# DOES DISTRACTION AFFECT VARIOUS PARAMETERS OF PAIN DIFFERENTLY?

## AN INVESTIGATION OF THE EFFECTS OF TWO DISTRACTERS ON THREE MEASURES OF PAIN

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# ABSTRACT

Generally, research indicates that the distraction of attention away from painful sensations reduces both experimental and clinical pain. In addition, the literature suggests that different distracters may influence different parts of the pain experience. The present study used thirty subjects and compared the effects of visual distraction, imaginal distraction, and no-distraction on pain threshold, pain tolerance, and pain ratings. Pain was induced through potassium iontophoresis. The present study tested the assumptions that (1) Both distracter tasks will be effective in raising pain threshold and pain tolerance in comparison with the control condition (2) The visual distracter will be more effective in raising pain threshold than the imaginal distracter (3) The imaginal distracter will be more effective in raising pain tolerance than the visual distracter (4) Pain ratings will be reduced in both distraction conditions in comparison with the control condition (5) Males will have higher pain threshold and pain tolerance levels than females. Findings revealed that none of the distracters heightened pain threshold in comparison with the control condition. However, the visual detection task proved to be the most effective in increasing pain tolerance. This is contrary to predictions that the imaginal distracter would have the most influence on pain tolerance. The data showed that there was no significant difference found between males and females regarding both pain threshold and pain tolerance. The implications of findings for the management of clinical pain are discussed.

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# CHAPTER ONE

## INTRODUCTION

Pain is one of the most important human experiences, and also one of the most complex. Pain is defined by the International Association for the Study of Pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Wells & Woolf, 1991, p.i). Other researchers utilise more emotive language to convey the concept of pain as a feeling of distress, suffering, or agony caused by stimulation of specialised nerve endings (Miller & Keane, 1978; cited in Stewart, 1987).

Thus, as one can already see, pain can be defined in a number of ways depending on where the emphasis is placed - whether it be on the physical sensation or the emotional response. This notion has implications when one is looking at coping strategies and the respective ways they operate in order to reduce pain perception and/or distress.

In this chapter, the physiology of this vital phenomenon is examined, as are the functions of pain and the distinction between acute and chronic pain.

There is a discussion of the theories of pain, with special emphasis on Melzack and Wall's (1965) gate control theory. Issues relating to the psychology of the pain experience are briefly noted, and the link to coping strategies established. Finally, the induction and measurement of pain in an experimental setting is explored.

## PAIN PHYSIOLOGY AND FUNCTION

In physiological terms, pain information is carried by unmyelinated and some thinly myelinated axons to the spinal cord, which releases a synaptic neurotransmitter known as substance P to the neurons they contact in the spinal cord. The spinal cord neurons in turn send their information up two spinal pathways to the ventrobasal nucleus of the thalamus which then sends information to the somatosensory cortex, to be processed as 'pain' (Kalat, 1988).

Pain performs the important function of alerting an individual to an injury, forcing the sufferer to take charge of the situation and find out and do something about whatever is causing the sensation (Wall, 1979). Further, it discourages the use and motion of injured parts and encourages rest and recuperation.

However, it is imperative that a distinction be made between acute and chronic pain. Acute pain is a complex experience of extreme somatic discomfort associated with tissue injury, inflammation, or a disease process (Chapman & Turner, 1986). Useful in notifying the presence of an illness, it is time-limited and hence less subject to learning and conditioning. In contrast, chronic pain rarely serves any biological function, and can lead to major changes in lifestyle activities and relationships.

## PAIN THEORIES

Theoretically, the nature of pain has been the subject of speculation since time began. Prior to 1965, classical theories of pain concentrated on one or two aspects of pain and were founded mainly on a few clinical or anatomical facts.

Specificity theory, perhaps the most traditional assumption regarding pain, evolved from the ideas of Descartes in 1664, von Frey (1895), and Muller (1942), who proposed that the pain system consisted of a direct link between the site of injury and the brain (Melzack & Wall, 1965). Early sensory physiologists and psychophysicists further claimed that pain variation was due to the quality and the intensity of the sensory stimulus - cognitive and affective factors were relegated to a secondary position, being interpreted as merely *reactions* to pain (Turk, Meichenbaum, & Genest., 1983).

Pattern theory arose in part as a result of the notion that cutaneous receptors lacked morphological specialisation (Price, 1988). This theory contends that pain is produced by spatiotemporal patterns of neuronal impulses, coded by the central nervous system, which result in the perception of pain (Turk et al., 1983).

However, what both the sensory input and pattern theories of pain fail to consider is the complex nature of the pain experience. These models do not explore the large differences that are apparent in the distress responses of individuals with similar injuries in different situations (Beecher, 1946); nor do they account for concepts such as phantom limb pain and the low congruity between physical stimulation and pain report (Melzack, 1991).

Melzack and Wall (1965) thus proposed the gate control theory of pain, which views pain perception and response as resulting from the interaction between sensory-discriminative, motivational-affective, and cognitive-evaluative components. Similarly, Leventhal and Everhart (1980; cited in McCaul & Haugtvedt, 1982) have recently developed the parallel-processing model to explain the pain experience, suggesting that pain can be processed in two ways -as objective sensations or as distressing, painful sensations.

The latter two theories imply that how an individual interprets painful sensations plays a major role in determining the degree of distress produced by them. This is supported by clinical observations and laboratory data which indicate that an adequate conceptualisation of pain must be multidimensional in nature, incorporating cognitive and affective phenomena as well as the physical stimuli and sensory physiology (Weisenberg, 1987).

The gate control theory has focused attention on the evidence that pain is not a function of any individual system alone, but alternatively that various parts of the nervous system as a whole are involved in the pain experience. It states that "a neural mechanism in the dorsal horns of the spinal cord acts like a gate which can increase or decrease the flow of nerve impulses from peripheral fibres to the central nervous system. Somatic input is therefore subjected to the modulating influence of the gate before it evokes pain perception and response" (Melzack & Wall, 1982, p.222).

In short, this theory suggests that psychology has much to offer in both understanding and treating pain. It implies that cognitive activities such as focused attention and distraction can influence pain by operating at the earliest levels of sensory transmission. In addition, the assumption by Meichenbaum and Turk (1976) that the psychological dimensions stated by Melzack and Wall (1965) call for different kinds of coping strategies is a paramount issue.

## EXPERIMENTAL PAIN

Although the purpose of studying pain is for the most part to assist the development of methods for enhancing its management, there are a number of constraints which exist.

According to Keele and Smith (1962), experimental pain is easily quantified, reproducible, the intensity of the stimulus can be varied to suit experimental requirements, and homogeneity in experimental design can be achieved.

However, the neuronal pathways of experimental pain may differ from those of organic or pathological pain, and the emotional and motivational aspects of experimental pain vary from those of organic pain. Heyneman, Fremouw, Gano, Kirkland, and Heiden (1990), who undertook a recent study which looked at individual differences in the use and effectiveness of coping strategies, cite the lack of strong support for the generalisability of experimental pain data.

Dworkin and Chen (1982) highlight that laboratory studies use volunteer subjects who do not arrive in pain or expect to leave in pain, there is explicit assurance that no permanent tissue damage will occur, and the subjects know there will be no lasting effects. Obviously, pathological pain has ecological validity, yet the ethical issues foregrounded in experimental human research do not permit any *real* damage to be done.

The criteria for an ideal experimental pain stimulus have been catalogued by many (Benjamin & Helvey, 1963; Keele & Smith, 1962; Wolff, 1977); generally, the stimulus should be specific for pain sensation, should allow the subject to ascertain changes in pain intensity throughout the effective range of the stimulus, can be conveniently applied, is reproducible, and does not elicit tissue damage. Further, it should be valid in that it represents the worldwide sensation that is recognised as pain - by innervating those nerve fibres which elicit the feeling.

In order to study pain in a laboratory setting, a number of experimental methods of inducing nociception have been generated. Perhaps the most frequently used is the cold pressor method - although known as a reliable and valid procedure (Wolff, 1977), it is problematic in that only a limited number of trials can be administered in a short period of time. This is due to the need for a break to allow the subjects' hands to return to homeostatic equilibrium (Keele & Smith, 1962).

Radiant heat as a pain induction technique was used extensively in initial pain research; a serious limitation is the risk of burn injury (Benjamin & Helvey, 1963; Keele & Smith, 1962).

Electrical stimulation has been widely utilised as a pain stimulus for several reasons - it is readily available, relatively cheap, repeatable, simple to administer, parameters are easily measured, and it is generally safe (Wolff, 1977). However, it has been found to have low ecological validity in that it bears little qualitative relationship to clinical pain - due to the fact that it excites all nerve fibres, not just those associated with pain stimulation (Humphries & Johnson, 1992).

Mechanical methods, such as those associated with pressure, are also pain methods that are easily executed and fast to apply. Unfortunately, they are unreliable, with a poor correlation to other pain methods (Wolff, 1977), and a comparatively high risk of injury.

Chemical techniques involve the use of chemical stimulation at various tissue depths, and include such methods as the hypertonic saline method, the cantharidin blister method, ischemic methods, and potassium iontophoresis. In all but the latter, administration time is a drawback, and tissue damage is a very real possibility if caution is not used.

## PAIN MEASUREMENT

Because pain is a complex perceptual experience that can be quantified only indirectly, pain measurement attempts have been preliminary (Chapman, Casey, Dubner, Foley, Gracely, & Reading, 1985). In experimental studies and some clinical studies with human patients and volunteer subjects, researchers have mainly utilised two basic measures - pain threshold and pain tolerance.

Pain threshold is the point at which pain is first sensed, or, if investigated in more psychophysical studies, "the 50% mark at which half the time there is pain and half the time there is no pain" (Wolff, 1977, p.275). Historically, pain threshold was the measure most studied by initial investigators, such as Beecher (1946) in his classic study following the Second World War, but its popularity has since diminished in pain research.

Pain tolerance is the greatest level of pain which a person is prepared to endure; it has been referred to as an upper threshold (Wolff, 1977). Collier, Mehta, and Spear (1990) point out that in the determination of pain tolerance, subjects are normally instructed by the experimenter that the definition of 'tolerance' is not to be interpreted as to imply any sort of endurance test and that therefore the level to be defined is not the maximum level that they can tolerate, but rather some lower level that represents a significantly unpleasant experience.

In general, many experiments have demonstrated that both pain threshold and pain tolerance are constructs which can be measured reliably in terms of the intensity of the stimulus at which they are identified (Merskey & Spear, 1967; cited in Collier et al., 1990).

A further measure is pain sensitivity range - a function of the relationship between pain threshold and pain tolerance, essentially being the difference between the two (Wolff, 1977).

In clinical studies, probably the most common measurement of pain is a rating, typically using visual analogue scales (VAS). This is due to the fact that they are simple, economical, and easy for subjects to comprehend (Chapman et al., 1985). Price, Harkins, and Barker (1987) have reported that VAS can allow separate assessments of the intensity and the unpleasantness of pain. This could aid in the evaluation of the influence of etiological and psychological factors on perceived pain intensity, and the impact of psychological factors that may selectively enhance or reduce the affective versus the sensory dimension of pain.

## SUMMARY

In summary, the concepts of what constitutes pain in an experimental sense, and how to measure that pain, vary considerably. Theoretically, it is generally accepted that pain is multidimensional in nature; however, the variation that exists regarding induction techniques and pain measures within the field needs to be limited somewhat in order to guide research in a clear direction.

# CHAPTER TWO

## FACTORS AFFECTING PAIN

As one can imagine, there are many diverse factors which can influence an individual's pain experience and report. Ample evidence exists that suggests the importance of a wide range of variables associated with information processing, both for enhancing and inhibiting pain perception.

Chen, Dworkin, Haug, and Gehrig (1989a; 1989b), in discussing the results of their studies that have investigated pain and its relation to aspects of personality, have argued that human pain responsivity may include three factors: "(a) influence of psychological traits (b) determination by physiological factors (c) dependence on the interaction between physiological and psychological determinants" (p.144). This assumption indicates the need to separate the physiology of pain from the psychology of pain in order to determine what variables are having an influence, and in which area.

This chapter will examine both physiological and psychological factors that have been shown to impinge upon pain experience and pain report; as well as explore the interaction between the two.

## PHYSIOLOGICAL FACTORS AFFECTING PAIN

Perhaps the most consistent finding in the experimental literature on pain has been the differences between men and women. Otto and Dougher (1985) relate the finding that higher pain thresholds have been established for men for cold pressor, electric shock, and focal pressure. Rollman and Harris (1987) ascribe inconsistencies across pain studies to stimulus and response differences between men and women. Bonica (1974) points out that physiologically, the cutaneous pain threshold is significantly lower in women than in men, with the threshold increasing progressively with ascending age - although the difference between men and women continues throughout the lifespan.

