Imagery and Emotion in Chronic Pain

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Table of Contents

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List of Tables

List of Figures

Abstract

Psychological factors have important implications for adjustment to chronic pain, which itself has a variety of emotional consequences. Mental imagery has historically been assumed to be closely connected to emotional responses, and some experimental and clinical evidence has supported this claim. Around two in five people with chronic pain spontaneously report having mind's-eye mental images of their pain, although this phenomenon has received only limited research attention.

This study aimed to see whether, for people with chronic pain who report these images, evoking their pain images is different from describing their pain using only single descriptive words. It was hypothesised that evoking the images would result in a stronger negative emotional response, weaker positive emotional response and an increase in the perceived pain intensity. It was also hypothesised that, compared to baseline scores, emotional and pain intensity ratings would be higher under both experimental conditions. Thirty-six participants completed an experiment interview, which employed a repeated measures design. The dependent variables were visual analogue scale ratings of pain intensity and strength of emotional experience (fear, sadness, anger, disgust and happiness). Other measures completed assessed the nature of the imagery and level of overall psychological distress.

The study found that evoking pain-related mental images resulted in a temporary increase in pain intensity, sadness, anger and disgust and a decrease in happiness. However, these emotional responses were no different from those experienced when participants described their pain in single words, although this verbal task did not result in the increase in pain intensity seen when images were evoked. These results suggest that for this group of people, pain imagery is no more closely connected to emotional responses than equivalent verbal representations. However, the fact that imagery evocation resulted in a temporary increase in pain intensity where the verbal condition did not perhaps suggests that this represents a qualitatively different kind of paying attention to pain. The next steps for this small but growing field of research are considered.

Chapter 1: Psychological Factors in Chronic Pain

1.1 Definition of chronic pain

Although pain is an integral part of human experience, defining what people mean when they talk about pain presents a complex challenge. Historically, philosophers and psychologists have questioned whether pain is best described as a sensation or an emotion (Trigg, 1970) . For example, Wittgenstein (1958) notes that the concept of pain resembles both a tactile sensation through the characteristics of localisation, duration, intensity and quality and at the same time an emotion through its expression in facial expressions, gestures and noises. The International Association for the Study of Pain (IASP) recognises both the sensory and emotional aspects of pain, defining it as:

> *' An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.' (Merskey & Bogduk, 1994, p.213)*

This widely used definition also recognises the complexity of pain and its subjective nature. Because there are no objective tests for or physiological markers of pain, to understand another person's pain we must rely on the subjective narration of their personal experience of it (Field & Swarm, 2008).

Pain can be classified along various dimensions; commonly temporal (acute, chronic), mechanism of transmission (nociceptive, neuropathic, central), disease state causing the pain (for example arthritis) and anatomical site (for example low back pain, headache) (Turk & Okifuji, 2001). This thesis is concerned only with chronic pain, which is usually defined as pain lasting longer than three or six months (Merskey & Bogduk, 1994) or pain that persists beyond the expected time for healing (Field & Swarm, 2008), although the latter criterion clearly requires some degree of subjective judgement. It is

generally understood that unlike acute pain, chronic pain does not serve as a warning of further tissue damage and generally serves no adaptive purpose (Taylor, 2003).

1.2 Prevalence and economic impact

Because there are no objective tests for chronic pain, it is difficult to obtain accurate epidemiological data on the prevalence of this condition. A large scale computer assisted telephone survey of chronic pain in over 40 thousand adults across 15 European countries and Israel found that 19 per cent had moderate to severe pain which seriously affected the quality of their social and working lives (Breivik *et al.*, 2006). In the UK, prevalence estimates of chronic pain in the general population range from 12 per cent to 35 per cent (Harstall & Ospina, 2003). In one Scottish study, 50 per cent of a sample of 3,605 patients from a primary care population were found to meet IASP criteria for chronic pain (Elliott *et al.*, 1999). However, this study collected data via a postal survey, and thus a response bias may potentially have inflated this prevalence figure.

Chronic pain exacts tremendous costs from patients, employers and the health care system. Second only to colds and flu, pain is the foremost reason for visits to physicians (Field & Swarm, 2008). Chronic pain in the absence of discernable physical causes is the most common reason for lost workdays in the United States (Rosenthal, 1992). Using data from the American Productivity Audit, one study (Stewart *et al.*, 2003) estimated that 13 per cent of the American workforce lost productive work time due to common pain conditions including headache, back pain, arthritis and other musculoskeletal conditions. This lost productivity was calculated to cost employers $61.2 billion per year, 77 per cent of which was attributed to reduced performance while at work rather than work absence. In the UK, Maniadakis and Gray (2000) estimated the direct health care cost of back pain in 1998 to be £1632 million, with the indirect costs of informal care and loss of economic production totalling £10,668 million. In common with findings from other countries, the authors reported that these calculations indicate that back pain is one of the most costly conditions to the UK's economy.

From an individual's point of view, chronic pain can have persistent and pervasive implications, impacting on cognitive function, reducing engagement with numerous activities, disturbing sleep and appetite and upsetting morale (Taylor, 2003). In sum, it can dramatically impair the individual's social, vocational and psychological well-being (Merskey & Bogduk, 1994). Chronic pain has been described as 'one of the most distressing experiences known to man' (Tyrer, 1992, p.3), perhaps partly due to the difficulties that traditional medical approaches have had with understanding, explaining and treating this phenomenon (Strong, 2002). Chronic pain is thus an important topic of study, with advances in our understanding and treatment of this condition potentially significantly impacting on our economies and improving the lives of millions of people.

1.3 Psychological factors in theories of pain

Experiencing acute pain is critical to survival because it provides feedback about the functioning of our bodily symptoms. It motivates us to withdraw from damaging or potentially damaging stimuli or situations, protect the damaged body part while it heals, and avoid those situations in the future (Holden & Winlow, 1984). Descartes (1664) famously proposed in his specificity theory of pain that pain messages travel from the body to the brain in a mechanical fashion, following a fixed pathway from the site of injury. He also suggested that a one-to-one relationship existed between the degree of injury and the experience of pain, with psychological factors having no influence on this process. However, this and other early dualistic models of the mind (or soul) and body as entirely separate 'substances' began to be challenged in the mid 20th century by a variety of medical and scientific observations. For example, Dr Henry Beecher (1946; 1956) noted that even when they experienced similar physical injury, civilians and wounded soldiers made vastly different subjective pain reports and requests for medication. His opinion was that this was because civilians and soldiers attributed differing meanings to the pain, and by suggesting this he was one of the first to propose a strong role for psychological factors as well as physical ones in pain perception.

Melzack and Wall (1965, 1982) developed the gate control theory of pain, which asserts that both physiological and psychological factors play a significant role in pain experiences. Their model proposed that the transmission of pain-related nerve impulses is modulated by a 'gating' mechanism at the dorsal horn of the spinal cord, which can be affected by physical, emotional and behavioural factors. The gate control theory states that pain perception is influenced by the balance between large- and small-diameter nerve fibre activity, with small-diameter fibres facilitating transmission (i.e. opening the gate) and large-diameter fibres inhibiting transmission (closing the gate). Melzack and Casey (1968) extended the gate control theory, proposing that pain is comprised of three dimensions: sensory-discriminative, cognitive-evaluative and affective-motivational. Thus pain is determined not only by physiological factors (for example location, duration and intensity of the stimulus) but also cognitive evaluations of its meaning (influenced by, for example, appraisal and cultural beliefs) and unpleasant emotional responses that serve to motivate behaviour, often escape.

By allowing for the existence of mediating variables and emphasising active perception rather than passive sensation, Melzack and colleagues' work significantly influenced research and generated much interest in understanding the influence of psychological variables on pain. However, the gate control theory's assumption of there being an organic basis for pain has led to criticisms due to its difficulty in explaining phantom limb pain (Ogden, 2007). Additionally, most of the dorsal horn neurons identified in the theory as inhibitory are in fact excitatory (Woolf, 2007). However, although there have been substantial advances in the understanding of the neurophysiology of pain transmission, the gate control model remains an important heuristic for understanding and treating pain (Field & Swarm, 2008). Furthermore, Melzack and Casey's (1968) description of the dimensions of pain continues to guide research in the functional neuroanatomy and psychology of pain (Skevington, 1995).

As a result of extensive research on the neurophysiology of pain and the use of functional brain imaging, pain is no longer understood as a primitive sensory message recognised by the somatosensory cortex but rather the end product of massive distributed and parallel processing within the brain (Turk & Okifuji, 2002). Pain has

emotional and cognitive features because it is the end product of central processing in brain areas that produce the interdependent processes of emotion and cognition. Furthermore as highly social animals, human pain is always subject to a social context which can have significant effects on pain perception, expression and response (Skevington, 1995).

1.4 Psychological factors in chronic pain

Although there is debate about when acute pain transitions to chronic pain, there is good evidence that psychological factors play a role in this transition (Linton, 2000) and are particularly important in chronic pain perception and coping (Field & Swarm, 2008). Following the recognition that conventional medical management approaches were inadequate and the importance of psychological factors in chronic pain, the IASP advocated a multi-disciplinary approach (Loeser, 1991). Thus it is now common to find chronic pain teams which include psychologists working alongside, for example, physicians, nurses, physiotherapists and occupational therapists (Strong, 2002).

Chronic pain involves the complex interaction of physiological, psychological, social and behavioural components (Taylor, 2003) and is often associated with serious mental health effects (Tyrer, 1992). This thesis will now provide an overview of the well established behavioural, emotional and cognitive factors involved in the experience of chronic pain.

1.4.1 Behavioural factors

With the rise of behaviourism in the 20th century came the proposal that operant conditioning principles could be used to explain and modify chronic pain behaviours. Fordyce (1976) was the pioneer of this approach, which proposed that acute pain behaviours, although initiated by a traumatic injury or disease, are reinforced over time by interpersonal and environmental factors. In chronic pain, these become illness

behaviours which increase both pain perception and disability. Pain behaviours include distorted posture or movement, negative affect, facial/audible expressions of distress and avoidance of activity (Turk *et al.*, 1985). These may be positively reinforced via, for example, sympathy and attention or negatively reinforced through a reduction in immediate pain or time off work. Some authors have argued that the operant conditioning model by itself is overly simplistic, and each person's beliefs about the cause of their pain and how it should be managed must also be understood to account fully for illness behaviours. For example, persistent help-seeking behaviours may stem from a pain evaluation which leads to expectations that more can still be done to cure pain (James, 1992b).

