

Investigation of the Rebound Effect

The recovery rates did not differ significantly between the groups which is inconsistent with Cioffi and Holloway's (1993) results. Cioffi and Holloway also report a significant difference in response to ambiguous stimuli following the use of the mental strategies. The results of the present study failed to find this effect. Once again there are several possible explanations for these results.

The first one to consider is that the distraction tasks used did not effect recovery because they were ineffective in changing the tolerance times. Although Cioffi and Holloway's (1993) distraction tasks also did not significantly effect tolerance their effects may have been slightly more powerful. Secondly, as discussed in chapter five, it is unclear from the thought suppression theory whether activities as well as thoughts used as distractors are subject to the rebound. Therefore the active element of the strategies used in this study may have inhibited the rebound effect. However there was no rebound effect found for the suppression group and this was a passive task.

Secondly, the experimental design employed to check for the second part of the rebound effect differed from that used by Cioffi and Holloway. The present study used a change in individuals rating of a moderately painful stimuli from pre to post pressor administrations. Cioffi and Holloway instead compared the group's rating of a ambiguous stimuli, to a control group's ratings. As discussed in Chapter six , according to the suppression theory the painful stimulus should have been more susceptible to contamination by the rebound. In addition, the change in individual ratings should have been more sensitive to effects of the mental strategy used.

Finally, the recovery rate was found to be significantly related to tolerance time in the present study. Cioffi and Holloway (1993) failed to control for this effect. It may be

that the distribution of the pain tolerant and pain sensitive individuals was not equal between the groups in their study.

As stated above, the recovery rate in the present study was significantly related to the tolerance time. The participants were divided into the two tolerance groups based on the bimodal distribution of the tolerance variable.) From research using the cold pressor task, several researchers have suggested a behavioural dichotomy of pain tolerant versus pain sensitive individuals (eg. Dubreuil, Endler and Spanos, 1988; Geisser, Robinson, & Pickren, 1992). The present study provides consistent results, with two groups differing significantly in terms of tolerance time. The two tolerance groups also differed significantly in terms of their recovery ratings from the cold pressor. The simple explanation for this result is that time in the cold water effects the rate of recovery. However it is possible that the two tolerance groups differed in terms of some other variable, such as coping styles or mood (Geisser, Robinson, and Pickren, 1992).

The difference in tolerance to the cold pressor has been related to cognitive coping style by Geisser, Robinson and Pickren (1992). Therefore in the current study, individual coping styles may have inhibited the use of assigned coping strategy. However, one would expect these coping styles to also effect other pain inducing procedures. In this study, iotophoresis was used to induce a moderate level of pain. Participants rated a set of baseline trials and from their rating an iontophresis level was chosen which was as close as possible to their rating of moderate pain. In this way participants chose the level of iontophoresis. The participant's choice of iontophoresis level was not related to their tolerance group. Although one might expect individuals with high tolerance to be more likely to choose higher levels of iontophoresis, this was not the case. Although the two pain measures are different, tolerance versus pain ratings, the lack of correlation suggests that the bimodal distribution found in cold pressor studies, may not be present for iontophoresis. It may be that some variable unique to the cold pressor, such as past experience with cold pain, separates the two

tolerance groups. However it is clear from the results that regardless of assigned coping strategy, participants who tolerated the cold water recovered more slowly.

Implications for Future Research

The results of the present study suggest that a simple overt response does not increase the effectiveness of distraction strategies. It appears that the overt response must be a controlled processing task which requires information processing resources additional to those required by the distraction task itself. Experiments are needed which compare tasks with and without a controlled processing overt response, while controlling for overall attentional demand. McCaul et al., (1992) and Eccleston (1995 a,b) suggest that one way to examine attentional demand is to document changes in performance on distraction tasks during painful stimulation.

The results of the present study do not support the hypothesis that the avoidant mental strategies of suppression and distraction carry with them a cost in terms of recovery or rebound. However, they do not on their own refute this hypothesis. This rebound hypothesis needs to be examined in future studies which provide more powerful distractor effects. The results of the present study do however provide support for the hypothesis that recovery time is significantly related to tolerance time. Further research is needed to replicate this finding. Furthermore, any future studies examining recovery need to control for exposure to the cold water in their analysis as it appears to be an important variable in recovery.

Finally, in the past, research on individual differences in pain coping styles suggested that a behavioural dichotomy of pain tolerant versus pain sensitive individual exists (Giesser, et al., 1992). The results of the present study support the existence of this dichotomy with the cold pressor. The results also provide some evidence which suggests that dichotomy as not generalising to iontophoretic pain. Further research needs to examine this bimodal distribution in qualitatively different pain induction methods.

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APPENDIX

APPENDIX A

Information Sheet

You have been invited to participate in a study about the effects of distraction on pain perception. Theory suggests that certain tasks can change peoples' experience and recovery from pain. This study is designed to test this hypothesis. Increasing knowledge of the experience of pain will lead to more efficient and effective treatments to help people who must cope with both chronic and short term pain.

If you choose to participate in this study you will be asked to hold your hand in cold water, which will be maintained between 3 and 5 degrees Celsius, and give some ratings of discomfort. You may also be asked to perform a simple light detection task at the same time.

The other procedure in this study is called potassium iontophoresis, which involves the application of potassium ions to the skin (forearm) using an electric current. The electric current being used is not enough to produce a shock. The procedure is completely safe and produces no tissue damage. The entire study takes between 20 and 30 minutes.

This study is being conducted by Constance Oates, a psychology graduate student, who can be contacted through the psychology department (address and telephone number above). The research will be supervised by Malcolm Johnson, a senior lecturer in the psychology department.

If you wish to receive a summary of the studies findings when it is concluded, please indicate this on the consent form, and include a contact address it can be sent to.

If you take part in the study you have the right to:

*Refuse to answer any particular question, and to withdraw from the study at any time.
*Ask any further questions about the study that occur to you during your participation.
*Provide information on the understanding that it is completely confidential to the researchers. All information is collected anonymously, and it will not be possible to identify you in any reports that are prepared from the study.
*Be given access to a summary of the findings from the study when it is concluded.

APPENDIX B

Medical Checklist

Subjects name:_____

Please answer the following questions:

1. Have you ever had any form of epilepsy? yes/no

2. Have you ever suffered from diabetes? yes/no

3. Have you ever experienced and thyroid problems? yes/no

4. Are you currently using any medication? yes/no

5. Do you have any known heart or circulatory condition? yes/no

6. Are you in good health? yes/no

7. In the past 6 months have you suffered from any painful injury or condition lasting more than 1 week? yes/no

8. Have you ever had any injury or medical condition that may effect your ability to sense pain? yes/no

9. Do you suffer from any skin disorders?

10. Have you ever suffered from frostbite? yes/no

11. Are you pregnant? yes/no

Signature:_____Date:_____

APPENDIX C

Consent Form

I have read the Information Sheet for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask fruther questions at any time.

I also understand that I am free to withdraw from the study at any time, or to decline to answer any particular questions in the study. I agree to provide information to the researchers on the understanding that it is completely confidential.

I wish to participate in this study under the conditions set out on the Information Sheet.

Signed:_____

Name:_____

Phone Number:_____

Date:_____

* I wish to receive a summary of the findings from the study when it is concluded. yes/no

CONTACT ADDRESS FOR THE SUMMARY _____

_____

_____