Men have shown greater pain tolerance than women to cold pressor, electric shock, thermal stimulation, mechanical pressure on the Achilles tendon, and focal pressure (Otto & Dougher, 1985). Yet it is vital to note that recent studies by Kohn, Cowles, and Dzinas (1989) and Otto and Dougher (1985), which explore sex differences and situational context, suggest that there are other personality, motivational, or conditioning factors which play an important role in the differences between the sexes in pain responsivity.

It is interesting to observe that pain sensitivity and the analgesic effect of drugs vary over the day (Atrens & Curthoys, 1982). Bonica (1974) touches on the fact that a circadian rhythm of pain threshold is present in both men and women, with acrophase in early morning. Bromm (1985) extends this understanding and points out a circatrigintan (monthly) rhythm that exists in both sexes.

Regarding personality and its link to pain responsivity, it appears that a behavioural dichotomy exists. Chen et al.(1989a; 1989b) demonstrated that there are two types of individuals - pain-tolerant and pain-sensitive. This finding was replicated by Geisser, Robinson, and Pickren (1992). However, this dichotomy appears not to be the only one 'discovered' by researchers. Pickett and Clum (1982), and Rosenbaum (1980) highlight the contrasts in the effectiveness of pain management found when an individual's locus of control is manipulated; Heyneman et al. (1990) suggest individuals should be classified as either 'catastrophisers' or 'noncatastrophisers'; Dubreuil, Endler, and Spanos (1988) contrast 'repressors' with 'sensitisers'; and Akins, Hollandsworth, and Alcorn (1983) compare cognitive style in terms of visual versus verbal information processing. Certainly the large number of psychological variables that are being examined suggests the need for further agreement by experimenters as to what factors are the most relevant and appropriate.

Arousability constructs have been related to pain tolerance. For example, Eysenck (1967; cited in Kohn et al., 1989) theorises that the higher pain tolerance often displayed by extroverts is due to the higher basal arousal of introverts, which results in the perception of pain as more intense by introverts than by extroverts.

Many anecdotal observations indicate that pain perception is decreased during periods of stress or increased physical exertion. A study by Janal, Colt, Clark, and Glusman (1984) provides several lines of evidence that suggest that prolonged physical exertion activates an opiate analgesic mechanism that is accompanied by mood-elevating effects. Feine, Chapman, Lund, Duncan, and Bushnell (1990) augment this by pointing out that motor activity decreases the ability to detect weak low-threshold cutaneous inputs, but has no effect on the perception of specific types of pain, such as warmth and heat.

In contrast, however, Grimm and Kanfer (1976) failed to confirm the assertion that a reduced level of physiological arousal (defined by heart rate) is accompanied by or results in increased pain tolerance and changes in pain ratings. Additionally, Heck (1988) found that although purposeful activity significantly enhanced pain tolerance, no tangible differences in peripheral skin temperature or heart rate were found.

Therefore, in terms of the influence that various factors associated with arousal have on pain, studies have conflicting results. A lack of definition in this area is evident - measures and pain induction methods need to be regimented in order to properly assess the links that exist between these different physiological factors.

## PSYCHOLOGICAL FACTORS AFFECTING PAIN

It is widely believed that clinical pain is, in part, mediated by emotional state. Researchers tend to agree that anxiety, irritability, and depression are integral factors in a person's perception and tolerance of pain; Rachman (1980) specifically noting that chronic pain has been linked to depression and helplessness, while acute pain has been strongly linked to the presence of anxiety.

Melzack and Wall (1982) assert that these factors interact with the motivational-affective system so that the sensory-discriminative system is influenced. The gate control model hence provides a framework for understanding how emotions can affect neural conduction, but it does not explain how they influence pain in a total sense (Cornwall & Donderi, 1988).

Hypnotic susceptibility is related to success in reducing experimentally-induced pain via suggestion, under both hypnotic (with prior induction) and waking (without prior induction) conditions (Chaves & Barber, 1974; Farthing, Venturino, & Brown, 1984; Malone, Kurtz, & Strube, 1986; Spanos, McNeil, Gwynn, & Stam, 1984; Spanos, Ollerhead, & Gwynn, 1986; Spanos, Radtke-Bodorik, Ferguson, & Jones, 1979). Research undertaken which accentuates such incidents as 'automatic writing' (where one hand writes answers to specific questions but the person is not aware of it) reflects the complexity of pain mechanisms, and leads one away from the notion that pain is subserved only by a direct pathway from nerve impulses to a 'pain centre' in the brain (Melzack & Wall, 1982; Price, 1988).

Perceived control, "the belief that one has at one's disposal a response that can influence the aversiveness of an event" (Litt, 1988, p.149) has been shown and accepted to be a basic mediating variable for both acute and chronic pain (Chapman & Turner, 1986; Grimm & Kanfer, 1976; Jensen, Turner, Romano, & Karoly, 1991; Kanfer & Seidner, 1973; Ladouceur & Carrier, 1983; Litt, 1988; Melzack & Wall, 1982; Thompson, 1981; Turk et al., 1983). Numerous laboratory studies have indicated that providing subjects with some degree of control over pain stimulation can reduce stress and raise pain tolerance (Berger & Kanfer, 1975; Jensen et al., 1991; Kanfer & Seidner, 1973; Litt, 1988; Rokke, Al Absi, Lall, & Oswald, 1991; Weisenberg, 1987), not to mention reduce performance deficits following exposure to aversive stimulation (Rosenbaum, 1980). Specifically, Thompson (1981) contends that perceived control may reduce pain because it reduces anxiety about the noxious stimulus; other researchers highlight the concept of self-efficacy.

Self-efficacy is defined as a personal belief that one can successfully perform a required behaviour in a given situation (Dolce, Doleys, Raczynski, Lossie, Poole, & Smith, 1986). A number of studies indicate that self-efficacy expectancies can strongly influence the manner in which people respond to noxious stimulation, following both experimental treatments and in naturally occurring situations (Bandura, Cioffi, Taylor, & Brouillard, 1988; Devine & Spanos, 1990; Dolce et al., 1986; Jensen et al., 1991; Litt, 1988; Marino, Gwynn, & Spanos, 1989; Williams & Kinney, 1991).

However, some theorists have argued that self-efficacy perceptions may simply reduce to or derive from outcome expectations - what people think the effects of a given course of action will be (Kazdin, 1978; Teasdale, 1978). Walmsley, Brockopp, and Brockopp (1992) point out that expectations are thought to develop in relation to an individual's prior experience with pain, their observation of others' pain experience, and their interpretation of the information conveyed about the pain experience. Indeed, even basic inconsistencies throughout literature on pain research have been put down to the very concept of expectancy (Bandura, 1977; Marino et al., 1989).

Significant correlations have been reported between expected and experienced pain (Baker & Kirsch, 1991; Devine & Spanos, 1990). However, this finding is not a consistent one, with other research finding that expectancy alone does not account for the obtained changes in pain (Beers & Karoly, 1979; Gilligan, Ascher, Wolper, & Bochachevsky, 1984; Marino et al., 1989).

A study by Johnson (1973) reflects the way in which experience modifies expectations. She found that holding accurate expectations did not prevent distress but delayed the emergence of the distress. Only when there was a combination of accurate expectations about sensations, and experience with the sensations, did a reduction in distress ratings occur. Hence the hypothesis was supported that the emotional response to a threatening event, such as pain, is affected by incongruency between expectations and experience. This underscores the multidimensional nature of suggestion-induced pain reduction, and the difficulties involved in attempting to account for this phenomenon by positing a single psychological variable like expectancy as its direct or final common cause (Marino et al., 1989).

Placebo effects are closely linked to expectancy theory. It has long been recognised that placebos can decrease self-reported pain intensity and enhance pain tolerance (Baker & Kirsch, 1987; Turk et al., 1983; Voudouris, Peck, & Coleman, 1985), not to mention reduce such complications as post-operative swelling (Ho, Hashish, Salmon, Freeman, & Harvey, 1988). Jospe (1978; cited in Price, 1988) has proposed that a prime component of placebo response in pain studies may be a reduction of anxiety. If this is correct, then one would expect that placebo effects would mainly influence the affective dimension of pain. The few studies that have separately measured sensory and affective dimensions have indeed shown this to be the case (Price et al, 1987; Reading, 1982).

To reduce expectancy, and the potentially confounding influences of perceived control and self-efficacy, familiarisation sessions are often included within an experimental design, preceding the experimental session, to allow the subject to realistically assess their competence in dealing with the respective pain stimulus.

A problem inherent in the literature is that of anxiety and pain often being confounded (Al Absi & Rokke, 1991; Cornwall & Donderi, 1988; Weisenberg, 1987). Further investigation has led to the deduction that anxiety has a differential impact on pain perception depending on whether or not the anxiety is relevant to the pain (Al Absi & Rokke, 1991; Cornwall & Donderi, 1988; Dougher, Goldstein, & Leight, 1987; Weisenberg, Aviram, Wolf, & Raphaeli, 1984). The general consensus that painful experiences can lead to anxiety, and heightened anxiety can lead to an increased perception of pain (King, 1991), can be modified to maintain that when people attribute their arousal to a stimulus that is not related to the source of pain, they are likely to be less concerned about the pain and more tolerant of it (Al Absi & Rokke, 1991).

Several studies have utilised relaxation to reduce pain in acute pain situations (Bobey & Davidson, 1970; Clum, Luscomb, & Scott, 1982; Corah, Gale, & Illig, 1979). Clum et al. (1982) hold that since anxiety is associated with the affective component of pain, and because muscle relaxation procedures are known to be effective in reducing anxiety, it is logical that relaxation would reduce the emotional component of pain - whether the pain was associated with the muscle tension or not. Thus, to the extent that pain is a stressor, changing a person's anxiety level by applying psychological manipulations should increase one's pain tolerance by 'closing the pain gate'.

## THE INTERACTION BETWEEN PHYSIOLOGICAL AND PSYCHOLOGICAL DETERMINANTS

Social and environmental influences are becoming recognised as salient factors that may exert an influence over pain behaviour (Keefe & Williams, 1989). With reference to the behavioural model, the execution of pain behaviour is seen not only as result of the history and personality of an individual but also of particular situational variables (Kanfer & Seidner, 1973).

This ties in with studies investigating cultural variations in response to painful stimuli (Sternbach & Tursky, 1965; Wells & Woolf, 1991; Zatzick & Dimsdale, 1990). Zatzick and Dimsdale (1990) concluded that although there is no evidence to suggest that the neurophysiological detection of pain varies across cultural boundaries, pain tolerance does reflect the behavioural aspects of pain that are profoundly influenced by culture. Sternbach and Tursky (1965) reported an example of tolerance differences across groups with diverse ethnic origins which were assumed to be attitudinal because the sensation thresholds did not vary.

Dworkin and Chen (1981) emphasise the fact that pain data collected in laboratory situations may have limited generalisation to pain reports actually encountered in clinical settings. They believe that changes in situational context to lower pain thresholds can be attributed to cognitive processes which yield different meanings for laboratory pain and clinically relevant pain. This notion is expanded upon by studies conducted by Spanos, Hodgins, Stam, and Gwynn (1984), who claim that the social structure of the experiment influences both the cognitive coping strategy and the degree of pain that subjects will report.

An additional point is the possibility that any anxiety on the part of the experimenter at having to apply the pain stimulus is communicated to the subject (Davidson, Evalyne, & McDougall, 1969). This issue should be recognised, when undertaking all experimental manipulations, as an effect of the social context, and should be controlled for by utilising an experimenter confident in the use of the respective pain induction technique.

Gender of the experimenter has been pinpointed as impacting upon pain report (Levine & De Simone, 1991) and the effectiveness of cognitive rehearsal in the experimental manipulation of pain (Bobey & Davidson, 1970). Social desirability and approval-seeking motivation have also been cited as important factors which may impinge upon pain report (Dubreuil & Kohn, 1986; Kohn et al., 1989; Otto & Dougher, 1985).

SUMMARY

It is obvious that there exists a large number of variables which have the potential to substantially affect pain experience and report. The basic fundamentals of how pain is influenced by such external variables need to be clarified through the determination of the effects of specific factors upon specific parts of the pain experience. Only then can conclusions be confidently drawn about the nature of pain in humans, and appropriate recommendations made as to what the most effective techniques in pain management are.

# CHAPTER THREE

## COPING STRATEGIES FOR PAIN

In general terms, coping refers to active attempts made to deal with noxious stimulation (Spanos et al., 1984). Recent literature reviews regarding the influence of coping strategies for pain in acute pain situations appear to support the notion that these strategies are effective in assuaging pain (Fernandez & Turk, 1989; McCaul & Malott, 1984).

Fernandez (1986) presents a trimodal classification of approaches to pain management, based on a study by Jaremko (1978). 'Cognitive strategies' pertain to procedures that impact upon the pain experience through a person's thoughts and cognitions; self-statements, attention-diversion, and imagery/fantasy are examples of cognitive techniques.