Experimental research has provided some support for the role of positive reinforcement in pain reporting. For example, in a study which involved experimentally induced pain in chronic back pain patients and healthy matched controls, Flor *et al.* (2002) found that the chronic pain patients displayed slower extinction when visual and monetary reinforcers of pain ratings were ceased. This was the case whether the reinforcement was of elevated or reduced pain ratings, and was not seen in the healthy matched controls. The authors suggest that the chronic pain patients were more easily influenced by operant conditioning factors and that this susceptibility may add to the maintenance of chronic pain. This study is commendable because it used a clinical population, however in common with other research which uses experimentally induced brief pain, the generalisability of this to chronic pain is questionable.

The validity of behaviourist accounts is supported by the success of behaviour change programmes which aim to reduce illness behaviours and increase 'well behaviours' through manipulations of reinforcers (Fordyce *et al.*, 1985). However, one criticism of these programmes is that although they may reduce, for example, the verbal expressions of pain, they do not actually treat pain per se but instead train patients to be more stoical about it (Schmidt, 1987). On the other hand, while the pain itself may not be affected, interventions which are successful in reducing the disability associated with pain may still be regarded as useful approaches (Skevington, 1995).

1.4.2 Emotional factors

The perception of pain has been shown to be attenuated or amplified by emotional processes (Craig, 2005). From a biological point of view, it has been proposed that pain, anxiety and depression may have a common neurochemical substrate in the serotonergic systems (Blier & Abbott, 2001). However, examining the emotional aspects of pain can be conceptually challenging as emotional distress serves not only as a component of pain but it can also be a cause of pain or concurrent problem from an independent source (Feuerstein & Skjei, 1979). Although this problem can be overcome by conceptualising both pain and emotion as multidimensional and sometimes overlapping processes with reciprocal influences on each other (Craig, 2005), critical literature reviews by Gamsa (1990) and Fishbain *et al.* (1997) suggest that emotional disturbance is more likely to be a consequence of chronic pain than an antecedent to it. The relationships between pain and each of the five basic emotions (fear, sadness, anger, happiness and disgust[1]) will be briefly reviewed below.

1.4.2.1 Fear

By their very nature, noxious stimuli will often evoke basic fearful responses. In patients who have experienced pain, the fear of this pain increasing or reoccurring can lead to the avoidance of a range of activities that are perceived to be high risk (Ogden, 2007). In the short term, avoidance of and escape from these activities will be negatively reinforced as pain intensity will decrease. The fear-avoidance model (Leeuw *et al.*, 2007; Lethem *et al.*, 1983; Slade *et al.*, 1983) proposes that this phenomenon can explain how and why musculoskeletal pain can become a chronic pain syndrome in some people but not others. The model states that some people respond to the fear of pain by confronting it, which leads to a reduction of fear over time as gentle exercise gradually decreases the pain intensity. However for others who avoid the pain, the fear is maintained and exacerbated, possibly generating a phobic state and resulting in restricted behaviours, hypervigilance to illness information and physical deconditioning

[1] See section 2.1.2 for an overview of the evidence for the existence of these categories

which all conspire to increase the pain intensity and interference (Vlaeyen & Linton, 2000).

This model is supported by a variety of research evidence, including a methodologically robust prospective study conducted by Linton *et al.* (2000). This study measured fear-avoidance beliefs (among other variables) in a community sample of 449 people who had reported no spinal pain during the preceding year. One year later, data from 415 people (92 per cent) were collected which indicated that 19 per cent of the sample had experienced an episode of back pain. People who had scores above the median on the measure of fear-avoidance beliefs at baseline were twice as likely to report an episode of back pain and had a 1.7 times higher risk of lowered physical functioning.

Within an occupational setting, a cross-sectional study of 1294 employees in Belgium and the Netherlands found that pain-related fear was a key risk factor for prolonged lower back pain (Gheldof *et al.*, 2005). Other researches have suggested that fear of pain is more disabling than pain itself, as it increases the amount of attention demanded by the pain, which in turn results in a lowered ability to focus on other activities (Crombez *et al.*, 1999).

From a biological point of view, pain, anxiety and tension can exacerbate each other in a well known vicious cycle seen in patients with musculoskeletal pain. Pain provokes anxiety because it is interpreted as a threat to well-being, self esteem and control (James, 1992b). The physiological element of anxiety can then result in prolonged muscle spasm at the pain location and other trigger points as well as vasoconstriction and the release of pain-producing substances (Craig, 2005). This then results in further pain and further anxiety. However, while this cycle is known to exacerbate pain, increased muscle tension alone cannot fully account for chronic pain in these patients (Turner & Chapman, 1982).

A significant proportion of people with chronic pain are also diagnosed with one or more anxiety disorders. For example, in a sample of 382 arthritis patients with chronic pain, 35 per cent also met criteria (assessed via structured interview) for one or more

anxiety disorders, compared to 18 per cent in the general population (McWilliams *et al.*, 2003). Furthermore, another study reported that up to half of patients attending a hospital psychiatric clinic reported experiencing chronic pain (Spear, 1967). Comorbidity is thought to be common not only because pain itself can elicit fearful responses, but also because trauma (for example through battle or a road traffic accident) can be a trigger for both injury-related pain and post-traumatic stress disorder, phobia or panic disorder (Gallagher & Verma, 2004). Additionally it is possible that personality factors could make individuals vulnerable to both chronic pain and anxiety disorders. For example, an individual's level of trait anxiety has been shown to be directly correlated with increased pain perception in laboratory induced pain in a student sample (James & Hardardottir, 2002) as well as in, for example, patients with chronic pelvic pain (McGowan *et al.*, 1998). However, a number of studies have failed to find effects of personality variables on chronic pain, and overall it appears that there is little conclusive evidence supporting the idea of a 'pain-prone' personality (Linton, 2000).

Partial evidence for the close link between fear and pain is found in the effectiveness of pain management interventions which utilise relaxation. Relaxation training has been found to be effective in reducing tension headache frequency (Turner & Chapman, 1982), and pain intensity, depression symptoms and disability in patients with chronic low back pain (Turner & Jensen, 1993). Relaxation is thought to help reduce fear, physical arousal and muscle tension and therefore also pain (Weisenberg, 1987). It is also likely that if a patient learns that they are able to reduce their pain through their own efforts this will improve their perceived control and self efficacy, which are also thought to be closely linked to pain perception (see 1.4.3.2). Thus although it is clear that relaxation training is effective, its action is likely to be multifaceted and therefore not only because of its ability to reduce fear.

1.4.2.2 Sadness

There is little research looking specifically at sadness in itself in chronic pain, although there is a large body of evidence examining the link and nature of the relationship

between chronic pain and depression. On the basis of self-report methods, the prevalence of depression in the chronic pain population has been estimated to be anywhere from 20 to 80 per cent (Gallagher & Verma, 2004), however more stringent criteria have placed the estimate at 30-54 per cent (Banks & Kerns, 1996). A large-scale population-based survey of musculoskeletal pain and depression in the United States found that 16 per cent of people with chronic pain met stringent psychiatric criteria for depression, in comparison to the 6 per cent who met the criteria in the population who did not have chronic pain (Magni *et al.*, 1993). On the basis of a large scale European study of over 4800 people with chronic pain, Fricker (2003) suggests that 19 per cent of the chronic pain population meet criteria for a diagnosis of depression, with up to half reporting feelings of helplessness or an inability to think or function normally.

These comorbidity prevalence estimates vary widely for a number of reasons. Estimates will be different on the basis of whether mild depressive disorders (such as dysthymia and adjustment disorder) are included or because of the nature of the assessment methods used (self-report questionnaire vs. structured interview with strict diagnostic criteria). Physical diagnoses in a psychiatric population are difficult to make because these patients tend to use pain language in a relatively indiscriminate and diffuse manner (Craig, 2005). Additionally there are overlapping symptoms between chronic pain and depression, for example some somatic symptoms of depression (insomnia, fatigue, changes in appetite, attention and concentration problems) could be partially or entirely attributable to the pain itself or medication used to treat it (Field & Swarm, 2008; Skevington, 1995).

Despite the problems associated with measuring comorbidity however, it is clear that chronic pain and depression often exist together. Depression may be a consequence of coping with pain, it may precede the onset of pain or pain and depression may co-occur. Clinical observation suggests that the commonest presentation within the chronic pain population is of mild to moderate depression, secondary to physical illness (James, 1992b). In support of this, a systematic review of pain and depression found that there was more evidence for depression being a consequence of chronic pain than an antecedent (Fishbain *et al.*, 1997). However, reflecting the nature of the population and

diversity of research methods, the studies in this review were heterogeneous in terms of type of chronic pain and the criteria used for diagnosing depression.

In terms of formulation, it is clear that depression could be a consequence of living not only with pain but also the associated physical limitations, interpersonal consequences and multiple losses that may occur. Furthermore, recursive vicious cycles may develop whereby pain increases unpleasant affect, promotes access to memories of unpleasant events and thoughts, which in turn intensifies the unpleasant affect and helps perpetuate the pain (Eich *et al.*, 1990). When someone with chronic pain has comorbid depression, this can complicate the presentation, clinical course, and their response to treatment (Leo, 2005).

According to a study by Keefe *et al*. (1986), depression can increase a patient's perception of pain and the extent to which they engage in chronic pain behaviours. This research examined the degree to which depression (measured using the Beck Depression Inventory) predicted pain and pain behaviour in 207 low back pain patients. Utilising regression methods, the researchers found that even after demographic and medical status variables were controlled for, depression still predicted a modest but significant amount of the variance in pain behaviours during physical examination and patient ratings of pain. While this study is commendable in that it controlled for a number of other predictor variables, the correlational relationship found does not indicate causality. However, some interesting experimental research has suggested that an induced sad mood will lower a person's tolerance to pain but not their ratings of pain intensity in a cold pressor immersion (Zelman *et al.*, 1991).