'Behavioural manipulations' refer to strategies which alter pain "through the modification of overt action or a combination of behaviours and cognitions" (Fernandez, 1986, p.142). Initially these manipulations are under some degree of external control - however, the amount of control varies depending upon the particular kind of behavioural strategy employed. Examples of this system of pain management include hypnosis, biofeedback, placebos, and cognitive dissonance (Fernandez, 1986).

A third category not related to psychology is 'physical intervention'. In contrast to the two classes of strategies outlined above, the medium of intervention here is the body, therefore control is largely external to the person involved - for example, physiotherapy, acupuncture, and surgery (Fernandez, 1986).

In this chapter, cognitive coping strategies will be focused upon - in particular, the use of attention-diversion, or distraction techniques, and imagery. The influence that these types of approaches have on pain perception will be explored. Following this, the multidimensionality of pain and its relationship to various cognitive coping strategies is discussed with regard to both experimental and clinical pain.

## COGNITIVE STRATEGIES

As highlighted previously, cognitive strategies can be categorised into three dimensions. Self-statements involve the periodic rehearsal of key phrases; they do not attempt to modify nociceptive input but rather accentuate the person's capacity to withstand the pain (Shumate & Worthington, 1987).

Attention-diversion strategies involve the direction of attention to a non-noxious event or stimulus in the immediate environment in order to achieve distraction from concurrent pain or distress (Fernandez, 1986). This type of diversion can be passive, such as listening to music (Corah, Gale, Pace, & Seyrek, 1981), or active, an example being the playing of video ping-pong games (Corah et al., 1979).

Imagery can be defined as the production of particular ideas or thoughts with pain-attenuating potential. In terms of subdivisions, there are two; imagery can be incompatible/irrelevant, or transformative/relevant. Incompatible imagery in turn branches into incompatible emotive imagery, which is designed to elicit emotions inconsistent with pain (Fernandez, 1986), and incompatible sensory imagery, which focuses upon images of 'pure' visual, auditory, or other sensations incompatible with pain but with no link to particular emotions (Fernandez, 1986). In contrast, transformative imagery is designed to alter specific features of the pain experience, such as the context, the stimulus, or the sensation (Fernandez, 1986) - for example, imagining a sensation to be numbness and not pain (Rybstein-Blinchik, 1979).

A number of 'package interventions' which involve a number of different pain management strategies as components, have been utilised in the amelioration of pain. This has been especially evident with respect to children's distress during medical procedures (Fowler-Kerry & Ramsay Lander, 1987; Jay, Elliot, Katz, & Siegel, 1987; Jay, Elliot, Ozolins, Olson, & Pruitt, 1985; Manne, Redd, Jacobsen, Gorfinkle, Schorr, & Rapkin, 1990), and in preparation for childbirth (Stevens & Heide, 1977).

The rationale for using multifaceted interventions is based upon two arguments. Firstly, Turk (1978) highlights the utility of providing clients with a 'smorgasboard of strategies' because different individuals may find different aspects of the intervention package useful. Secondly, it has been suggested that it is advisable to first develop an intervention package with a maximum probability of efficiency and then to conduct analytic studies to isolate the effective components - so that those components can be strengthened and perhaps other components dropped to make a more efficient, cost-effective package overall (Jay et al., 1985).

It should be noted that in two major reviews that have been undertaken recently (Fernandez & Turk, 1989; McCaul & Malott, 1984), many of the clinical studies were excluded from analysis because they consistently implemented 'package interventions' in which it was impossible to isolate the sole contribution of the cognitive component.

The meta-analysis of fifty-one relevant research studies recently tackled by Fernandez and Turk (1989) on the utility of cognitive coping strategies in altering pain perception concluded that 85% of the investigations showed cognitive strategies to have a positive effect in enhancing pain threshold and pain tolerance, and in attenuating pain ratings - as compared to both no-treatment and expectancy controls. This result is similar to the one found by an earlier review undertaken by McCaul and Malott (1984), who determined that distraction was more effective than no-treatment or placebo controls in coping with noxious stimulation.

However, it needs to be pointed out that the findings of both Fernandez and Turk (1989) and McCaul and Malott (1984) pertain largely to acute pain induced in experimental laboratory conditions. Differences have been found between clinical and experimental studies when looking at the effects of extraneous factors such as perceived control (Litt, 1988), the effect of a distracter being time-bound, and the effect this has on various pain situations (Holmes & Stevenson, 1990; Mullen & Suls, 1982). There is a need for more evidence that establishes that these cognitive strategies do have a role in enhancing coping with chronic or clinical pain, rather than just acute experimental pain.

Fernandez and Turk's (1989) review emphasised that the major difficulty posed for the review process in this area is the abundance of terminological inconsistencies that exist. For instance, what Thelen and Fry (1981) labelled as 'selective attention' was classed as 'incompatible imagery' by Beers and Karoly (1979) and as 'a strategy inconsistent with pain' by Spanos, Horton, and Chaves (1975).

Therefore, while this research demonstrates the importance of cognitive activity in coping with pain, it would be useful to evaluate the interaction between specific variables and different cognitive treatment procedures. An earlier selective review by Tan (1982) concluded this to be a major priority in future research.

## ATTENTION-DIVERSION

An element which seems to be included in most cognitive treatments for pain management is attention-diversion. Both folk wisdom and modern cognitive-behavioural psychology appreciate the power of distraction in reducing the distress linked to painful stimulation. A large number of studies have supported the assumption that attention-diversion techniques can reduce reports of pain and increase pain threshold and pain tolerance in many contexts (Anderson, Baron, & Logan, 1991; Dubreuil, Endler, & Spanos, 1988; Shimizu, Hatayama, & Ohyama, 1990; Stark, Allen, Hurst, Nash, Rigney, & Stokes, 1989).

However, this is not always the case (Clum et al., 1982; Jaremko, 1978; McCaul, Monson, & Maki, 1992; Scott & Barber, 1977). McCaul et al. (1992), who initially emphasised that "on the surface, distraction appears to help ..." (p.210), found that in their study, attention-diversion failed to reduce physiological, self-report, and behavioural responses to cold pressor pain. Yet beliefs in the efficacy of attention-diversion still persevere in the face of contradicting evidence. In an experiment by McCaul and Haugvedt (1982), they found that 80% of their subjects would have preferred distraction over the monitoring of sensations in coping with the pain.

Physiologically, distraction appears to operate by mediating the inhibition of nociceptor pathways (Chapman & Turner, 1986; Sieb, 1990). Relationships between the various neurotransmitters and the complex experience of pain are not yet grasped, but there seems to be an elaborate interdependence among the different pathways, in terms of the excitation associated with pain and the inhibition probably associated with pain alleviation.

The theoretical background related to the concept of distraction is varied - perhaps the earliest speculations were related to "the 'right of way of dominant stimuli' (Sherrington, 1906), and to 'the law of prior entry to consciousness' (Berlyne, 1951)" (Turk et al., 1983, p.90).

The theory that has had the biggest impact regarding distraction and pain is the limited-capacity theory (Kahneman, 1973), which postulates that attention has a finite capacity, and that given competing stimuli, attention becomes selective by filtering out part of the incoming information (Fernandez & Turk, 1989). Some evidence supports the contention that when the external environment yields relatively little information, the tendency to encode and elaborate on somatic information increases (Cioffi, 1991).

Furthermore, although two sources of distracting stimuli might compete with each other for attention, once the individual is attending away from the pain to the maximum degree possible, then the addition of distracting stimuli would not produce any further reduction in pain (Farthing et al., 1984).

Therefore, distraction may be seen as effective due to its ability to limit the central processing of pain by consuming part of a finite reservoir of attention (Stevens, Heise, & Pfost, 1989). Following Kahneman's (1973) line of thought, because attentional capacity is limited, it is reasonable to suppose that the more attention required for a distraction task, the less attention available for thinking about pain, and therefore the more effective the task will be in lowering pain perception and increasing pain tolerance (McCaul & Malott, 1984). However, Maltzman (1988), in her study of the efficacy of different complexities of visual distraction, found the mean preference level for stimuli to be of intermediate complexity. This questions the theory behind the limited-capacity hypothesis and reflects the need for more validation in this area.

The concept of distraction being time-bound is evident in a study by Mullen and Suls (1982). This research suggested that in the short-run, distraction is more adaptive than attention, while in the long-run, attention and self-monitoring is better than distraction. It has been argued that functionally, distraction may provide a break from the stressor, whereas attention may provide the information necessary to facilitate adaptive actions (Shontz, 1975; cited in Mullen & Suls, 1982). This conviction is supported by Holmes and Stevenson (1990) who reasoned that recent-onset patients were more positively adapted when they employed avoidant coping, whereas chronic patients fared best when using attentional coping techniques.

Hence it appears that the effectiveness of a distraction strategy is limited by both the intensity and the duration of the pain stimulus. Once the sensations become more salient and thus can no longer be easily ignored, the value of this coping technique may vanish (McCaul & Haugtvedt, 1982; McCaul & Malott, 1984; Suls & Fletcher, 1985). This issue has implications when one is comparing specific distracters, especially when the pain is chronic rather than acute.

## IMAGERY

The meta-analysis by Fernandez and Turk (1989) maintains that imagery strategies tend to be the most effective, whereas strategies involving the repetition of cognitions or the acknowledgement of sensations associated with pain are the least effective.

In terms of distraction per se, McCaul et al. (1992) hold that previous research has failed to determine whether it reduces pain-produced distress. They state that a number of variables have been confounded with distraction - for instance, "typically, one of the other ingredients is positive mood ... via relaxation or imagery" (p.210).

According to McGrath (1991), the efficacy of imagery depends upon the ability of the individual to select an appropriately vivid and emotive image consistent with the objective of pain relief, and to concentrate fully on that image. Interestingly, Spanos and O'Hara (1990) determined that success at using imaginal strategies for pain reduction is not facilitated in any way by an individual's general imaginal propensities.

That emotion is an influential factor in the perception of pain is indisputable; however, what is questioned is the effect of the content of the images being envisaged. Neutral imagery can be described as imaginings of neither a pleasant nor unpleasant quality; Fernandez and Turk (1989) cite an imagined attendance of a lecture by one's instructor as an example. Their meta-analysis revealed neutral imagery to be the most effective cognitive strategy, just ahead of pleasant imagery, in influencing pain report.

Pleasant imagery is defined as a strategy that involves, for instance, an individual imagining oneself sitting in comfort and listening to music (Fernandez & Turk, 1989) - a technique that evokes a sense of enjoyment.

When individuals have engaged in pleasant imagery, they have consistently tolerated aversive stimulation longer than most comparison groups (Chaves & Barber, 1974; Grimm & Kanfer, 1976; Horan, Layng, & Pursell, 1976; Kanfer & Seidner, 1973; Pearson, 1987; Ruiz-Fernandez, 1985; Stevens et al., 1989; Stevens, Pfost, & Rapp, 1987; Stone, Demchik-Stone, & Horan, 1977).

In a study which compared pleasant with neutral imagery, Worthington (1978) failed to obtain either tolerance or self-report differences in response to cold-pressor pain. Similarly, when efforts are made to equate conditions for the vividness of the imagery, and hence its ability to use up attentional resources, there are no differences between pleasant and neutral imagery (Beers & Karoly, 1979).

This has led to suggestions that the past success of pleasant imagery may be due to its relative complexity or its ability to produce higher subject involvement when compared with other experimental conditions. This is especially relevant when one is informed that in past experiments, pleasant imagery has generally been complex imagery, and neutral imagery comparatively simple. This is supported by Stevens and Rogers (1990), Spanos et al. (1979), and Jaremko (1978), who agree that highly pleasant cognitions seem to facilitate pain tolerance because of the attention consumed, the *absorption* in the strategy, and the positive expectations raised in coping with the noxious stimulus.

This is upheld by Maltzman (1988), who contends that affect has been confounded with complexity and novelty in research investigating specific distraction strategies for pain control. Therefore, it appears that the assumption that pleasantness per se contributes to strategy effectiveness is no longer tenable.

Greene and Reyher (1972) theorised about the effectiveness of imagery in pain relief, stating that by having people visualise past pleasant experiences, anxiety, and therefore pain, is reduced. They added that the particular focus of the pleasant image may have an influence on pain tolerance, "in accord with Szaz's (1957) contention that a prime requisite for a reduction in the experience of pain is an ego orientation away from the body" (p.35).

The efficacy of pleasant imagery appears to depend on the type of pain, whether it is acute or chronic. Although Newshan and Balamuth (1991) and Rybstein-Blinchik (1979) both found imagery a powerful and effective technique in the treatment of chronic pain patients, Raft, Smith, and Warren (1986) assert that in contrast with their acute pain patients, the imaginal strategy's effectiveness was increasingly less evident on each successive day for their chronic pain group.

This result may be due to imagery being time-bound (Spanos & Brazil, 1984). As touched on earlier, studies have shown external distraction to be effective only for stressor durations of one minute or less (e.g. Farthing et al., 1984).

As Rosenstiel and Keefe (1983) suggest, a person who knows that his or her pain will be short-term may find pain reduction strategies based on pleasant imagery more feasible. It should be noted, however, that Anderson et al. (1991) did find imagery to be effective well over this one minute limit, with the respective dental procedures varying from twenty to fifty minutes duration; although they do admit that this discrepancy may be due to the fact that anxiety and general physical discomfort were more likely to be the major sources of stress than the pain itself.

Given the characteristics of the affective dimension of pain manipulated by a distracter such as pleasant imagery, one can better anticipate the characteristics of neurons and neural mechanisms involved in the pain experience. Outlined by Price (1988), such neurons, while dependent upon sensory inputs, would coordinate diverse inputs from large body areas and over a longer period of time than sensory-discriminative neurons. Price (1988) sums up by arguing that responses of such neurons would be influenced by those factors that are known to selectively reduce pain-related affect, such as imagery and similar distraction strategies.

This supposition implies that different central neural mechanisms may exist - with different pathways conveying varied information about the pain experience, and the mediating factors impinging upon that pain. The link, therefore, between an individual's emotional state and the efficacy of positive imagery, might be biologically ingrained rather than purely psychological.

PAIN RATINGS AND PAIN PERCEPTION

A variety of psychological manipulations which have been shown to increase pain tolerance do not necessarily simultaneously reduce the perceived intensity of pain. A number of studies lead to the conclusion that it is much easier to change one's tolerance to pain than to change the perception of pain or the distress following pain (Berntzen, 1987; Johnson, 1973; Malone et al., 1989; Manne et al., 1990; Scott & Barber, 1977; Weisenberg, 1987; Zelman, Howland, Nichols, & Cleeland, 1991).

Dolce et al. (1986) observed that self-efficacy ratings were consistently associated with greater pain tolerance times, while pain ratings and tolerance times were not significantly correlated at any point. Litt (1988) adds that cognitive strategies do not appear to have any reliable effect on the experienced stressfulness or painfulness of the actual stimulus or on the physiological arousal it produces.

However, the opposite has also been found to be true. Manne et al. (1990) are quick to admit that their results were surprising, due to the fact that through their investigations it was apparent that other investigators have found behavioural interventions to reduce self-reported child pain. *Psychoanalgesia* has been upheld as a valid concept by Broome, Lillis, McGahee, and Bates

(1992), Cassens, Stalling, and Ahles (1988), Hodes et al. (1990), Miron, Duncan, and Bushnell (1989), and Stevens and Heide (1977), who add that in their study, the subjects who endured the pain for the longest times were able to do so because they perceived the pain the least. Hodes et al. (1990) found that an affectively neutral distracter significantly reduced pain ratings but did not affect pain tolerance. They inferred that because affectively neutral distraction only influenced pain ratings, the implication exists that this type of distraction alters processing in sensory pain systems.

Interestingly, Levine, Gordon, Smith, & Fields (1982) found a relationship between the frequency of pain ratings and pain level - where those individuals who rated their pain more frequently reported higher levels of pain. This finding is linked to the construct of attention, whereby in this case those individuals who monitored their pain level more intensely reported a higher degree of distress.

## THE MULTIDIMENSIONALITY OF PAIN

Much debate persists as to how pain threshold and pain tolerance relate to one another and which, if either, is a better measure of laboratory-induced painful stimulation. While Gelfand (1956; cited in Zatzick & Dimsdale, 1990) suggested that there is little relation between pain threshold and pain tolerance, Clark and Bindra (1956; cited in Zatzick & Dimsdale, 1990) demonstrated a high correlation between these two measures.

Several investigators (Chapman & Turner, 1986; Chen et al., 1989b; Price, 1988) have alleged that the reactive and sensory-discriminative dimensions of pain may be associated with different pain systems. This apparent physiological distinction is explained by Chapman and Turner (1986), who point out that the neurotransmitters and the neurotransmission pathways subserving the sensory aspect of pain are different from those involved with the affective dimension of pain. They add that although these complex factors are not fully understood, it is unequivocal that psychological interventions have a physiological rationale.

In terms of specific distracters, Hodes et al. (1990) state that affectively neutral distracters, such as focusing upon a light, are assumed to work by providing sensory input that competes with nociception for access to a limited capacity sensory processing mechanism. In contrast, manipulations that involve emotion modify pain by their influence on the emotional and evaluative processing of the painful stimulation. Hodes et al. (1990) summarise by saying that affectively potent distracters, such as positive imagery, should attenuate response in both neural pathways.

Wolff (1977) highlights the fact that there has been considerable speculation as to the theoretical and conceptual implications of the various pain response parameters. According to Gelfand (1956; cited in Wolff, 1977), pain threshold is basically a response parameter measuring the physiologic or sensory components of the pain response, whereas pain tolerance is more highly loaded with psychologic rather than physiologic elements.

This is supported by research undertaken by Marchand, Trudeau, Bushnell, and Duncan (1989) which stresses that the sensory components seem to have a proportionately greater role than psychological factors in determining pain threshold, while the reverse appears to be true of pain tolerance. Blitz and Dinnerstein (1968) affirm that tolerance is especially sensitive to motivational factors, while Chen et al. (1989b) emphasise affect. Stevens and Rogers (1990) suggest that, in accordance with their study and that of Stevens et al. (1989), pleasant affect per se triggers neuropharmacological mechanisms which mediate pain tolerance - again emphasising the biological aspect of the pain experience and establishing the link between physiological and psychological factors.

Ahles, Blanchard, and Leventhal (1983) concluded that pain threshold level is not affected by psychological manipulation at all - they believe that threshold is primarily determined by the physiological makeup of the individual and thus can only be altered through changing physiological parameters. However, as one can see, this assumption has never been firmly established, with a range of results indicating the effect to be partial rather than total. Studies like those outlined above emphasise the need to use multiple measures of pain, due to the fact that laboratory manipulations may affect only certain parts of the pain experience (Berntzen, 1987; Price, 1988; Zelman et al., 1991).

The demonstration that the sensation and distress components of the pain experience can be measured, at least partly, by the constructs of pain threshold and pain tolerance, challenges the traditional method of measuring the effectiveness of distraction by looking at threshold only. These pathways need to be confirmed in order to carry out clinical interventions to their maximum effectiveness level - especially when pain threshold and pain tolerance need to be dealt with independently.

## SUMMARY

It can be seen that cognitive coping strategies such as attention-diversion, and imagery, play a major role in the amelioration of both experimental and clinical pain. Although conflict exists as to the relative effects of distracters on specific measures such as pain threshold, pain tolerance, and pain ratings, there is general agreement regarding the potential efficacy of these techniques.

Pain is a multidimensional phenomenon and as such, requires assessment of the impact of various distracters upon all its components. It is theorised that pain threshold and pain tolerance measure different aspects of the total pain experience. Further research needs to be undertaken to pinpoint the interaction between such factors and bring their potential clinical benefits to fruition.

# CHAPTER FOUR

## THE PROPOSED RESEARCH

McCaul et al. (1992) stress the fact that only a few experiments have been undertaken that examine the supposition that distraction per se reduces pain perception and enhances pain threshold and pain tolerance. As highlighted in a previous section, critical reviews of investigations of procedures for pain management point to the multicomponent nature of clinical interventions, the partial overlap of presumably different manipulations, and the lack of information on the contribution of specific components and combinations of components to positive outcomes (Ludwick-Rosenthal & Neufeld, 1988).

Leventhal (1992) considers that what makes the McCaul et al. (1992) study important is "their effort to isolate one component of what is typically a complex experimental and/or clinical manipulation" (p.208). In doing so, Leventhal (1992) suggests that they point to a new set of questions to guide research and practice. These questions seek to identify the elements necessary for distraction to succeed in terms of pain amelioration, without being confounded with concepts such as expectancy, affect, and so on.

In addition, it appears that distraction may impact differently on the three *dimensions of pain identified by Melzack and Wall's (1965) gate control theory* -sensory-discriminative, motivational-affective, and cognitive-evaluative. Thus, there is a need to utilise multiple measures of the pain experience in order to explore this assumption. Previous research has indicated that pain threshold is basically a sensory measure; in contrast with pain tolerance which has been shown to reflect the motivational-affective component of pain (Chapman & Turner, 1986; Chen et al., 1989b; Gelfand, 1956, cited in Wolff, 1977; Marchand et al., 1989). Pain ratings, assumed to measure the physiological perception of pain (Hodes et al., 1990) are the most commonly utilised measure in the field of pain research.

## THE CURRENT STUDY

The primary objective of the current study is to compare the effects of three distraction conditions on three measures of pain. The three distraction conditions will be no-distraction, an imaginal distraction, and visual distraction. The measures are pain threshold, pain tolerance, and pain ratings.

It is predicted that imaginal distraction and visual distraction will be effective in enhancing both pain threshold and pain tolerance, when compared with the control condition. Moreover, due to the multidimensionality of the pain experience, it is expected that the visual detection task will enhance pain threshold more than the imagery distracter; and that alternatively, pain tolerance will be increased more when the individual is engaging in pleasant imagery than when they are being distracted by the visual detection task.

It is anticipated that pain ratings will be less when both distraction tasks are being undertaken, in comparison to the control condition. No predictions are made as to which of the distraction tasks will be more effective in the reduction of pain ratings.

Gender differences are predicted in accord with the general consensus - that males will have higher pain threshold and pain tolerance levels than females.

The specific hypotheses to be tested are:

(1) Both distracter tasks will be effective in raising pain threshold and pain tolerance when compared to the control condition.

(2) The visual distracter will be more effective in raising pain threshold than the imaginal distracter.

(3) The imaginal distracter will be more effective in raising pain tolerance than the visual distracter.

(4) Pain ratings will be reduced in both distraction conditions in comparison with the control condition.

(5) Males will have higher pain threshold and pain tolerance levels than females.

# CHAPTER FIVE

## METHOD

### SUBJECTS

The subjects were 30 volunteers who agreed to participate in an experiment on various pain parameters and distraction. There were 18 males and 12 females. The mean age was 23.1 years.

Prior to participation, subjects were required to read and complete a brief document containing -

(a) an outline of the nature of the experiment

(b) a consent form

(c) a short medical checklist to ensure the avoidance of any contraindicating conditions (see Appendices A, B, and C).

APPARATUS

All experimental pain stimulus presentations as well as the visual distracting stimulus were controlled by an IBM PC computer. All subject responses were recorded by the same computer.

THE PAIN STIMULUS

Iontophoresis is defined as "the migration of ions when an electrical current is passed through a solution containing ionised species" (Tyle, 1988, p.422), which causes a prickling sensation at lower levels of stimulation, and a burning feeling at higher levels. The few studies that have utilised potassium iontophoresis to engender pain (Benjamin & Helvey, 1963; Breakwell, 1992; Voudouris et al., 1985) have testified that potassium iontophoresis possesses many of the properties expected of an experimental pain stimulus.

The degree of noxious stimulation is dependent upon the amount of current and the duration of administration, and is independent of skin resistance (Benjamin & Helvey, 1963). Pain produced in this way is thought to be linear in nature - there being a correspondence between amperage and pain experienced (Benjamin & Helvey, 1963; Humphries & Johnson, 1990; Voudouris et al., 1985). There are no session effects, at least up to a period of three days (Voudouris, 1981; cited in Voudouris et al., 1985).

Although differences between subjects may be large, there is relatively small intra-subject variability (Benjamin & Helvey, 1963). The intra-subject reliability of response to iontophoretic potassium stimulation, as well as its capacity to be presented repeatedly and rapidly, makes it feasible for repeated-measure experimental designs (Breakwell, 1992).

IONTOPHORETIC PAIN GENERATOR

The pain stimulus was delivered by an iontophoretic pain generator designed and developed in the Massey University Psychology Department. This device consisted of a constant-current power source, and was designed to deliver a selected current ranging between 0 and 25 milliamps - beyond which an automatic cutoff switch terminated the stimulus.

ELECTRODE PLACEMENT

Electrode placement was similar to that of Breakwell (1992), Benjamin and Helvey (1963) and Voudouris et al. (1985), with the cathode secured to the volar surface of each subject's right forearm, and the anode situated exactly opposite on the dorsal surface of the forearm. Two elastic straps were used to fasten the electrode next to each subject's arm. The anode consisted of a plastic ring which converted into a bowl using the dorsal surface of the subject's arm as a base. Once filled with a potassium chloride solution (3% w/w), there was a surface area of $12.5cm^2$ of solution in direct contact with the subject's skin. To reduce seepage of the solution between the bowl and the arm, 1g of agar was added per 100ml of potassium chloride solution. The cathode consisted of a 4cm x l3cm silver plate covered with several layers of saline-saturated medical gauze (4% w/w sodium chloride) (see Figure 1).