1.4.2.3 Anger

The majority of research examining affect in pain has focussed on depression and anxiety; however anger is now increasingly being recognised as an important emotional component of chronic pain (Fernandez & Turk, 1995; Greenwood *et al.*, 2003). People with chronic pain often report feeling angry at themselves, others or their life situation

(Okifuji *et al.*, 1999). In a study which sought to identify which of the nine primary emotions [based on Izard's (1991) categories] were key in chronic pain, Fernandez and Milburn (1994) found that anger, fear and sadness were the strongest predictors of the affective component of pain. From a biological perspective, anger (as with fear and sadness) can provoke substantial autonomic, visceral and skeletal activity which can then result in increased pain (Craig, 2005). Clinical and some research evidence suggest that chronic pain and anger ratings are connected, for example Gaskin *et al.* (1992) found state anger to be an important predictor of affective pain ratings. In addition to exacerbating pain, anger and its expression can cause difficulty with pain management as it can disrupt relationships with healthcare providers, partners, family, friends and co-workers (Greenwood *et al.*, 2003).

Some researchers have emphasised the cognitive appraisal component of anger in chronic pain; namely disapproving of someone's blameworthy action and being displeased about the related undesirable event (Fernandez & Turk, 1995). However, there is also some evidence that certain stimuli which are physiologically offensive such as pain, foul odours and high temperatures can innately trigger angry reactions without cognitive mediation, although cognitive processes can suppress, intensify or modify this primitive response (Berkowitz, 1993).

Wade *et al.* (1990) explored the relationship between anger, frustration, anxiety, fear and depression and pain-related unpleasantness (all measured using visual analogue scales). They found that anxiety and frustration were the most important predictors of emotional unpleasantness after the influence of pain sensation was controlled for. However, the types of negative affect they chose to examine were not based on a theoretical consideration of the nature of basic emotions (discussed further in 2.1.2).

Other researchers have examined the different styles of anger expression and their relationship to chronic pain intensity and behaviour. Some models of pain propose that chronic pain can result from a pervasive inability to express negative emotions (Braha & Catchlove, 1986), and in support of this Kerns *et al.* (1994) found that an emotional management style of inhibiting the expression of angry feelings was the strongest

predictor of pain intensity and pain behaviour. However, other researchers have pointed out that the majority of the evidence for an aetiological role for anger suppression in pain has utilised correlational methods which cannot prove causality, and that it is less contentious to suggest that inhibited anger may exacerbate rather than cause chronic pain (Fernandez & Turk, 1995).

1.4.2.4 Disgust

Little research has examined the relationship between chronic pain and disgust, although some qualitative research indicated that a sample of ten women with chronic muscular pain were disgusted by the illness-focussed talk of others with similar medical presentations who complained about their pain (Werner *et al.*, 2004). The authors suggest that their interview transcripts (interpreted within a feminist frame of reference, inspired by narrative theory and discourse analysis) reveal that talking about illness is a private and forbidden subject which should not be done because it becomes whining and complaining. This is seen by the authors as an expression of a culture's marginalising, disgust and tabooing of illnesses such as medically unexplained symptoms. While this raises some interesting ideas about feelings of disgust in chronic pain patients, in common with other qualitative research which utilise very small and select samples, the generalisability of the findings is limited.

Other research has examined facial expressions in patients with chronic pain, to ascertain whether a reliable and valid facial expression of pain could be identified in a similar way to the large body of research which has identified the universal human facial expressions of the emotions anger, fear, enjoyment, sadness and disgust (Ekman, 1992). LeResche and Dworkin (1988) videotaped the facial expressions of 28 patients with chronic temporomandibular disorder pain during a painful clinical examination procedure and coded their expressions using a anatomically based system. They found that they could identify a particular facial expression associated with pain, and also identified that six (21 per cent) of their subjects displayed a facial expression of disgust during the examination. In a study which examined 60 health professionals' judgements

of facial expressions, Kappesser and Williams (2002) found that pictures of pain facial expressions were identified correctly by 75 per cent of the participants, with 19 per cent of the professionals incorrectly categorising pain faces as expressing disgust. A related study by Keltner (1996) also found that 20 per cent of subjects misidentified pain as disgust. The fact that facial expressions of pain are more often confused with disgust than any other emotion suggests that that the demonstration of pain and disgust are closely related.

1.4.2.5 Happiness

Very few studies have specifically examined happiness in the chronic pain population. However, a large body of research on experimentally induced pain suggests that manipulations that have a positive effect on mood or emotional state will reduce pain perception (Craig, 2005; Villemure & Bushnell, 2002). Positive affect has been generated through music (Roy *et al.*, 2008), affective pictures (Meagher *et al.*, 2001), photographs of loved ones (Master *et al.*, 2009), inducing laughter (Cogan *et al.*, 1987), and pleasant odours (Marchand & Arsenault, 2002). Other research has suggested that the relationship between happiness and experimentally induced pain intensity is not this straightforward. For example, Villemure and Bushnell (2002) suggest that the interpretation of these studies is difficult because they do not always clearly dissociate changes in mood from changes in attention. In a study in which they manipulated attention and emotional state separately, Villemure *et al.* (2003) found that focussing attention on the pain increased pain intensity and unpleasantness ratings, whereas mood manipulations changed only the pain unpleasantness but not the pain intensity.

Some research indicates that positive moods change the tolerance of pain rather than the pain intensity. For example, a study which encouraged participants to think of images that produced positive feelings such as self-assertion, pride or mirth enhanced cold-pressor pain tolerance (Horan & Dellinger, 1974). Zelman *et al.* (1991) found that a group of participants who underwent elated mood induction (through reading positive statements) displayed no difference in (cold-pressor) pain intensity ratings but did

demonstrate increased pain tolerance in comparison to a group who had a depressive mood induced. However, the lack of difference in pain ratings in this study should be interpreted with caution because the authors report that as their data were positively skewed they used non-parametric statistics rather than utilising transformations and then employing (more powerful) parametric methods.

Skevington (1995) argues that positive perceptions of well-being and happiness should be included in a holistic assessment of people with chronic pain. The few studies which have examined this suggest that positive as well as negative emotions are closely tied to pain. For example, when Fernandez and Milburn (1994) assessed emotion and the affective component of pain in 40 people with chronic pain they found that emotions which were neutral or positive (surprise, interest and joy) were inversely related to pain-related distress. Additionally, a study of 70 pain patients with intervertebral disk disease indicated that while negative mood best predicted pain severity (accounting for 21 per cent of the variance in scores), positive moods could explain a substantial 16 per cent of the variance (Shacham & Cleeland, 1984).

1.4.3 Cognitive factors

The cognitive movement in psychology in the latter half of the twentieth century brought with it a significant rise in interest in the cognitive factors relevant to pain. A full review of these is outwith the scope of this thesis, however the research examining attention and distraction as well as some of the key beliefs thought to impact on chronic pain will be discussed.

1.4.3.1 Attention and distraction

The interaction between attention and pain has been studied both in terms of the effects of attending to pain (top-down) and the impact of pain on attention (bottom-up). Neuroimaging studies suggest that these two processes have distinct associated brain structures but also interact (Legrain *et al.*, 2009; Villemure & Bushnell, 2002).

Attention directs limited perceptual resources to selected stimuli in the internal and external environment (Chapman & Okifuji, 2004). Both experimental and clinical studies have demonstrated that deliberately paying attention to pain can lead to temporary increases in reports of pain severity whereas distraction can reduce pain intensity (Brewer & Karoly, 1989; Ogden, 2007; Villemure *et al.*, 2003). James (1992b) suggests that this fact can make chronic pain worse for people who have a tendency or bias to notice internal sensations due to previous illness, degree of introspection or family attentiveness.

Distraction techniques as a method of decreasing perceived pain intensity have been explored with both acute and chronic pain. Techniques include listening to music, reading, focusing on the immediate environment, concentrating on mental activities and paying attention to alternative bodily sensations such as warmth, breathing and touch (James, 1992a). Many researchers have suggested that distraction is effective because it consumes some of a person's limited attentional capacity thereby preventing their full attention from being available for the cognitive interpretations which are crucial to the degree of pain-associated distress experienced (Legrain *et al.*, 2009; McCaul & Malott, 1984).

Some experimental research indicates that the effectiveness of distraction is dependent on the motivational relevance of the task, particularly among people who display catastrophic thinking about pain (Verhoeven *et al.*, 2010). Another study suggested that the effectiveness of distraction also depends on levels of trait anxiety (James & Hardardottir, 2002). These interactions demonstrate how the complex interplay of attention, motivation, traits and beliefs can make designing effective interventions for pain difficult.

Distraction techniques appear to be most successful with acute low-level pain (Taylor, 2003) but it has been suggested that their beneficial effects are only seen after a delay because they alter the memory of pain rather that the perceived intensity at the time (Christenfeld, 1997). For people with chronic pain, continual distraction as utilised in

experimental research on acute pain is not possible. However, distraction techniques can be helpful during episodes of increased pain (Waters *et al.*, 2004) and their successful use can have a general positive impact on evaluations of self efficacy.

In terms of bottom-up processing, Eccleston and Crombez (1999) report that pain interrupts and demands attention, a natural mechanism by which the individual is prompted to act or escape to relieve the pain. This shift in attention results in a reduced ability to focus on other tasks, a hypothesis which has been supported in a number of experimental studies (Crombez *et al.*, 1998; 1999; Eccleston, 1994). Again, complex interactions in this process emerge, for example the amount of attention demanded is influenced by how somatically aware the person is as well as the degree of negative affect (Eccleston *et al.*, 1997).

1.4.3.2 Beliefs

People's beliefs about pain have strong associations with their ability to function and adjust to living with chronic pain (Jensen *et al.*, 1991). For example, a common belief amongst chronic pain patients is that increased physical activity will cause harm (Philips, 1987), whereas for chronic benign pain the opposite is recommended for treatment and rehabilitation. Research has also found that people with chronic pain often refer to changes in the weather as a reason behind an increase or decrease in their pain (Shutty *et al.*, 1992), although systematic investigation has failed to find scientific evidence for this (Redelmeier & Tversky, 1996). Whether or not this belief is an accurate one however, it implies an external source of control of pain symptoms, which may undermine positive self efficacy beliefs.

A patient's sense of pain-related self efficacy (i.e. the extent to which they believe in their ability to control their pain and function in spite of it) is negatively correlated with measures of depression and ratings of disability amongst chronic pain patients (Turner *et al.*, 2005). A study which utilised regression methods has also found that self efficacy beliefs are a more important determinant of disability than fear-avoidance levels, pain

intensity and pain duration in chronic musculoskeletal pain (Eva *et al.*, 2004). Other researchers suggest that increased pain self efficacy may be an important factor in determining the degree of pain perception (Turk *et al.*, 1983).

Another cognitive factor which has received much research attention in chronic pain is catastrophising. According to Keefe *et al.* (2000), catastrophising involves three components: (a) rumination – focussing on threatening internal and external information, (b) magnification – overestimating the extent of the threat and (c) helplessness – underestimating personal and external resources which may reduce the danger or disastrous consequences. Catastrophising has been linked to the transition from acute to chronic pain as well as the maintenance of chronic pain (Sullivan *et al.*, 2001). It has also been found to be predictive of pain intensity, psychological distress and pain-related disability even after controlling for the effects of demographic and injury-related variables in patients with chronic pain and spinal cord injury (Turner *et al.*, 2002). A study by Crombez *et al.* (1998) indicated that catastrophising also impacts on attention such that high catastrophisers have more difficulty diverting their attention away from pain. However, this study used a non-clinical undergraduate population and experimentally induced pain and therefore caution should be exercised when generalising the results to the chronic pain population.

According to a review by Jensen *et al.* (1991), patients who believe they can control their pain, who avoid catastrophising and who believe that they are not severely disabled, function better than those who do not. However, much the data supporting these assertions is correlational and beliefs measured at different stages of treatment may reflect a state of mind rather than a personality trait and so consequently, cause and effect are not always clear (Craig, 2005). Nevertheless, cognitive approaches to chronic pain management have been effective (Weisenberg, 1998). Specifically, one element of Cognitive Behavioural Therapy (CBT) is concerned with targeting unhelpful beliefs, and this approach has been applied successfully to numerous chronic pain problems. Meta-analyses have indicated that CBT is efficacious in improving health-related quality of life, reducing pain intensity, pain-related interference, behavioural expression of pain and depression (Hoffman *et al.*, 2007; Morley *et al.*, 1999).

The beliefs discussed in this section are predominantly expressed through verbal language-based constructs. However, cognition is commonly conceptualised as consisting of both language-based and image-based thoughts. Images in particular are thought to be closely tied to emotional experience and processing (Holmes & Mathews, 2010). Chapter 3 will explore and discuss imagery in chronic pain but first Chapter 2 will discuss the current conceptualisation of mental imagery within academic psychology and review the evidence for the link between images and emotion.

Chapter 2: Imagery and Emotion

2.1 Definitions

2.1.1 Mental imagery

The form and function of human internal mental representation has been a source of fascination for philosophers, linguists and psychologists for centuries. The concept of mental imagery likewise has an extensive history, for example over 2000 years ago Aristotle regarded imagery as the main medium of thought (Eysenck & Keane, 2000). Mental imagery has long been conceptualised as a type of thought, an analogical representation of cognition. Kosslyn *et al.* (2006) report that:

> *'a mental image occurs when a representation of the type created during the initial phases of perception is present but the stimulus is not actually being perceived; such representations preserve the perceptible properties of the stimulus and ultimately give rise to the subjective experience of perception' (Kosslyn et al., 2006, p.4)*

This definition of mental imagery highlights that it is a mental phenomenon that a person is consciously aware of, but may or may not deliberately call to mind. It can be spontaneous (for example while dreaming) or intentionally generated (for example while trying to remember someone's appearance). A mental image may include any modality of sensory perception and so may be visual, olfactory, auditory, gustatory, proprioceptive or tactile (Power & Dalgleish, 2008). However, visually-based mental images have been the most extensively studied (Kosslyn *et al.*, 2001).

2.1.2 Emotion

Defining precisely what is meant by the term ‘emotion’ can become a complex debate about the theoretical approach to the structure of emotion, yet emotions are a familiar concept and the word is used frequently in everyday language. The Oxford English Dictionary (2008) defines emotion as:

> *‘a strong feeling deriving from one's circumstances, mood, or relationships with others’ (Sloans & Stevenson, 2008, p.374).*

Emotions are characterised by changes in facial expression, physiological disturbance, gestures, behaviours and particular types of thoughts, beliefs and desires (Power & Dalgleish, 2008). There has been a great deal of debate concerning the structure of emotions, with some theorists preferring a categorical approach and others dimensional models. Although there is much support for the dimensional approach, the majority of researchers have adopted a categorical one (Eysenck & Keane, 2010).

Oatley and Johnson-Laird (1987) proposed that there are five basic emotions (fear, sadness, anger, disgust and happiness) which occur universally in humans and are elicited by significant junctures of plans or goals. Fear occurs when a self-preservation goal is threatened and sadness when there is a failure of a major plan or loss of active goal. Anger occurs when a current goal is frustrated or blocked, disgust when a gustatory goal is violated and happiness when progress has been made or a goal has been achieved. The conditions under which disgust is elicited has been further extrapolated by Dalgleish and Power (2004) to include an appraisal involving an unwanted contamination by a person, object or idea that is repulsive to the self, valued roles, goals or ideals. Evidence from a range of sources supports the universality of these five emotions, including cross-cultural studies of facial expression, structural equation analysis of emotion linguistic terms, research on characteristic neurological activity and physiological signals as well as studies of emotional development in children (Ekman, 1992; LeDoux, 2000; Oatley & Johnson-Laird, 1987; Power & Dalgleish, 2008; Power, 2006).

2.2 Theoretical models

There are several theoretical models which attempt to describe the nature of cognition (including imagery) and the link between cognition and emotion. As an evaluation of all of these is outwith the scope of this thesis, only the two theories which are most relevant to this work will be discussed, namely dual coding theory (Paivio, 1972) and the Schematic, Propositional, Analogical and Associative Representational Systems (SPAARS) model (Power & Dalgleish, 1997, 2008).

2.2.1 Dual coding theory

Following observations from a number of different memory and learning experiments (some of which explicitly utilised imagery methods), Allan Paivio (e.g. 1971; 1972, 1990) proposed that there are two distinct systems for the representation and processing of information. A verbal system deals with linguistic information and stores it in an appropriate verbal form and a separate non-verbal system carries out image-based processing and representation. A wealth of experimental data supports this theory, including the outcomes of memory tasks and neuropsychological studies (Eysenck & Keane, 2000). For example, Paivio (1972) proposed that the reason memory for pictures is superior to memory for verbal material is because imagery conditions increase the probability that both imaginal and verbal processes are engaged in the task of retrieval. Neuropsychological data indicate that that there is localisation of the two symbolic systems within the brain, as generally speaking the left hemisphere is used for language-based processing, and the right for non-verbal material such as face identification (Kolb & Whishaw, 2003).

Paivio argued that both propositional (conceptual, abstract and language-like) and analogical (sensory and picture-like) forms of mental representation are essential to any understanding of human cognition. However, other psychologists such as Pylyshyn (e.g.

1973; 1981, 1999) deny the validity of an analogical-propositional distinction, and assert that the external world is represented mentally entirely by propositions. Towards the end of the twentieth century, much research was conducted that provided evidence for one or other of these two schools of thought in the so-called 'Great Imagery Debate' (Denis, 1991). Although more recently the propositional-analogical debate and dual coding theory has generated much less research interest, the basic premise behind dual coding theory of a verbal vs. nonverbal distinction continues to influence cognitive and other psychological models (e.g. Brewin *et al.*, 1996a; Sun, 2002).

2.2.2 SPAARS

A more recent model of cognition which also takes account of the distinction between conscious and non-conscious emotional processes is the Schematic, Propositional, Analogical and Associative Representational Systems (SPAARS) model proposed by Power and Dalgleish (1997, 2008). This model is represented schematically in Figure 1.

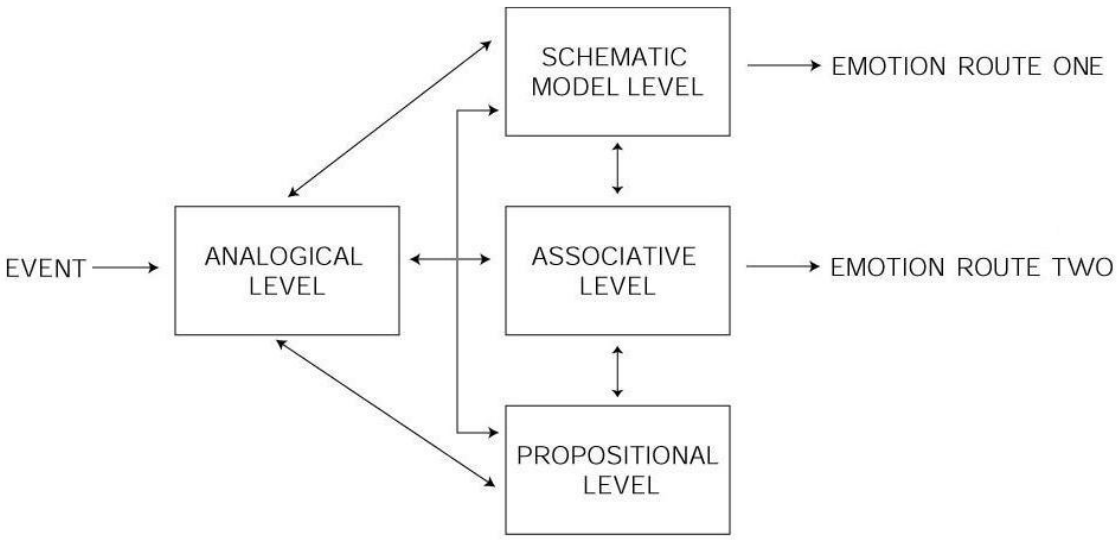

Figure 1: The SPAARS model of cognition and emotion (Power & Dalgleish, 1997, 2008)

In this multi-level model, the analogical system is involved with basic sensory processing of stimuli, be that visual, olfactory, auditory, gustatory, proprioceptive or tactile information. Note that the 'event' processed this way can be the 'live' environment or the result of memory recall. The analogical output then feeds into three semantic representation systems which link to each other and operate in parallel. The propositional level is the most language-like (although not language-specific) and contains beliefs, ideas, objects and concepts and the relations between them. The associative level (below the level of conscious awareness) can lead directly to the generation of emotion (route two) as the result of repeated stimuli-response pairs as seen in classical conditioning. Within the schematic model level, information from the analogical, propositional and/or associative levels is combined with information about the person's current goals to produce an internal model of the situation. This appraisal process then leads to the generation of emotion (route one), as described by Oatley and Johnson-Laird (1987).