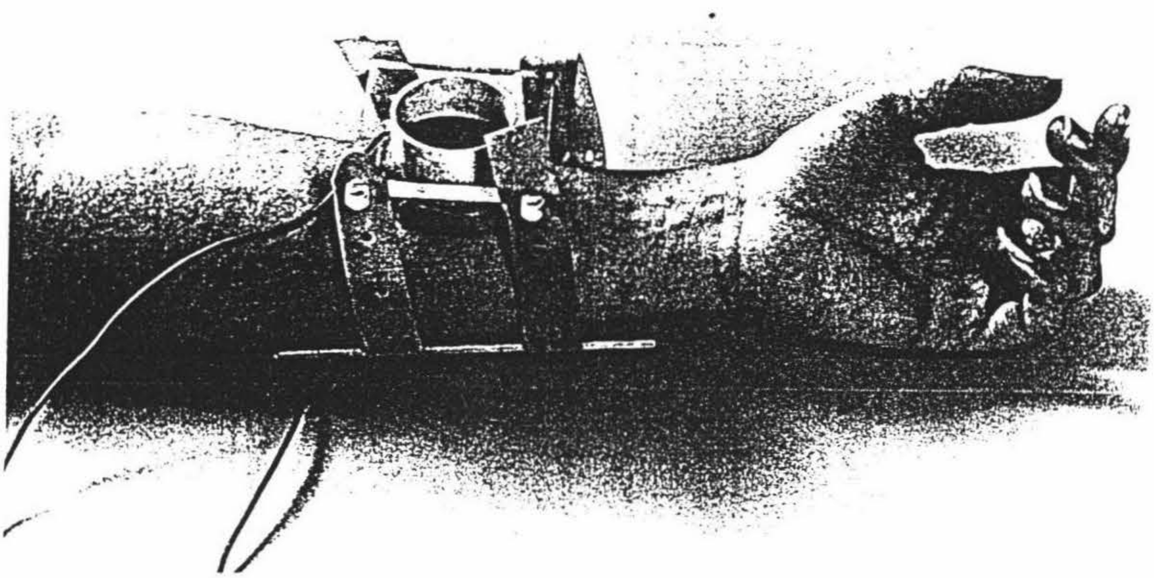

**Figure 1: Electrode Placement in the Iontophoretic Administration of Potassium Ions**

DELIVERY OF THE PAIN STIMULUS

The stimuli were presented in 5 trial blocks which were identical in configuration across all subjects and all experimental manipulations. The iontophoretic trials within each block varied in the delay before the stimulus was initiated, and in the rate of increase in current (ramp rate). These were altered to avoid the anticipation of pain sensation with respect to time. The current was also ramped to avert the sensation of electric shock associated with sudden current changes (Balogun, 1986). With regard to the ratings trials, their intensities were determined by the preceding tolerance trial - that is, being 50% of that tolerance trial.

## MEASURES

### PAIN THRESHOLD MEASUREMENT

In order to obtain a pain threshold measure, the subjects were instructed to press a button at the point when they first felt that the stimulus was painful. The pressure on the button stopped stimulation and recorded pain threshold in milliamps.

### PAIN TOLERANCE MEASUREMENT

In order to obtain a pain tolerance measure, the subjects were instructed to press a button when they felt that they had had enough of the stimulus. The pressure on the button stopped stimulation and recorded pain tolerance in milliamps.

### PAIN RATINGS

In order to obtain pain ratings, a visual analogue scale (VAS) was employed. Pain measures should be valid, measuring unequivocally a specific dimension of pain, and reliable, yielding consistent results over time. They should also be versatile, applicable both for experimental pain and for acute and chronic clinical pain and practical in a variety of medical settings (Price, McGrath, Rafii, & Buckingham, 1983). VAS, a form of cross-modality matching, in which line length is the response continuum, have been recounted as valid and reliable measures for the intensity of pain (Duncan, Bushnell, & Lavigne, 1989; Jensen, Karoly, & Braver, 1986; Price et al., 1983; Sriwatanakui, Kelvie, Lasagna, Calimlim, Weis, & Mehta, 1983).

The apparent simplicity of the technique and its adaptability to a wide range of research settings have made it an attractive measurement option. Proponents have claimed that VAS are simple to construct, quick and easy to administer and score, suitable for frequent and repeated use, easily understood by subjects, very sensitive with a discriminating capacity superior to other scales, requiring little motivation for completion by subjects, suitable for use by untrained staff, and allowing the use of numerical values suitable for statistical analysis (Chapman et al., 1985; Deschamps, Band, & Coldman, 1988; McCormack, DelHorne, & Sheather, 1988).

The length of the scale in the present study was 150mm, with the anchor phrases being 'no pain sensation at all' and 'very strong pain sensation'. No intervals were marked on the scale between these anchors. Situated on a computer screen, responses were made by each subject via appropriately labelled buttons (see Figure 2).

| | |
|---|---|
| NO PAIN SENSATION ______________________________ | VERY STRONG PAIN |
| AT ALL | SENSATION |

**Figure 2: The Visual Analogue Scale**

THE DISTRACTERS

Two forms of distraction were used:

(a) a visual (light) distracter

(b) an imagery distracter (engaging in positive imaginings)

(a) The Visual Distracter

The visual distracting apparatus involved a circular 15mm diameter red light positioned at the end of a 610mm long (250mm wide x 300mm high) darkened tunnel. The light was designed to deliver 1 second light pulses which would brighten and then fade back to the base light intensity of 3.0 NITS (candellas/$m^2$ as measured by a Tetronix J523-2 1 Narrow Angle Luminance Probe). A variable delay ranging between 5 and 15 seconds occurred between pulses to minimise the expectation of each delivery.

Subjects were seated in front of the tunnel with their head resting in the entrance. Subjects responded by pressing a button each time they discerned a stimulus pulse, and these responses were recorded by the same computer apparatus being used for all other aspects of the study.

(b) The Imagery Distracter

Instructions promoting positive imaginings were similar to those used by Grimm and Kanfer (1976) where subjects were encouraged to imagine their ideal holiday destination. These were used because the relative effect associated with the positive imagery condition in the Grimm and Kanfer (1976) study was among the highest of those evaluated by Fernandez and Turk (1989).

## PROCEDURE

## EXPERIMENTAL DESIGN

The design utilised in this study was a three (conditions) by three (measures) repeated-measures design. A repeated-measures design was used to reduce the impact of inter-subject variability known to be associated with the pain producing properties of iontophoretically delivered potassium ions (Benjamin & Helvey, 1963). The measures were presented in the same order for all subjects (that is, pain threshold, pain tolerance, pain ratings); however, the conditions (control, visual distraction, imaginal distraction) - were administered in a predetermined counterbalanced series, in order to avoid potential sequence effects.

All subjects were required to attend two sessions, of approximately 20 minutes and 50 minutes respectively -

(a) Familiarisation session

(b) Experimental session

(a) FAMILIARISATION SESSION

The purpose of this session was (i) to decrease anxiety related to experimentation and the anticipated pain stimulus, and (ii) to familiarise the subjects with the tasks required in the experimental session.

The protocol for the familiarisation session was the same for all subjects. Following an overview of the experiment, in which each subject was told that the purpose of the familiarisation session was to decrease anxiety related to the experimental manipulation and to acquaint them with the tasks to be used in the experimental session, (1) the light detection procedure was conducted, and (2) the iontophoretic preparation protocol and familiarisation exercise was undertaken.

(1) light detection procedure - each subject was seated comfortably in front of a darkened tunnel which contained the red light. They were then read the following instructions which were repeated if the subject appeared unsure of the task:

"First I would like to acquaint you with the visual detection task. What it involves is you focusing on the red light in front of you. This light is going to brighten and then fade back to its current brightness. Every time that you notice a change, I want you to press this 'detect' button. Do you understand?"

Subjects were then presented with the series of stimuli used for the light detection task, shown in Table 1. These five trials of ascending brightness were repeated to ensure that the subjects' responses were valid.

**Table 1: Schedule of Light Pulses in Familiarisation Session**

| TRIAL | DURATION (s) | INTERVAL (s) | INTENSITY |
|---|---|---|---|
| 1 | 10 | 10 | 2 |
| 2 | 20 | 10 | 4 |
| 3 | 30 | 10 | 6 |
| 4 | 40 | 10 | 8 |
| 5 | 50 | 10 | 10 |

(2) iontophoretic preparation protocol and familiarisation exercise - prior to the application of the electrodes, the volar and dorsal surfaces of each subject's forearm were cleaned by briefly rubbing with distilled water, followed by an 80:20 solution of alcohol and acetone, and then again with distilled water. This formality was performed to lower and stabilise skin resistance - allowing for more consistent pain responding. Additionally, the block of 5 iontophoretic trials comprising 3 threshold and 2 tolerance trials was then given (but the data were not recorded). These schedules can be seen in Tables 2 and 3 respectively. A ratings trial followed each of the two tolerance trials.

**Table 2: Familiarisation Session/Threshold Trials**

| TRIAL | STIMULUS DELAY (s) | RAMP RATE (mA) |
|---|---|---|
| 1 | 5 | 30 |
| 2 | 10 | 25 |
| 3 | 5 | 30 |

**Table 3: Familiarisation Session/Tolerance Trials**

| TRIAL | STIMULUS DELAY (s) | RAMP RATE (mA) |
|---|---|---|
| 1 | 5 | 30 |
| 2 | 0 | 25 |

In anticipation of this preparation block of trials, subjects were given the following instructions (as appropriate):

"Now I would like to familiarise you with the pain stimulus. What I want you to do is to press the button when you first feel that the stimulus is painful, and the stimulation will immediately stop. Do you understand?"

"Now what I want you to do is to press the button when you have had enough, and the stimulation will instantly stop. Okay? After 15 seconds, you will feel a 4 second trial of stimulus somewhere between your threshold and tolerance level. A scale will then appear on the screen - I want you to rate the pain level of that 4 second trial using these buttons. Do you understand?".

This was performed because repeated iontophoretic stimulation has been found to lower skin resistance, which in turns leads to optimal pain responding (Humphries, 1989). Note that this procedure was also followed at the beginning of each experimental session.

(b) EXPERIMENTAL SESSION

Prior to receiving the different experimental manipulations, each subject underwent the standard preparation protocol involving forearm scrub; electrode placement; and preliminary block of iontophoretic trials (this was performed according to the procedure outlined in the familiarisation session). The delivery of the pain stimulus was the same across all subjects. After receiving this preliminary block of trials, each subject then received 6 blocks of 5 trials, counterbalanced as mentioned previously (see Table 4).

There was a 20 second delay between each trial, and a 2 minute delay between blocks. These delays allowed time for the subjects to be instructed about the required tasks and reduced the potential for habituation or sensitisation to the pain stimulus. In addition to the breaks between trials, there was also a within-trial period ranging from 0 to 10 seconds before the onset of iontophoretic stimulation. This allowed time for the subjects to engage in the stipulated distracter tasks before the onset of iontophoretic stimulation, and reduced anticipation of the pain stimulus.

**Table 4: Schedule For All Experimental Sessions**

| TRIAL | STIMULUS DELAY (s) | RAMP RATE (mA) |
|---|---|---|
| 1 | 5 | 30 |
| 2 | 0 | 20 |
| 3 | 10 | 25 |
| 4 | 5 | 15 |
| 5 | 0 | 20 |

(i) Visual distraction - before commencing this block of trials, subjects were given the following instructions (as appropriate):

"For this block of 5 trials, I want you to press the button when you first feel that the stimulus is painful. However, at the same time I would like you to be focusing on the red light in front of you. This light is going to brighten and then fade back to its current brightness. Every time that you notice a change, I want you to press the 'detect' button. Do you understand?"

"For this block of 5 trials I want you to press the button when you have had enough, and the stimulation will stop. However, at the same time, I want you to be focusing on the red light, pressing the 'detect' button whenever you notice a change. Do you understand? Following each tolerance trial, after 15 seconds you will feel a 4 second trial of stimulus somewhere between your threshold and tolerance level. When this occurs, I want you to still be focusing on the red light in front of you. A scale will appear on the screen; I would like you to rate the pain level of that 4 second trial using these buttons. After you have done so, there will be a 20 second break, and then another trial will begin. Do you understand?".

The instructions were read twice to all subjects, and when the experimenter was sure the instructions were clear, she said "Ready?" and started the first of the 5 trials. Prior to each subsequent trial, the experimenter said either "Same again" or "Continue pressing the 'detect' button each time you see the light change".

(ii) Imaginal distraction - Prior to commencing the block of trials, subjects were given the following instructions (as appropriate):

"For this block of 5 trials, I want you to press the button when you first feel that the stimulus is painful. However, at the same time I want you to perform an imaginal task. First I want you to select a place that would rate as one of your ideal holiday destinations" (let subject acknowledge this). "During each trial I want you to focus all your attention on imagining yourself at this place. I want you to picture the surroundings, the people, the sounds, and all the images related to you being at this place. At the end of this block of trials, I will ask you briefly about your imaginings. Do you understand?"

"For this block of 5 trials, I want you to press the button when you have had enough, and the stimulation will stop. However, at the same time I want you to perform the same imaginal task. During each trial I want you to focus all your attention on imagining yourself at this place. I want you to picture the surroundings, the people, the sounds, and all the images related to you being at this place. Do you understand? Following each tolerance trial, after 15 seconds you will feel a 4 second trial of stimulus somewhere between your threshold and your tolerance level. When this occurs, I want you to be imagining your ideal holiday destination. A scale will appear on the screen. I would like you to rate the pain level of that 4 second trial using these buttons. After you have done so, there will be a 20 second break, and then another trial will begin. At the end of this block of trials I will ask you briefly about your imaginings. Do you understand?".

The instructions were read twice to all subjects, and once the experimenter was sure the instructions were clear, she said "Ready?" and started the first of the 5 trials. Prior to each subsequent trial the experimenter said either "Same again" or "Okay, continue to imagine yourself at this place, and all the images related to this wonderful holiday".

(iii) Control (no-distraction) - Prior to commencing this block of trials, the subjects were given the following instructions (as appropriate):

"For this block of 5 trials, I want you to press the button when you first feel that the stimulus is painful. Do you understand?"

"For this block of 5 trials I want you to press the button when you have had enough, and the stimulation will stop. Do you understand? Following each tolerance trial, after 15 seconds you will feel a 4 second trial of stimulus somewhere between your threshold and tolerance level. A scale will appear on the screen; I would like you to rate the pain level of that 4 second trial using these buttons. After you have done so, there will be a 20 second break, and then another trial will begin. Do you understand?".

The instructions were read twice to all subjects, and when the experimenter was sure the instructions were clear, she said "Ready?" and started the first of the 5 trials. Prior to each subsequent trial, the experimenter said either "Same again" or "Continue to press the button when you first feel that the stimulus is painful/until you have had enough".

FOLLOW-UP

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

# CHAPTER SIX

## RESULTS

To enable data analyses, the threshold, tolerance, and ratings data were averaged for each 5-trial block - thus generating a mean score for the control, imaginal, and visual distraction conditions for each of the thirty subjects.

### INTERACTION BETWEEN MEASURES AND CONDITIONS

To assess whether there was an interaction effect between the measures and the conditions, a repeated measures multivariate analysis (MANOVA) was undertaken using SPSS/PC - the Statistics Package for Social Sciences. The Pillias test was the main test used throughout the MANOVAs.

The analysis of data indicated that the assumptions for this procedure were met:

(i) Use of interval data

(ii) Normality of the data distribution in all cases (by skew and kurtosis centred around 1.00)

(iii) Equal variances for all groups (standard deviations similar in all cases)

A MANOVA was carried out to see whether the observed changes across the distracters depended upon whether a threshold or a tolerance measure was used.

The main effect for condition was ($F(2,28) = 6.48$, $p < .01$).

The main effect for measure was ($F(2,58) = 7.42$, $p < .01$).

The measure by condition interaction effect was not significant - ($F(2,28) = 0.66$, $p > .05$). Figure 2 displays the measure-by-condition interaction effect.

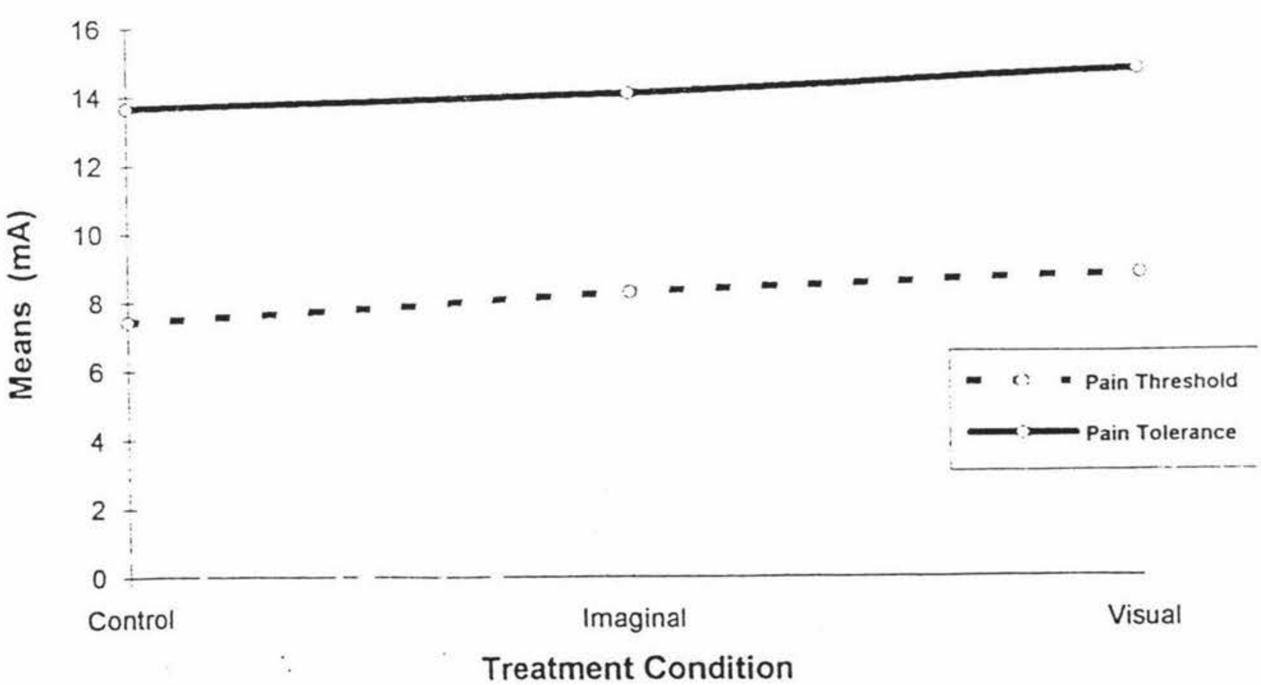


**Figure 3: The Measure-by-Condition Interaction Effect**

PAIN THRESHOLD

The first hypothesis predicted that both distracter tasks would be effective in raising pain threshold when compared to the control condition. Overall means and standard deviations of pain threshold for all three distraction conditions can be seen in Table 5.

**Table 5: Overall Means and Standard Deviations of Pain Threshold for the Different Distraction Conditions**

| TREATMENT CONDITION | PAIN THRESHOLD (mA) | |
|---|---|---|
| | mean | sd |
| Control | 7.41 | 3.80 |
| Imaginal | 8.30 | 4.03 |
| Visual | 8.81 | 5.11 |

To compare the effects of the three distraction conditions (control, imaginal, and visual) on pain threshold, paired t-tests were performed. This analysis is associated with the hypothesis that the visual distracter would be more effective in raising pain threshold than the imaginal distracter. The outcome of the analysis is presented in Table 6.

**Table 6: t and 2-tailed p-values Obtained from Paired t-tests Comparing Pain Threshold Across the Different Distraction Conditions**

| | | |
|---|---|---|
| Control vs Imaginal | $t(29) = -2.02$ | $p > .05$ |
| Control vs Visual | $t(29) = -2.43$ | $p < .05$ |
| Imaginal vs Visual | $t(29) = -1.11$ | $p > .05$ |

Table 6 shows that involvement in the visual distraction task was associated with a significant (at .05 confidence level) increase in pain threshold when compared to the control condition. However, when comparisons were drawn between imaginal distraction and visual distraction, and between the control condition and the imaginal distraction, and their relative effects on pain threshold, the effects were non-significant.

PAIN TOLERANCE

The first hypothesis stated that both distracter tasks would be effective in raising pain tolerance (as well as pain threshold as mentioned previously) when compared to the control condition. Overall means and standard deviations for pain tolerance for all three distraction conditions can be seen in Table 7.

**Table 7: Overall Means and Standard Deviations of Pain Tolerance for the Different Distraction Conditions**

| TREATMENT CONDITION | PAIN TOLERANCE (mA) | |
|---|---|---|
| | mean | sd |
| Control | 13.66 | 6.28 |
| Imaginal | 14.08 | 6.38 |
| Visual | 14.75 | 6.32 |

To compare the effects of the three distraction conditions (control, imaginal, and visual) on pain tolerance, a MANOVA was undertaken. A significant effect was found for pain tolerance and the different distraction conditions ($F(2,28) = 6.92$, $p < .01$).

Having found an overall MANOVA effect, paired t-tests were performed to compare the differences between each of the distraction conditions. This analysis is associated with the fourth hypothesis which predicted that the imaginal distracter would be more effective in raising pain tolerance than the visual distracter. The outcome of the analysis can be seen in Table 8.

**Table 8: t and 2-tailed p-values Obtained From Paired t-tests Comparing Pain Tolerance Across the Different Distraction Conditions**

| | | |
|---|---|---|
| Control vs Imaginal | $t(29) = -1.27$ | $p > .05$ |
| Control vs Visual | $t(29) = -3.67$ | $p < .01$ |
| Imaginal vs Visual | $t(29) = -1.83$ | $p > .05$ |

Table 8 shows that involvement in the visual distraction task was associated with significant (to a .01 confidence level) increase in pain tolerance when compared to the control condition. However, when imaginal and visual distractions, and control and imaginal distractions, were compared in relation to pain tolerance, no significant effects were found.

PAIN RATINGS

It was hypothesised that pain ratings would be reduced in both distraction conditions in comparison with the control condition. Overall means and standard deviations of pain ratings for all three distraction conditions can be seen in Table 9.

**Table 9: Overall Means and Standard Deviations of Pain Ratings (as measured on a VAS) for the Different Distraction Conditions**

| TREATMENT CONDITION | PAIN RATINGS | |
|---|---|---|
| | mean | sd |
| Control | 66.07 | 32.64 |
| Imaginal | 62.85 | 33.61 |
| Visual | 60.77 | 34.64 |

Table 10 shows the ratings divided by the milliamp (mA) level of the previous tolerance trial. This was undertaken so as to control for the fact that differences were likely to occur when subjectively rating a pain level if one is comparing the 4-second stimulus to a greater/lesser preceding tolerance trial.

**Table 10: Overall Means and Standard Deviations of Pain Ratings [ratings(VAS)/tolerance(mA)] for the Different Distraction Conditions**

| TREATMENT CONDITION | PAIN RATINGS | |
|---|---|---|
| | mean | sd |
| Control | 4.07 | 3.97 |
| Imaginal | 3.74 | 3.29 |
| Visual | 3.82 | 3.38 |

To compare the effects of the three distraction conditions on pain ratings, a MANOVA was undertaken. No significant effect was found ($F(2,28) = 0.90$, $p > .05$).

GENDER EFFECTS

An analysis of gender was undertaken to check whether there were any differences between males and females in terms of their pain threshold levels, pain tolerance levels, how they rated the pain, and whether different distraction conditions and measures had varying impacts according to what sex the subject was.

It was predicted that males would have higher pain threshold and pain tolerance levels than females. Tables 11 and 12 show overall means and standard deviations of pain threshold and pain tolerance for both males and females in all three distraction conditions.

**Table 11: Overall Means and Standard Deviations of Pain Threshold for the Different Distraction Conditions by Gender**

| TREATMENT CONDITION | PAIN THRESHOLD (mA) | | | |
|---|---|---|---|---|
| | mean | | sd | |
| | M | F | M | F |
| Control | 8.20 | 6.23 | 3.58 | 3.97 |
| Imaginal | 8.80 | 7.53 | 3.35 | 4.94 |
| Visual | 9.56 | 7.69 | 5.07 | 5.18 |

**Table 12: Overall Means and Standard Deviations of Pain Tolerance for the Different Distraction Conditions by Gender**

| TREATMENT CONDITION | PAIN TOLERANCE (mA) | | | |
|---|---|---|---|---|
| | mean | | sd | |
| | M | F | M | F |
| Control | 15.54 | 10.86 | 6.30 | 5.32 |
| Imaginal | 15.76 | 11.55 | 6.34 | 5.79 |
| Visual | 16.37 | 12.34 | 6.52 | 5.38 |

Displayed in Table 13 are ratings by gender as measured on the visual analogue scale presented to the subjects. However, in Table 14 are the ratings when divided by the milliamp (mA) level of the previous tolerance trial.