One of SPAARS' strengths lies in the fact that it provides an account of everyday emotional responses as well as those seen in emotional disorders. It was developed following a review of the evidence for a wide variety of other models of cognition and emotion in both academic cognitive psychology and clinical psychology. As such it is well-grounded in empirical research, and there is good evidence for the existence of all the main components of the model (Power & Dalgleish, 2008). However, as it is relatively new, further research needs to be conducted to clarify the ways in which the various processes involved interact with each other (Eysenck & Keane, 2010). The implications of this model for the link between imagery and emotion are discussed further in 2.4.3.2.

2.3 Psychological research into imagery

Although mental imagery had long been a source of discussion amongst philosophers, Galton (1883) is commonly credited with one of the earliest attempts to study imagery in a systematic manner. He asked scientific colleagues and friends a series of open-

ended questions on visualising and found that the answers revealed marked individual differences in the strength and quality of people's reported mental imagery. Furthermore, a proportion of people (12 per cent) reported that they did not experience mental imagery at all. Although during the behaviourist era research into mental imagery fell out of fashion because of its reliance on introspective evidence, it re-emerged with the cognitive revolution. Individual differences in mental imagery use, nature and quality were investigated, with imagery vividness receiving the most research attention. A number of studies, for example, found that people who score highly on measures of imagery vividness have significantly better memory for pictorial stimuli (Marks, 1972).

As previously discussed, research into imagery as a phenomenon in its own right was questioned (by, for example, Pylyshyn) and defended (by, for example, Paivio) in the analogical-propositional debate. Another famous imagery researcher, Stephen Kosslyn, took a slightly different approach from Allan Paivio. Kosslyn (e.g. 1975; 2001; 2006) proposed that information is stored permanently (in long term memory) in propositional form, however imagery experiences are generated from this amodal database when specific modal processes are implemented (for example, tasks which require mental rotation will elicit imagery). Thus images need to be investigated in their own right, as genuine forms of mental representation that cannot be reduced to other functional forms of representation (Kosslyn & Pomerantz, 1977). Accordingly, in the latter part of the twentieth century, cognitive science researchers amassed a wealth of studies which explored the structure of imagery through experimentation with, for example, mental rotation (e.g. Cooper & Shepard, 1973; Shepard & Metzler, 1971) and image scanning (e.g. Kosslyn *et al.*, 1978).

2.3.1 Physiological effects of imagery

Psychologists have also explored the effect of mental imagery on physiological and immune system functioning, with evidence from a range of researchers indicating that self-generated mental imagery has a number of objectively measureable physiological

effects. Deschaumes-Molinaro *et al.* (1992) investigated autonomic nervous system (ANS) functions (skin potential and resistance, skin temperature and blood flow, heart rate) in a group of marksmen and archers. The participants were asked to visualise a shooting sequence and two neutral imagery scenes, additionally their ANS functions were also measured during actual shooting practice. The results indicated that the shooting imagery resulted in more ANS activity than the neutral imagery and furthermore ANS responses were the same for the visualisation of the shooting sequence as for when the participants were actually engaged in this activity. Other studies have found that imagery of appealing food can increase salivary flow (Barber *et al.*, 1964; Wooley & Wooley, 1973), and instructions to imagine that specific skin regions are hotter or colder can change blood flow (Kunzendorf, 1981; McGuirk *et al.*, 1998). Physically or emotionally arousing imagery results in increased heart rate (e.g. Carroll *et al.*, 1982; Deschaumes-Molinaro *et al.*, 1992; Kunzendorf *et al.*, 1997), with relaxing imagery being found to decrease heart rate (Arabian, 1982). In clinical settings, long-term reductions in both systolic and diastolic blood pressure have been achieved through relaxing imagery (Crowther, 1983). It must be noted however, that the effects of the relaxing imagery are not easily disentangled from the effects of the relaxation procedure itself, namely sitting comfortably and slowing down breathing rate. Some research has found that self-generated images of emotional and bodily arousal can increase galvanic skin response (Passchier & Helm-Hylkema, 1981), with one study also revealing that the strength of this increase is positively correlated with imagery vividness (Drummond *et al.*, 1978).

A number of studies have examined immune system functioning and imagery, for example Schneider *et al.* (1990) found that in healthy subjects' immune system functioning (as indicated by neutrophil adherence) was improved by images of 'white blood cells attacking germs'. Other research with cancer patients has found that the likelihood of remission can be improved by mental images of tumours being absorbed or attacked by white blood cells (Gruber *et al.*, 1993). With students preparing for exams, Gruzelier *et al.* (2001) compared self-hypnosis training which included imagery connected to the immune system or relaxation-based imagery. The training was delivered in three weekly group sessions and the researchers found that the students in

the immune-system imagery group had fewer viral illnesses during the exam period than those in the relaxation-imagery group. However, many of these experimental studies conducted with student populations have very short contact periods with no follow-up, and so the changes seen may not be maintained in the long-term (Bakke *et al.*, 2002).

For some of these studies, the methodological rigorousness is questionable. Additionally, as negative results are not often published, conclusions drawn from this body of research should be tentative. However, overall it would appear that deliberate manipulation of mental imagery has the ability to have a significant effect on a number of physiological parameters (Sheikh, 2003) and perhaps therefore also chronic pain experiences.

2.4 Is there a special relationship between imagery and emotion?

In both experimental and clinical psychology it is common to find assumptions about imagery and emotion being closely connected, although this claim is often based on anecdotal reports of clinical observations rather than rigorous research evidence (Holmes & Mathews, 2005, 2010; Watts, 1997). The experimental and clinical evidence for a special relationship existing between imagery and emotion will now be reviewed, along with some exploration of potential reasons for such a relationship existing.

2.4.1 Experimental evidence

Vrana *et al.* (1986) gave 64 undergraduates written descriptions of fearful or neutral events and asked them to silently read them to themselves and then imagine the events. They found that their participants' heart rates accelerated more for the fearful events than the neutral ones but more importantly that this difference was greater when they were imaging the event compared to silently verbally rehearsing it. Similarly, Miller *et*

al., (1987) found that (self-rated) 'good imagers' displayed greater physiological activity than 'poor imagers' when imaging emotional events. Other experimental evidence has found that, in comparison to verbal processing and focussing on the meaning of fictional described events, instructions to participants to use imagery amplifies emotional responses for both negative (Holmes & Mathews, 2005) and positive (Holmes *et al.*, 2009; Holmes *et al.*, 2006) affect.

However, in all of the studies cited thus far, the participants (necessarily) had to first verbally process the material by reading or listening to it before using imagery, which makes comparisons problematic. It could be argued that the emotion in the imagery conditions resulted from both verbal and imaginal processing, whereas only verbal processing occurs in verbal conditions. This difficulty was overcome, however, in a study by Holmes *et al.* (2008) by the use of a slightly different experimental methodology. In this study, participants were presented with pictures and single word captions and asked to combine them using either an image or a verbal statement. The pictures and captions alone were relatively neutral but their combination would result in an affective response (for example, a picture of the view from a high bridge with the caption 'leap'). The researchers found, as expected, that state anxiety increased when participants were asked to use images as compared to verbal statements to combine the pictures and captions.

Experimental research has also found a link between imagery vividness and emotionality. Bywaters *et al.* (2004a) asked 80 undergraduate students to form a mental image of 25 pictures from the International Affective Picture System, and found that slides previously rated as extremely emotionally valenced (both positive and negative) and highly arousing were more vividly imaged than neutral slides. This effect was most pronounced when the recall occurred 15 minutes after the presentation of the pictures, and still evident after a one week delay (although the study only managed to retain 46 per cent of the original sample). Additionally, one study found that the number of aversions reported by 348 university students was correlated with their imaginal ability, i.e. the degree to which they could generate and manipulate vivid and realistic images (Dadds *et al.*, 2004).

2.4.2 Imagery as part of psychological disorder

2.4.2.1 Anxiety disorders

Hackmann and Holmes (2004) claim that the appraisal of intrusive imagery and consequential behaviour intended to reduce the perceived threat is key in the maintenance of several anxiety disorders. The imagery in post-traumatic stress disorder (PTSD) has been the most extensively studied. A cardinal feature of PTSD is the persistent re-experiencing of a traumatic event, commonly as intrusive images (American Psychiatric Association, 1994). These so-called 'flashbacks' result in a powerful anxiety response (Andrews *et al.*, 2003), again suggesting a close link between imagery and emotion. The images are considered to be meaningful fragments of a trauma memory that lack adequate contextual information, are retrieved from memory unintentionally, and contain important meanings related to themes of threat and helplessness (Hackmann & Holmes, 2004). One very influential theoretical model in the literature on PTSD was developed by Brewin *et al.* (1996a). They suggested that there are two levels of representation, verbally accessible memories (VAMs) and situationally accessible memories (SAMs). The authors propose that flashbacks occur because of the activation of SAM representations. The distinction between the verbal encoding in VAMs and the occurrence of flashbacks as a result of SAMs again suggests a verbal-imaginal distinction with imaginal consequences being closely connected to the emotional arousal experienced. The first line evidence-based interventions recommended in clinical practice guidelines for PTSD are Trauma-Focused CBT and EMDR (NICE, 2005). Both of these utilise imaginal exposure, in recognition of the importance of imagery in the maintenance of this condition.

Although less extensively studied than imagery in PTSD, images of the self containing both visual and auditory information are thought to be a key component in social phobia (Clark & Wells, 1995; Hirsch & Clark, 2007). These images are triggered by the perception of threat in social situations, are seen from an observer perspective and

distorted in several characteristic ways (for example, people imagining themselves as trembling more or a brighter shade of red than they actually are). A number of studies have found evidence for the existence of these images (Hackmann *et al.*, 1998; Hirsch *et al.*, 2003; Hirsch *et al.*, 2004). Furthermore, effective therapeutic interventions have been devised which are primarily based on imagery-rescripting (Wild *et al.*, 2008) or target self imagery modification within cognitive therapy (Clark *et al.*, 2006).