**Table 13: Overall Means and Standard Deviations of Pain Ratings for the Different Distraction Conditions by Gender**

| TREATMENT CONDITION | PAIN RATINGS | | | |
|---|---|---|---|---|
| | mean | | sd | |
| | M | F | M | F |
| Control | 67.14 | 64.47 | 31.02 | 35.14 |
| Imaginal | 59.08 | 68.52 | 34.51 | 31.64 |
| Visual | 60.13 | 61.73 | 33.51 | 36.55 |

**Table 14: Overall Means and Standard Deviations of Pain Ratings [ratings(VAS)/tolerance(mA)] for the Different Distraction Conditions by Gender**

| TREATMENT CONDITION | PAIN RATINGS | | | |
|---|---|---|---|---|
| | mean | | sd | |
| | M | F | M | F |
| Control | 3.13 | 5.48 | 2.23 | 5.40 |
| Imaginal | 3.30 | 4.41 | 2.53 | 4.13 |
| Visual | 3.05 | 4.60 | 1.89 | 4.88 |

The gender by measure interaction was non-significant ($F(2,27) = 2.23$, $p > .05$). Gender by condition was not found to be significant ($F(2,27) = 0.15$, $p > .05$). Gender by measure by condition was not found to be significant ($F(4,25) = 1.30$, $p > .05$).

## AVERAGE PAIN THRESHOLD AND AVERAGE PAIN TOLERANCE ACCORDING TO GENDER

To separate the effect of each measure, an average was taken of threshold, and of tolerance, across all three distraction conditions, according to gender. These averages can be seen in Table 15, and graphically in Figure 3.

**Table 15: Overall Means and Standard Deviations of Average Pain Threshold and Average Pain Tolerance According to Gender**

| GENDER | PAIN THRESHOLD (mA) | | PAIN TOLERANCE (mA) | |
|---|---|---|---|---|
| | mean | sd | mean | sd |
| Male | 8.85 | 3.70 | 15.89 | 6.33 |
| Female | 7.15 | 4.54 | 11.58 | 5.38 |

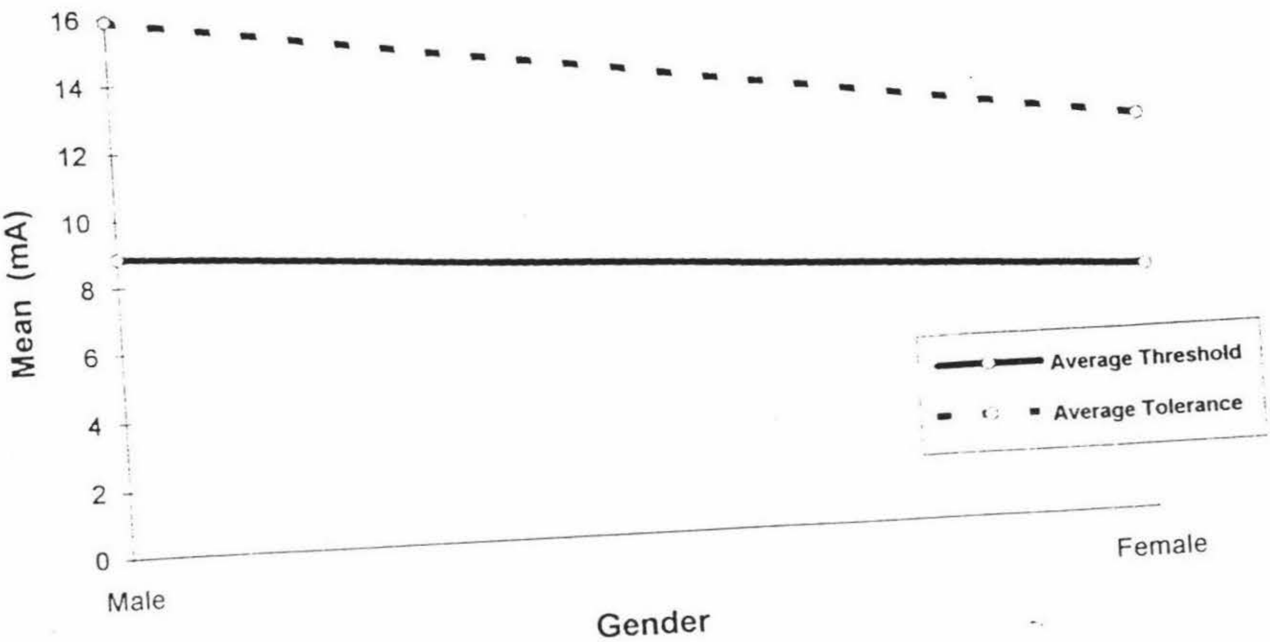


**Figure 4: Average Pain Threshold and Average Pain Tolerance by Gender**

Independent t-tests compared gender with average threshold, and gender with average tolerance. Males did not have a significantly higher average pain threshold than females ($t(28) = 1.13$, $p > .05$). Similarly, males were also found to not have a significantly higher average pain tolerance level than females ($t(28) = 1.94$, $p > .05$).

# CHAPTER SEVEN

## DISCUSSION

### REVIEW OF HYPOTHESES AND FINDINGS

In general, research indicates that distraction enhances both pain threshold and pain tolerance, and has a positive effect on the management of pain (Fernandez & Turk, 1989; McCaul & Malott, 1984). The primary objective of the present study was to compare the effects of three different distraction conditions on three pain parameter measures. This was undertaken in order to assess whether different distracters have a varied impact depending on the pain measure used -be it pain threshold, pain tolerance, or pain ratings.

Pain ratings, which have been assumed to measure the perception of pain (Hodes et al., 1990), were assessed to evaluate whether the distraction conditions impacted not just upon pain threshold or pain tolerance, but on the actual sensation of pain.

It was hypothesised that the distracter tasks used in the present study would be effective in raising pain threshold and pain tolerance when compared to the control condition. To examine this, two distraction conditions were utilised: a visual detection task which required the subject to discern small changes in a low level light stimulus; and the engagement in positive imagery. As predicted, both distraction treatment conditions produced significantly higher pain tolerance levels than the control condition. However, a significant result was not obtained for pain threshold in either distraction condition, in comparison to the control condition. Thus, the first hypothesis, that 'distraction works' in enhancing pain threshold and pain tolerance, was supported for pain tolerance but not for pain threshold.

Following the establishment of the basic notion that distraction can attenuate pain in general, the question arose regarding the efficacy of specific distracters on different aspects of the pain experience.

Prior research has suggested that pain threshold is primarily determined by sensory components, and pain tolerance through psychological/motivational factors (Chen et al., 1989b; Marchand et al., 1989; Wolff, 1977; Zelman et al., 1991). It was hypothesised that the visual detection task would be more effective in raising pain threshold than the imagery distracter. Conversely, it was hypothesised that the imagery distracter would be more effective in raising pain tolerance than the visual distracter.

Findings showed that the visual distracter was more effective in raising pain threshold than the imaginal distracter, supporting the second hypothesis of the present study. However, pain tolerance was also found to be enhanced more when the visual distracter was used in comparison with the imaginal distracter - failing to support the third hypothesis which predicted the opposite.

The fourth hypothesis predicted that pain ratings would be reduced in both distraction conditions in comparison to the control condition. Despite directional findings supporting the hypothesis, no significant effects were found.

Gender was a factor that was investigated with respect to pain threshold and pain tolerance. It was hypothesised that males would have higher pain threshold and pain tolerance levels than females. This was not supported in any of the three treatment conditions.

## THEORETICAL IMPLICATIONS

### THE LINK BETWEEN MEASURES AND DISTRACTERS

As highlighted earlier, the literature suggests that pain threshold is essentially a sensory measure, in comparison with pain tolerance which tends to incorporate a more motivational-affective component (Chen et al., 1989b; Marchand et al., 1989; Wolff, 1977; Zelman et al., 1991). The inference that these dimensions may be associated with different aspects of pain processing accentuates the need for studies that examine specific types of distracters.

This is what the present study aimed to accomplish - to explore the relative impact of different distracters on different pain outcome measures. Thus, it was assumed that the sensory components of pain, such as pain threshold, would be altered by affectively neutral distractions such as the visual detection task. Alternatively, positive imagery would be expected to impact more upon emotional processing and so have more of an effect on pain tolerance.

Berntzen (1987) emphasises the implications of this statement by pointing out that when pain becomes too intense for an individual to deal with using one specified coping strategy, they should switch to another - taking into account personal style and the intensity of the stimulus. This proposition, that individuals are able to cope better with pain at different intensity levels by employing dissimilar coping strategies, follows the work of McCaul and Malott (1984). Indeed, the practical application of this would be to compose one or several techniques for each person in order to design individualised programmes for the management of pain.

In the present study, the visual detection task was found to enhance pain threshold more than when the imaginal distracter was engaged in. However, in contrast to predictions, the visual distracter also increased pain tolerance more than the imaginal distracter did.

## THE VISUAL DISTRACTER

There are a number of possible reasons why the visual detection task proved to be the most effective distracter in enhancing pain tolerance in this study. Frisby (1980) discusses the conviction that vision is one of, if not the most, dominant sense a human possesses. This may have been a major factor in the determination of the visual distracter's ability to consume more of the limited reservoir of attention of the subjects than the positive imagery did.

Additionally, this effect may have been compounded because of the competitive nature of the visual detection task. The motivation to succeed may have led to an increase in the degree of concentration applied to the task. This increase in concentration may have inflated the apparent efficacy of the visual distracter by introducing a confounding variable - motivation level. This contrasts with the imaginal distracter which did not embody a 'test' component.

## THE IMAGINAL DISTRACTER

A significant difference was not found between the imaginal distracter and the control condition in both pain threshold and pain tolerance measures, and the efficacy of imagery as a distracter in comparison with the visual distracter was not as the literature commonly suggests (Fernandez & Turk, 1989; Pearson, 1987; Stevens et al., 1989). As highlighted previously, Fernandez and Turk (1989) found imagery to be the most effective distraction technique in their recent meta-analysis. Breakwell (1992), who found imagery to be the least effective distracter when matched with somatic and visual distracters, holds that one should question the advisedness of drawing too strong a conclusion from meta-analyses such as Fernandez and Turk's (1989) without direct experimental verification.

One possible reason why imagery did not perform as initially expected could be that subjects were not actually engaging in imagery. Imagery is such an intangible process that it is difficult to confirm if subjects are engaging in the experimental manipulation during the entire period of painful stimulation (Avia & Kanfer, 1980; Scott & Barber, 1977). In the present study, the monitoring of each subject's level of imaginal engagement was achieved by the experimenter asking what each subject envisioned during every imagery trial. This has been previously recommended by Turk et al. (1983) who stressed that studies should contain manipulation checks to ensure that subjects use the strategies outlined to them by the researcher.

This highlights another potential problem - the implementation of the subject's own personal coping strategies. Individuals entering a pain study already have general adaptive coping skills in their repertoires which they may employ. Moreover, brief training in specific coping skills such as imagery may even interfere with subjects' preferred modes of coping (Turk et al., 1983). This issue was dealt with in the present study to a certain degree, by the reiteration of clear and non-biased instructions by the experimenter at the beginning of each trial. These directives clarified what was to be expected from the subject during each set of conditions.

However, as Devine and Spanos (1990) point out, individual differences in personality or skill variables may influence the efficacy of a technique such as imagery. For example, skill factors such as the capacity to enact a strategy that involves imagining may affect the performance of that strategy. This premise is supported by Jaremko (1978) who adds that in his study, those subjects who used imagery the least actually showed a negative effect - that is, their post-test pain threshold dropped below their pre-test pain threshold level.

Yet a recent study by Spanos and O'Hara (1989) failed to support the proposition that success at using imagery strategies for pain reduction is facilitated by general imaginal properties. This is supported by Worthington (1978) who emphasises that high vividness of imagery scale scores are not predictive of an enhanced pain tolerance when imaginal distraction is used. The present study maximised each individual's potential for vivid thoughts by allowing each subject to choose their own 'ideal holiday destination'.

## PAIN RATINGS AND PAIN PERCEPTION

The present study found that pain ratings did not decrease significantly when a distracter was utilised, in comparison with the control condition.

In general, past literature supports the finding that pain perception *is* lowered when distraction is implemented as a pain management strategy (Broome et al., 1992; Cassens et al., 1988; Hodes et al., 1990; Miron et al., 1989). However, conflicting views do exist (Berntzen, 1987; Litt, 1988; Malone et al., 1989; Manne et al., 1990; Zelman et al., 1991). For example, Malone et al. (1989) found that although hypnotic-relaxation suggestion reduced the unpleasantness of pain, it did not alter the perceived intensity of the stimuli. Further, as mentioned earlier, Hodes et al. (1990) pinpointed the fact that even if pain ratings do decrease as a direct result of distraction, this does not necessarily mean that pain threshold or pain tolerance increases.

This suggests the need for further research investigating the link between pain tolerance and actual pain perception. The assumption that the enhancement of pain tolerance reduces the experience of pain needs to be investigated in order that pain management strategies be optimised in a clinical setting. Practitioners and researchers must be cautious in equating less behavioural response with less distress and more optimal outcomes (Broome et al., 1992). Overall, research proposes that emotionally-neutral distraction will be the most beneficial in reducing pain perception when an individual is exposed to relatively brief painful stimulation (Hodes et al., 1990). Thus, for persistent or chronic pain, the choice of distraction technique should not be guided by the distracter's attentional demands but by the attempt to either modify an individual's emotional state, or an individual's appraisal or evaluation of their pain.

EXPECTANCY EFFECT

McCaul et al. (1992), when assessing the efficacy of distraction, discussed the issue of expectancy effects. They argued that, in short, it is possible that distraction does prove to be effective because subjects tend to hold a 'commonsense' belief in its efficacy. An individual's beliefs should theoretically influence their expectations about their ability to cope.

Indeed, McCaul and Haugvedt (1982) found that when subjects are given a choice of a pain management strategy, there is a strong tendency for them to prefer distraction. Similarly, Leventhal, Leventhal, Shachman, and Easterling (1989) found that subjects gave very high ratings to distractive procedures for effective pain control and very low ratings to sensation monitoring, even though monitoring proved to be the most effective analgesic.

Although expectancies were not investigated, there is evidence enough to suggest that the present study's results were not confounded by such a variable. If the 'expectancy hypothesis' was a contributing factor in the present study, one would expect there to be no difference between the effects of the visual distracter and the imaginal distracter - as expectations presumably would have been the same in each condition. The differences found in the present study between the two distracters, in both pain threshold and tolerance measures, trended in the predicted direction. These findings are analogous to Breakwell's (1992), who reported a difference between somatic distraction and visual distraction; similarly, Williams and Kinney (1991) found a difference between three distraction tasks, even when expected outcomes were taken into account.

McCaul et al. (1992) and Leventhal (1992) admit that there need to be experiments that control for expectancy, which document differences in attentional demands of distraction tasks, and then show reductions in persons' emotional responses to painful stimuli.

## METHODOLOGICAL ISSUES

In considering experimental studies, one should note that a number of procedural and methodological difficulties can arise and contribute to the often ambiguous and conflicting results. Pain research is no exception. Dworkin and Chen (1982) emphasise the limited generality of laboratory studies to a clinical population. The most pervasive difficulty that a pain investigator encounters when evaluating studies undertaken in the area of pain, is the lack of comparability of the various pain induction procedures (Scott & Barber, 1977); especially with respect to the duration of stimulation, rate of onset, rate of intensification, and subjective interpretation or appraisal (Turk et al., 1983). This is particularly important if one notes that a study by Turner, Clancy, and Vitaliano (1987) argued that an individual's coping success in dealing with a stressor (such as pain) is more influenced by the characteristics of the stressor than by a general predisposition toward coping with stressors in a certain way.

Potassium iontophoresis was used in the present study because of the amount of experimental manipulation it allows. Iontophoresis possesses many of the properties expected of a pain stimulus (Benjamin & Helvey, 1963; Voudouris et al., 1985), and has been proven to be a feasible and reliable pain induction technique (Breakwell, 1992; Humphries, 1989). As outlined previously, the ability of potassium iontophoresis to be administered repeatedly and rapidly makes it especially suitable for an experiment using a repeated-measures design such as the present study.

## PAIN MEASURES

Methodologically speaking, difficulties exist regarding the lack of equivalence of the dependent measures in assessing the effectiveness of coping strategies. This study chose to assess pain threshold, pain tolerance, and pain ratings in order to tentatively establish the possible links between them, as well as to highlight the specific role that each measure plays in the pain experience - especially in relation to different distracters.

Multidimensional models of pain, such as Melzack and Wall's (1965) gate control theory, and Leventhal and Everhart's parallel-processing model (McCaul & Haugtvedt, 1982), view pain perception and response as resulting from the interaction between particular dimensions. In general, these can be categorised as having sensory, motivational-affective, and cognitive components.

It has already been pointed out that a number of investigators believe that pain threshold is a sensory measure, while pain tolerance is more influenced by psychological or evaluative/emotional circumstances (Chen et al., 1989b; Marchand et al., 1989; Wolff, 1977; Zelman et al., 1991). However, findings did not support this hypothesis. There are three reasons to explain why results were contrary to predictions. Firstly, pain threshold and pain tolerance do not represent and reflect different parts of the pain experience. Secondly, that various distracters do not impact differently upon different parts of the pain experience. Thirdly, a combination of both these statements.

Pain ratings, which have been assumed to measure the perception of pain (Hodes et al., 1990), were assessed to determine whether an affectively neutral or a more emotionally biased distracter had the greatest effect on pain perception. A problem that was encountered in the present study was the methodology of the four-second ratings trial. The increased attention the beeps (used to signal an ensuing ratings trial) would elicit may have nullified the effects of the distracter being engaged in at that time.

Additionally, because the amperage of the ratings trial was dependent upon the tolerance trial preceding it (being half the amperage of that tolerance trial), those who endured more pain initially would have sensed the difference between that and the four-second trial as greater, and so may have tended to rate that short trial as less painful. The present study, throughout data analysis, recognised this problem and so attempted to remedy it by dividing ratings by the amperage of the preceding tolerance trial. Another way of avoiding this methodological problem, suggested by Baker and Kirsch (1991), is to take pain measurements while the pain stimulus is being applied, so that the differences in tolerance can be controlled for in testing for differences in self-reported ratings of pain. However, if the theory for distraction is valid, pain assessment during the tolerance task will inhibit the effects of the cognitive strategies that are being evaluated.

## GENDER AND PAIN REPORT

The hypothesis was that males, in general, would have higher pain threshold and pain tolerance levels than females. This was not found to be the case, hence one has to acknowledge the nuances that can occur with relation to social context and gender.

Levine and De Simone (1991) found that males reported significantly less pain in front of a female experimenter than a male experimenter. The difference in female subjects was not significant, although they tended to report higher pain levels to the male experimenter. It should be noted that in the present study only a female experimenter was utilised.

## FUTURE RESEARCH

The present study suggests a number of ideas for future research. A major conclusion is that psychological and cognitive factors affect performance in pain situations - what needs to be clarified is the effect of individual distracters on different pain outcome measures. The present study provides a basis from which to expand; through the utilisation of different distracters in various settings.

This brings in the issue of distraction being time-bound, especially when related to the constructs of pain threshold and pain tolerance (Holmes & Stevenson, 1990; Mullen & Suls, 1982). If different distracters do work best when limited to a specific part of the pain experience, there is a need to find out just what types of distraction are most advantageous at certain points.

The potency of neutral imagery, found to be the most effective distracter in the meta-analysis by Fernandez and Turk (1989), could be assessed regarding pain threshold and pain tolerance; and direct comparisons could be made against both the visual distraction task and positive imagery. This type of research would seek to identify whether additional components such as mood or emotion are necessary for distraction-induced analgesia.

In addition, elements such as the gender of the experimenter, especially in relation to the gender of the subject(s), could be manipulated to comprehend how far-reaching the effects of social context are.

Other pain induction techniques, such as the cold pressor, could be implemented while using the distracters outlined in the present study, to evaluate their impact upon pain threshold, tolerance, and ratings. This would clarify the extent to which one can generalise findings when the pain stimulus differs.

Alternatively, more studies could be undertaken using the pain stimulus of potassium iontophoresis. These would further validate the use of such a pain induction procedure, as well as increase the generalisability of the present study.

The usefulness of the current findings may be seen with respect to the management of not just experimental pain, but clinical pain. Potassium iontophoresis elicits an acute rather than a chronic pain, so the utilisation of these findings in a clinical setting would need to involve only instances of acute pain.

This highlights the need for research exploring the effects of different distracters on pain outcome measures when the pain is chronic - rather than acute. This notion is supported by Leventhal (1992) who adds that an increase in our understanding of the combinations and mechanisms underlying short-term distraction-based analgesia may take us a step toward identifying the components that allow us to avoid the experience of chronic pain.

## RESEARCH SUMMARY

This study sought to investigate the effects of different types of distracters on various pain outcome measures. Findings confirmed that both distracters were effective in raising pain tolerance, but not pain threshold, when compared to the control condition. However, despite the supposition that the sensory distracter would affect pain threshold to a greater extent, and the emotive distracter would affect pain tolerance, it was discovered that the visual detection task proved most effectual on all accounts. This is in contrast to the findings of Fernandez and Turk's (1989) meta-analysis, and prompts further research in order to clarify the issues at hand.

The assessment of pain ratings reflected the finding that pain perception does not necessarily decline significantly when distraction is being employed - even if pain tolerance is on the increase. This was discussed with reference to a number of studies which found both for and against psychoanalgesia.

There were no significant differences between males and females regarding pain threshold and pain tolerance. This finding was investigated in terms of social context and factors of the experimental setting, and conclusions formed accordingly.

Finally, some suggestions were made regarding future research in this area. It can be seen that pain research needs to get back-to-basics in order to properly isolate the operative elements that are of value in determining the most effective distraction methods. Only then can the study of cognitive and attentional processes be furthered in the area of pain management and pain research in general.

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# APPENDIX A

## SUBJECT INFORMATION SHEET

### PAIN AND DISTRACTION

Pain is a major human concern which influences numerous aspects of life. However, many facets of this complex phenomenon are still poorly understood. Therefore, increasing our knowledge of how pain works will help to develop ways to assist the many individuals who experience pathological pain. We know that a number of psychological factors can have an important bearing on the degree and extent of pain. The study you are volunteering to participate in is one of a series of studies designed to look at the influence of attentional factors on pain response and recovery.

The method of stimulation implemented in this study uses an electric current to administer potassium ions. The procedure does not involve electric shock and is not dangerous in any way. You will simply be asked to press a button when the stimulation becomes painful, and when you have endured enough. This will terminate the stimulation. Simultaneously with the pain stimulation you will be required to do two things in turn: to detect the change in a visual stimulus; and to engage in positive imaginings (this will be explained to you).

You will be required on two consecutive occasions - the first session taking about 20 minutes, the second approximately 50 minutes.

Once all the data is collected, and before analysis, all names will be removed and the data identified by number only, ensuring your complete anonymity. At the end of the study, there will be a debriefing and an opportunity for you to ask any questions you may have.

Thank you for your participation.

Wanda Douglas

Department of Psychology

Massey University

# APPENDIX B

## SUBJECT CONSENT FORM

I have read and understood the subject information sheet and I understand that my participation in this study will involve some discomfort.

I am aware that I can withdraw from the study at any time.

I am prepared to be a subject in this study.

Signed Date

Witnessed Date

Contact address for results:

(if desired)

# APPENDIX C

## MEDICAL CHECKLIST

Subject name ..........................................................................

Please answer the following questions:

| | | |
|---|---|---|
| 1. | Have you ever had any form of epilepsy? | yes/no |
| 2. | Are you currently using medication of any type? | yes/no |
| 3. | Do you have any known heart or circulatory condition? | yes/no |
| 4. | Do you have hypertension? | yes/no |
| 5. | Do you suffer from any skin disorders? | yes/no |
| 6. | Are you in good general health? | yes/no |
| 7. | In the past six months, have you suffered from any painful injury or condition lasting more than a week? | yes/no |
| 8. | Have you ever had any injury or medical condition that may affect your ability to sense pain? | yes/no |

Signature ............................................ Date .........................

# APPENDIX D

## STUDY REVIEW SENT TO SUBJECTS

Dear

This letter is firstly to thank you again for your participation as a volunteer in my pain and distraction study; and secondly to inform you of the main findings of the research undertaken.

There are a number of indicators in the literature that suggest that different distracters may influence different parts of the pain experience. Emotionally-neutral distracters, such as the visual detection task used in the present study, are assumed to work by providing sensory input that competes with pain for access to a limited reservoir of attention. In contrast, mood and cognitive distracters, such as pleasant imagery, modify pain by their influence on the emotional and evaluative processing of the painful stimuli.

The study in which you participated set out to test the assumption that a 'sensory' distracter such as the visual detection task would enhance pain threshold more than the imagery task; conversely, that pleasant imagery, which has an effect on emotional factors, would have a greater effect on increasing pain tolerance than the visual detection task. Additionally, pain ratings were gauged to determine whether the actual perception of pain changed as a result of the engagement in any particular distraction strategy.

Findings revealed that both distracter tasks heightened pain tolerance, but not pain threshold, in comparison with the control condition. The visual detection task proved to be the most effective in increasing pain threshold and pain tolerance. This is contrary to predictions that the imaginal distracter would have the most influence on pain tolerance. The data indicated that males do not have higher pain threshold and pain tolerance levels than females.

Although the study demonstrated that distraction does lower pain perception and increase an individual's pain threshold and pain tolerance, it emphasises that specific distracters do have different impacts and there exists a need to clarify the links between types of distraction and pain outcome measures.

The results of the study have provided some interesting findings and these could not have been achieved without your participation. Thanks again for your time and help. If you have any further queries about this research, please feel free to contact me.

Regards

Wanda Douglas