Imagery is also thought to play a key role in generalised anxiety disorder (GAD), with verbal worrying and rumination being used to inhibit aversive emotional imagery of negative outcomes (and associated somatic sensations) which would otherwise intrude (Borkovec & Inz, 1990). Borkovec *et al.* (1998) propose that thinking about an emotional topic in verbal thoughts results in a drop in physiological response and inhibition of emotional processing, whereas the translation of the concern into an image will increase physiological response in the short term but ultimately facilitate successful processing and resolution of the worry and associated emotion. Characteristic imagery has also been identified in agoraphobia (Day *et al.*, 2004) and obsessive-compulsive disorder (Rachman, 2007; Speckens *et al.*, 2007), with images being automatically triggered and often incorporating aspects of upsetting memories that carry important meanings (Hackmann & Holmes, 2004).

Evidence has also been found which suggests that people who have snake and spider phobias experience imagery related to their fear (Hunt *et al.*, 2006; Pratt *et al.*, 2004). One study (Hunt & Fenton, 2007) attempted to improve the efficacy of in vivo exposure for snake fear by combining it with cognitive therapy methods which included imagery rescripting. The imagery rescripting involved the participants (52 students with self-reported snake fear) identifying and then modifying their frightening snake-related imagery by, for example, picturing the snake with no teeth or imagining that they were wrapped in protective body armour. Although the addition of cognitive therapy to in vivo exposure did not statistically significantly improve the outcomes, cognitive therapy alone was as effective as in vivo exposure alone, with all active treatments found to be more effective than a relaxation control (Hunt & Fenton, 2007). The power of imagery has long been used in systematic desensitisation methods [first described by Wolpe

(1958)] which are commonly used to treat phobias and other anxiety conditions. Patients are encouraged to imagine their feared object or situation for a long enough time that a reduction in the anxiety generated by the image occurs (habituation and extinction), and a number of studies have supported the effectiveness of this approach (Andrews *et al.*, 2003).

2.4.2.2 Mood and other psychological disorders

Mansell and Lam (2004) found that in people with remitted unipolar and bipolar depression, specific memories in particular are associated with imagery. However, a number of memory studies have indicated that people with depression have difficulty in recalling specific memories (Williams & Broadbent, 1986; Williams & Scott, 1988) and this overgeneral memory bias is thought to be a maintenance factor for depression as it is associated with poor problem solving (Scott *et al.*, 2000). Taken as a whole this would appear to suggest that people with depression are less likely to experience vivid imagery related to memories. When asked to intentionally recall and rate the vividness of emotionally valenced images however, vividness ratings increase with increasing depressive symptoms (as indicated by BDI scores), even after imagery ability is controlled for (Bywaters *et al.*, 2004a). The apparent confliction between these results could be accounted for by the fact that the researchers employed very different methodologies. The studies cited first were investigating naturally occurring imagery from patients' memories rather than intentionally introducing images by asking participants to remember them. This difference is clearly an important one, and it could be hypothesised that people with depression avoid specific imagery based memories because they are too vivid and distressing (similar to the imagery avoidance seen in GAD). A study by Brewin *et al.* (1998) lends some support to this hypothesis. These researchers found that in cancer patients, depression severity was related to the frequency of intrusive memories and the level of avoidance of them. However, this is correlational data, and causality between imagery vividness, imagery avoidance and depressive symptomatology remains unclear.

Research into intrusive memories in people with depression suggests that they are similar in frequency and other characteristics to the intrusive memories in PTSD (Brewin *et al.*, 1996b), and may play a significant role in maintaining depressive symptoms (Patel *et al.*, 2007). These memories are more likely to be negative in people with depression (Bywaters *et al.*, 2004b) and often have particular themes including instances of the person being told that they are a failure as well as the recall of past depressive episodes (Mansell & Lam, 2004). Consequently there has been some initial exploration of the potential application of rescripting techniques with depressive intrusive sensory memories (Brewin *et al.*, 2009; Wheatley *et al.*, 2007). This research has indicated that imagery rescripting as a stand alone treatment with people who have severe and recurrent depression shows promise, furthermore gains were maintained at one-year follow-up (Brewin *et al.*, 2009). However, these two studies only involved twelve individuals in total and so clearly more controlled and comparative research needs to be conducted before imagery rescripting is established as an effective intervention.

Clinical practice guidelines for depression recommend CBT as an evidence based treatment (NICE, 2009; SIGN, 2010). Although in the past, cognitive therapy has been criticised for focusing almost exclusively on language-based mental representation, the founder, Aaron T Beck, stated that cognitions relevant to psychological distress can take the form of both verbal thoughts and mental images (Beck, 1976) and that modifying upsetting visual cognitions can lead to significant emotional shifts (Beck *et al.*, 1985). Furthermore, as indicated by clinical texts, clinicians utilising cognitive therapy have used mental imagery techniques for some time. However, from the predominant focus on verbal representations in the literature it is clear that the science of imagery has significantly lagged behind the cognitive therapists' clinical creativity.

Other psychological disorders in which characteristic mental images have been found include bulimia nervosa (Somerville *et al.*, 2007), psychosis (Morrison, 2004; Morrison *et al.*, 2002) and body dysmorphic disorder (Osman *et al.*, 2004). Nelson and Harvey (2002) conducted an interesting study with students who experienced sleep-onset insomnia. They told participants before they got into bed that they would have to give a

speech the following day which would be videotaped and marked for performance. They were instructed to think about the speech and its implications when in bed in either images or verbal thought. The researchers found that students in the image group reported more distress and arousal before going to sleep than those in the verbal group. However, in comparison to the verbal group, the next day the image group estimated that they fell asleep more quickly and reported less anxiety about giving the speech. Thus although it appeared that imagery instructions initially resulted in higher emotional distress, in terms of the successful management of a stressful situation it was ultimately more effective to engage in imaginal rather than verbal processing (Nelson & Harvey, 2002).

In summary, imagery (and its avoidance) appears to play an important role in the development and maintenance of a number of psychological disorders. Furthermore, imagery techniques can be powerfully utilised within traditional behavioural therapy exposure based interventions for anxiety (Wolpe, 1958). Additionally, imagery rescripting methods (as a component of cognitive therapy) which encompass both modification of the image itself as well as its implicational meaning and associated appraisals, are growing in popularity and show some promise (Holmes *et al.*, 2007; Holmes & Mathews, 2010). The body of work reviewed here suggests that in a range of psychological disorders, characteristic imagery can be closely connected to emotion.

2.4.3 Reasons why a special relationship might exist

2.4.3.1 Imagery and perception

One suggestion as to why imagery and emotion are so closely connected is that the same brain systems are involved in processing the emotional aspects of imagery as would be utilised if the events were being directly perceived. This is vividly illustrated in PTSD, where flashbacks can be experienced and responded to (emotionally, physically and behaviourally) as if the trauma is actually happening again. In terms of

visual images, there is evidence from a number of neuroimaging studies which supports this view (Holmes & Mathews, 2010). Furthermore, mental images appear to share properties with perceptual representations derived from direct sensory experience (Kosslyn *et al.*, 2001). From an evolutionary perspective it would be reasonable to assume that imaginal processing is more closely linked to emotions than verbal processing because basic emotions preceded the development of language-like representational systems (Holmes & Mathews, 2005). Similarly, developmentally speaking, our visual perceptual system develops much more rapidly and at an earlier age than we can even understand verbal utterances.

2.4.3.2 SPAARS

Using the SPAARS model (Power & Dalgleish, 1997, 2008), emotional systems might be particularly sensitive to imagery as compared to verbal representations because cognitions at the propositional level of meaning are not directly linked with emotion. However, imagery can directly access the schematic level and hence may have greater impact on emotion (route one). Both words and images could also lead to emotion through route two through classical conditioning. Imagery in particular is thought to be able to function as an unconditioned or conditioned stimulus (Dadds *et al.*, 1997; 2004). This fact underlies the theoretical rationale for the use of imaginal exposure in systematic desensitisation (Wolpe, 1958) (discussed in section 2.4.2.1).

2.4.3.3 Images and autobiographical memory

Imagery is thought to be central to autobiographical memory (Conway, 1990; Conway & Pleydell-Pearce, 2000). This assertion is supported by a variety of evidence, including some studies which have compared verbal and imaginal conditions in the creation of false memories (Mazzoni & Memon, 2003). For example, Hyman and Pentland (1996) found that false childhood events were more likely to be recalled later if participants had been asked to form a mental image of the event than if they had been asked just to ‘think about it’. Holmes and Mathews (2010) propose that if the generation

of imagery draws on autobiographical memory, then this process may naturally evoke the emotions which were experienced at the time the memory was encoded. In the second part of the experiment by Holmes *et al.* (2008) described earlier, participants were asked to describe their image or descriptive sentence which had been used to combine the picture and caption. Content analysis by independent raters indicated that the descriptions provided by people in the imagery condition were more likely to include more specific events, involve the self and use more words describing emotions and sensations. In contrast, participants in the verbal condition constructed sentences which had less personal and emotional impact because they were constructed from generic semantic knowledge. For example:

> *'In response to a picture of someone swimming in the sea and the caption "race", an imagery condition participant said "Swimming in the sea, very, very cold, racing with other people coming up behind me" while another in the verbal condition said "The swimmer was having difficulty finishing the race across the channel".' (Holmes et al., 2008, p.404)*

This provides support to the hypothesis that access to autobiographical memory may partially mediate the emotional effects of imagery

2.4.4 Summary

Imagery and its avoidance appear to play a significant role in emotional disorders; additionally, growing experimental evidence indicates that imagery is closely linked to emotion. The reason for this close relationship could be understood with reference to a multi-level theory of emotion, SPAARS, through the exploration of the overlap between imagery and direct perception as well as its link with autobiographical memory. Given the importance of emotional factors in chronic pain, a potentially significant area of exploration would be the link between emotions and chronic pain imagery. Although thus far there has been limited examination of this, Chapter 3 reviews the relevant literature in this area.

Chapter 3: Imagery in Chronic Pain

The overwhelming majority of research which has investigated imagery in chronic pain has examined the effectiveness of guided imagery techniques for the reduction of pain. There are also a few isolated descriptions of imagery modification techniques which target naturally-occurring mental imagery associated with pain, and two (currently unpublished) studies which have explored the nature and functional impact of specific chronic pain imagery (Gosden, 2008; Potter, 2007). Chapter 3 will review each of these areas in turn and in so doing provide the justification for the present study.

3.1 Imagery-based interventions for chronic pain

The most commonly cited use for imagery is for the intentional generation of pleasant images to aid relaxation and divert attention away from pain (see 3.1.1). However, it should be noted that imagery has also been used in other idiosyncratic ways such as transforming the pain sensation itself (for example imagining the pain is tingling or numbness) or transforming the interpretation of pain sensations (for example imagining being a spy or Olympic athlete who continues on despite being injured) (Pincus & Sheikh, 2009; Turk *et al.*, 1983).

3.1.1 Guided relaxation or pleasant imagery

Guided imagery involves a client being taught to evoke a mental image which has relaxing or soothing qualities (Horan *et al.*, 1976). The images can be generated by the client or they can be described by the therapist. A self-generated image could, for example, be prompted through a suggestion to think of 'a beautiful place' and connect with all the sensory aspects of that place. A therapist-guided image could be evoked through a sensory-rich description of, for example, a beach scene (Field & Swarm, 2008). The beneficial effects of this method for pain relief are thought to be

both the result of the physiological effect of imagery (see 2.3.1) as well as the fact that the self-generation and maintenance of pleasant or relaxing imagery is very attentionally demanding and so provides an effective distraction from the pain (James, 1992a; Skevington, 1995).

In a meta-analysis of 51 studies (involving more than 2000 participants) which examined the effectiveness of cognitive strategies to alter pain perception, using pleasant and neutral imagery was found to be the most effective at changing pain tolerance, threshold, and intensity (Fernandez & Turk, 1989). However, the majority of the studies reviewed examined acute pain in laboratory conditions and so the conclusions cannot necessarily be generalised to chronic pain. More recent clinically-based studies have indicated that guided imagery can be effective in reducing the pain associated with cancer (Keefe *et al.*, 2010; Sloman, 1995) as well as perioperative (Rampkin *et al.*, 1991; Tusek *et al.*, 1997) and postoperative (Huth *et al.*, 2004) acute pain symptoms.

In terms of chronic pain, numerous widely available chronic pain treatment guides recommend the use of relaxation imagery techniques (Otis, 2007; Thorn, 2004), and there is evidence from a number of studies that guided imagery can improve outcomes for people with chronic pain. For example, Turner and Jensen (1993) found that a combination of guided imagery and progressive muscular relaxation (PMR) were as effective as cognitive therapy at reducing pain intensity ratings in a sample of people with chronic low back pain. In fact, the addition of cognitive techniques to the PMR and guided imagery did not improve the effectiveness, as was also found by (Syrjala *et al.*, 1995) in a controlled trail with patients with cancer pain.

In a well designed and implemented study with women with a diagnosis of fibromyalgia, Fors *et al.* (2002) investigated the effectiveness of amitriptyline and two different guided imagery conditions (which included music and relaxation) on daily visual analogue scale ratings of pain intensity. Fifty-five women were randomised to either pleasant imagery, attention imagery (which involved focussing

on the 'active works of the internal pain and control systems'[1]) or a control group (treatment as usual). The participants were also randomly assigned to 50 mg per day of amitriptyline or a placebo. The results indicated that, in comparison to the control group, pain intensity decreased for the women in the pleasant imagery group but not the attention imagery group. There was no main effect or interaction effect of amitriptyline. As the study design utilised an alternative imagery intervention which did not prove to be effective, we can confidently conclude that the improvement seen for the pleasant imagery group was due to the nature of the imagery and not the interventions' generic relaxation and musical component. Unfortunately however, the study only collected data over a period of a month and so it is unclear whether the improvements seen were maintained. Guided imagery interventions have also resulted in improvements in pain ratings in a heterogeneous clinical sample from a chronic pain clinic (Lewandowski, 2004) as well as people with osteoarthritis (Baird & Sands, 2006), headache (Mannix *et al.*, 1999) and children with recurrent abdominal pain (Weydert *et al.*, 2006).

Taken together, these results indicate that the use of pleasant or relaxing guided imagery techniques can be effective in reducing pain and improving outcomes not only for experimentally induced and acute pain but also some chronic pain conditions. However, the methodological quality is poor in some of the studies and in many of them the use of imagery has been combined with general relaxation instructions or hypnosis and so the relative contributions of these elements is hard to determine. Overall however, it appears that guided imagery can result in at least short term reductions in acute and chronic pain although the long term effectiveness of this technique for chronic pain is yet to be established.

[1] This involved participants visualising their own pain-alleviating biological systems, with audiotapes providing descriptions of how endorphins and inhibitory neurons act to limit pain.

3.1.2 Pain imagery modification

None of the imagery techniques referred to in the previous section have utilised people's naturally occurring mental images, although, for example, large catalogues of artwork (Padfield *et al.*, 2003; www.painexhibit.com) would suggest that visual imagery is, at the very least, a powerful medium through which pain can be expressed and explored (Henare *et al.*, 2003). Self help guides for chronic pain management often refer to imaginal methods which describe, for example, 'visualisation techniques to obtain an image of the pain itself and then change it to one more tolerable' (Sadler, 2007, p.65). Furthermore, clinical guides for health practitioners frequently contain references to (and scripts for) helping patients identify and then change their own pain imagery (Field & Swarm, 2008; Pincus & Sheikh, 2009). Pincus *et al.* (2004a) describe what they term 'deep imagery' techniques which have been used for spiritual and physical healing for centuries by Buddhist healers and shamanistic practitioners. These include transformational methods of changing the size, colour or location of their pain, dissociating from a symbolic representation of the pain or otherwise changing their relationship to the mental image, for example by viewing it from a distance (Pincus *et al.*, 2004a).

However, imagery techniques centred on manipulating naturally occurring spontaneous images of pain appear to have been neglected in the scientific research outcome literature. Currently, there is very little rigorous scientific research published in mainstream clinical journals which indicates that these techniques are effective. This has perhaps happened because of the idiosyncratic nature of imagery as well as imagery transformation techniques having Eastern spiritual and new-age origins. This lack of research is unfortunate given the potential power of the manipulation of imagery to help people with chronic pain articulate and modify beliefs and feelings related to their pain which are less readily accessible via verbal cognitive techniques (Gosden, 2008).

3.2 Spontaneously occurring imagery in chronic pain

It is surprising that the naturally occurring imagery associated with pain has thus far received little research attention, although perhaps given that mental imagery is becoming one of the ‘‘hot topics’’ in modern cognitive behaviour therapy (Holmes *et al.*, 2007), this will not remain the case. Everyday language used to describe pain often refers to what could be considered imaginal descriptors, for example ‘burning’, ‘stabbing’, ‘squeezing’ (Craig, 2005). Furthermore, clinical anecdote indicates that people who experience chronic pain often spontaneously offer imagery-like descriptions of their pain, or indeed overtly report experiencing a mental image.

To date there have been two key pieces of (currently unpublished) work which have explored the nature and functional impact of naturally occurring chronic pain mental images. Potter (2007) conducted a questionnaire study and received 83 responses from a heterogeneous sample of people presenting to a chronic pain clinic. When asked the question: ‘Some people report having a mental image and/or pictures of their pain, do you have these?’ (Potter, 2007, p.41), a significant proportion (23 per cent) of the respondents said yes. On further exploration, the results indicated that reporting chronic pain images was associated with higher anxiety, depression and catastrophising but not greater pain, disability or other psychological factors (including acceptance, resourcefulness, coping thoughts and helplessness). However, as only 19 of the respondents indicated that they did experience a mental image, the between group comparisons (imagers vs. non-imagers) were underpowered and therefore may have missed effects. Furthermore, the way the question about pain imagery was asked limited it to only visual pain images rather than also encompassing other sensory modalities.

Nevertheless, these were significant findings, and subsequently Gosden (2008) further explored this phenomenon through another questionnaire study which examined the characteristics and nature of the chronic pain images. From his heterogeneous sample of 105 people from a specialist chronic pain clinic, 39 per cent reported experiencing a mental image of their pain. The large difference between this

and the proportion found by Potter (2007) is attributable to the slightly different question asked in this study, which enquired about mental imagery in all sensory modalities rather than just visual:

> *'We are particularly interested in finding out if you have a picture or a mental image of what your pain is like. A mental image is like having a picture in your head which may include things you can imagine seeing, hearing or feeling' (Gosden, 2008, p.90)*

Similar to Potter (2007), Gosden (2008) also found that people who reported having a mental image also reported significantly higher levels of depression, and although there was also a trend toward higher anxiety in the imagers group, the difference was not statistically significant. This different finding for anxiety was potentially because of the measure used, as Potter (2007) measured anxiety and depressive symptomatology with the hospital anxiety and depression scale (HADS, Zigmond & Snaith, 1983) whereas Gosden (2008) used the depression, anxiety and positive outlook scale (DAPOS, Pincus *et al.*, 2004b). As the DAPOS employs only three items to measure anxiety, it is potentially less sensitive.

Gosden (2008) found that imagers rated their pain as more unpleasant than non-imagers, despite reporting the same level of pain intensity. The questionnaire responses also indicated that the chronic pain images were distressing, occurred frequently (at least every day) and interfered with daily life. A thematic analysis of the written descriptions of the pain imagery provided by the imagers was conducted and revealed distinct themes. These related to the sensory qualities of the pain, individuals' beliefs about the physical cause of pain and personal meanings that the presence of pain had for the individual, with themes of victimisation or punishment most common (Gosden, 2008).

Aside from the questionnaire study, Gosden (2008) also conducted a small number of exploratory semi-structured interviews to collect further information about the nature of the chronic pain images experienced. The reports of the fourteen participants

whose data were retained (as two people interviewed were unable to generate an image) indicated that mental images were primarily visual and tactile, although auditory, olfactory and taste modalities within imagery were also reported. Images were longstanding (having lasted three years on average) and largely stable over time. They were most frequently triggered by an increase in pain level, and people's reported reactions to the image occurring overwhelmingly attempted to avoid, reduce or suppress the image in some way.

At the end of the interview, the majority of the participants (86 per cent) reported that they had experienced a negative emotional response and an increase in physiological arousal (as indicated by self-rated muscular tension, sweatiness, heart rate, and breathing rate) while they had their image in mind. Furthermore, they reported that their pain intensity had increased. However, these were retrospective judgements as the study design did not include before and after rating comparisons.

Taken together, these studies have provided a great deal of novel information about the nature of spontaneous naturally occurring chronic pain images as well as the factors they are associated with. Some of the results of the interview element of Gosden's (2008) study are particularly intriguing, given the close connections found between imagery and emotion in both experimental research and psychological disorder, as discussed in 2.4. This field of research would benefit from a more rigorous systematic investigation of the 'live' emotional and pain intensity consequences of evoking chronic pain imagery, which is what this study aims to provide.

3.3 Aim of present study

This research aims to further our understanding of the links between thoughts (both word-based and image-based) and emotions in people who report experiencing chronic pain-related imagery. The experimental manipulation will aim to (separately) directly evoke verbal and imaginal cognitions and measure the effects of these a

variety of indices; specifically the intensity of perceived pain and strength of emotional response. These experimental conditions will be compared to baseline ratings.

Additionally, it will examine the nature of the imagery described by the participants, namely how often they experience the image, how vivid it is, how distressing or pleasant it is, how much it interferes with daily life, and how much they can control it. These variables will also be examined in relation to the level of overall psychological distress (anxiety and depression symptoms) reported by the participants as well as the vividness and degree of spontaneous general imagery experienced.

3.4 Hypotheses

3.4.1 Primary

Hypothesis 1: There will be a difference in the reported pain intensity (1a) and strength of emotions [fear (1b), sadness (1c), anger (1d), disgust (1e), and happiness (1f)] between the baseline and the experimental conditions.

Hypothesis 2: There will be a difference in the reported pain intensity (2a) and strength of emotions [fear (2b), sadness (2c), anger (2d), disgust (2e), and happiness (2f)] between the imaginal and verbal conditions.

3.4.2 Secondary

Hypothesis 3: Positive correlations will exist between imagery frequency, distress and interference. Negative correlations will exist between pain imagery controllability and imagery frequency, distress and interference.

Hypothesis 4: Less controllable, more frequently occurring, more distressing and more interfering images will be associated with higher levels of self-reported anxiety and depression.

Hypothesis 5: People who have more spontaneous and more vivid general everyday images will also experience pain images which are less controllable, occur more frequently, are more distressing and more interfering.

Chapter 4: Method

4.1 Stage one: Recruitment

4.1.1 Recruitment

A postal questionnaire design was used to recruit potential participants to the study.

4.1.2 Participants

4.1.2.1 Inclusion criteria

Potential participants were drawn from a heterogeneous population of chronic pain patients attending a chronic pain specialist clinic within a large NHS teaching hospital. All people attending this service are age 18 or over and experience a range of chronic pain types due to a variety of causes. Patients with cancer-related pain are not routinely seen within this service, unless their pain is the result of past surgical or medical intervention and they have been successfully treated for the disease. All patients who were referred to and attended an initial appointment (normally with a Consultant in Pain Medicine and Anaesthesia) within the pain service during the period January 2009 – December 2009 (inclusive) were contacted.

4.1.2.2 Exclusion criteria

Anyone who had received or was receiving psychology input from the experimenter or another qualified or trainee clinical psychologist within the pain service was excluded in order to avoid the possibility that they might feel pressure to take part.

4.1.2.3 Sample size

According to calculations detailed further below (see 4.2.2.3), a minimum of 34 experiment interview participants were needed from the recruitment stage. On the basis of response rates to other postal research in this field (Gosden, 2008; Potter, 2007) it was estimated that between 20 and 25 per cent of people would return their brief questionnaire. On the basis of previous research (Gosden, 2008) it was estimated that of these, approximately 20 per cent would meet criteria for the experiment interview and would consent to take part. Therefore, it was calculated that between 680 and 850 packs would need to be sent out. In 2009, 853 new appointments were attended within the pain service. Of these, 27 people had received or were receiving psychology input and therefore 826 packs were posted out.

4.1.3 Procedure

Potential participants were identified from pain service 2009 electronic patient lists. They were sent a letter (see **Error! Reference source not found.**) from the clinical leader of the pain service (a Consultant in Pain Medicine and Anaesthesia) with a brief questionnaire (see **Error! Reference source not found.**) to their home address, inviting them to take part in the study. Also enclosed in the envelope were a participant information sheet (see **Error! Reference source not found.**) and a stamped return envelope. As an incentive to increase the return rate, all participants who returned their questionnaire and indicated they wished to be included were entered into a prize draw for a £25 shopping voucher. The funding for this was provided by the University of Edinburgh.

The brief questionnaire asked participants to describe their pain, its location, duration and cause (if known). Mental images or mental imagery were not mentioned in the title of the questionnaire, the invitation letter, or the participant information sheet in order to avoid possible contamination of participants' initial description of their pain and to reduce the effects of suggestibility on participants' mental imagery report. On

the third page of the questionnaire the participant was asked whether they had a mental image of their pain using the following question (taken from Gosden, 2008):

> *'We are particularly interested in finding out if you have a picture or a mental image of what your pain is like. A mental image is like having a picture in your head which may include things you can imagine seeing, hearing or feeling. Do you ever have a mental image like this of your pain?'*

If they indicated that they did experience an image of this nature they were asked to briefly describe it. Finally, they were asked to provide contact details if they were willing to discuss taking part in an individual interview.

4.2 Stage two: Experiment interview

4.2.1 Design

A within subjects or repeated measures design was utilised with each participant being asked to describe their pain in two different ways. In the verbal condition they were asked to describe their pain using single descriptive words and in the imaginal condition they were asked to evoke and describe their pain imagery. The dependent variables were their rating of their pain intensity and ratings of the strength of their emotions. These were assessed using visual analogue scales in a questionnaire completed before the experimental procedure and immediately following each condition.

4.2.2 Participants

Potential participants identified during stage one recruitment were selected for the experiment interview using the inclusion and exclusion criteria outlined below.

4.2.2.1 Inclusion criteria

- NHS patients who were referred to and attended an initial appointment within the pain service during the period January 2009 – December 2009[1].
- Aged 18 or over[1].
- Identified themselves as experiencing chronic pain (pain that has lasted longer than six months)[2].
- Identified themselves as having a good working knowledge of the written and spoken English language[2].
- Reported experiencing a mental image of their pain[2].
- Consented to take part in an interview[3].

4.2.2.2 Exclusion criteria

- Any patient who had received or was receiving psychology input from the experimenter or another qualified or trainee clinical psychologist within the pain service[1].
- Anyone who provided an ambiguous description of their pain imagery[2]. Gosden (2008) identified a small group of participants within his sample who reported pain imagery, but the written descriptions provided were unclear and did not appear to actually describe imagery phenomena. As this had potentially arisen from a misunderstanding of the question, it was decided that only people who provided unambiguous descriptions of their imagery would be contacted for interview.
- Any patient who the medical team within the pain service raised concerns about taking part in an interview. The names of potential interview participants were shared with the team to check whether they were individuals who were likely to become overly distressed by the interview (on the basis of previous clinical interviews).

[1] Criteria identified at stage one recruitment

[2] Criteria identified from responses on brief questionnaire

[3] Criteria identified during phone call to discuss interview appointment

- Anyone who disclosed a current or previous diagnosis of Post Traumatic Stress Disorder (PTSD)[2]. These individuals were excluded as intrusive imagery or flashbacks are a characteristic part of PTSD and happen when the person re-experiences the traumatic event. This is imagery of a different nature to that which this study is interested in, furthermore if the experiment interview triggered this imagery it would be extremely distressing for the participant.
- Anyone who disclosed a current or previous diagnosis of psychosis[2]. Again, the imagery characteristic of this condition (hallucination) is of a different nature to that in which this study is interested.
- Anyone who identified themselves as having had therapeutic input involving imagery techniques[3]. These individuals were excluded as any previous experience of recalling and manipulating pain related imagery could be a confounding factor as this study is interested in the spontaneous, naturally occurring pain images.

4.2.2.3 Sample size

Statistical power is the ability of a test to detect an effect in a sample where one exists within the population. Power calculations can be conducted to determine the minimum sample size necessary to achieve a certain level of power given an estimated effect size and (the conventional) significance α-level of $p < .05$. Cohen (1992) suggests that we would hope to have a .2 probability of failing to detect a genuine effect (Type II error), and so recommends a power of at least .8.

For the present research, the minimum required sample size calculation was based on the primary hypotheses, which employs a repeated measures or within groups design. The effect size of the experimental manipulation was estimated to be medium to large [d = .5 to .8 according to conventions outlined by Cohen (1977)], on the basis of the previous work by Gosden (2008) (specific to mental imagery within chronic pain) as well as the work of Oxford University's imagery research group lead by

[2] Criteria identified from responses on brief questionnaire

[3] Criteria identified during phone call to discuss interview appointment

Emily Holmes (e.g. Holmes & Mathews, 2005; Holmes *et al.*, 2006). According to power calculations using G*Power, (Erdfelder *et al.*, 1996), using a repeated measures two-tailed *t*-test with two conditions, 34 experimental interview participants were needed to achieve .8 power assuming a medium effect size (d = .5) and $p < .05$.

4.2.2.4 Participant characteristics

Figure 2 overleaf presents an overview of the flow of participants throughout the study. Of the 826 brief questionnaire packs posted out 184 were returned, representing a response rate of 22 per cent. Of these, 42 per cent of people reported experiencing a mental image of their pain (N = 78).

Table 1 provides an overview of the experimental sample and recruitment sample (including those who were also in the experimental sample) participant characteristics. The information collected on participants' pain locations and (self-reported) cause of pain indicated that both the recruitment and experimental samples were heterogeneous groups, reflecting the nature of the chronic pain population seen in the specialist clinic.

Table 1: Recruitment sample and experimental sample participant characteristics

		Recruitment sample		Experimental sample	
			Total *N*		Total *N*
Sex (%)	Male	31.0	183	16.7	36
	Female	68.5		83.3	
Age (years)	Mean (SD)	53.3 (15.5)	184	53.1 (11.6)	36
	Range	18 – 85		24 – 71	
History of mental health problem(s) (%)	Yes	27.2	182	38.9	36
	No	71.7		61.1	
Pain duration (years)	Mean (SD)	10.0 (10.3)	174	11.2 (10.3)	36
	Range	0.67 – 63		0.67 – 40	
Number of pain locations	Mean (SD)	4.9 (3.9)	184	4.4 (3.1)	36
	Range	1 – 16		1 – 14	

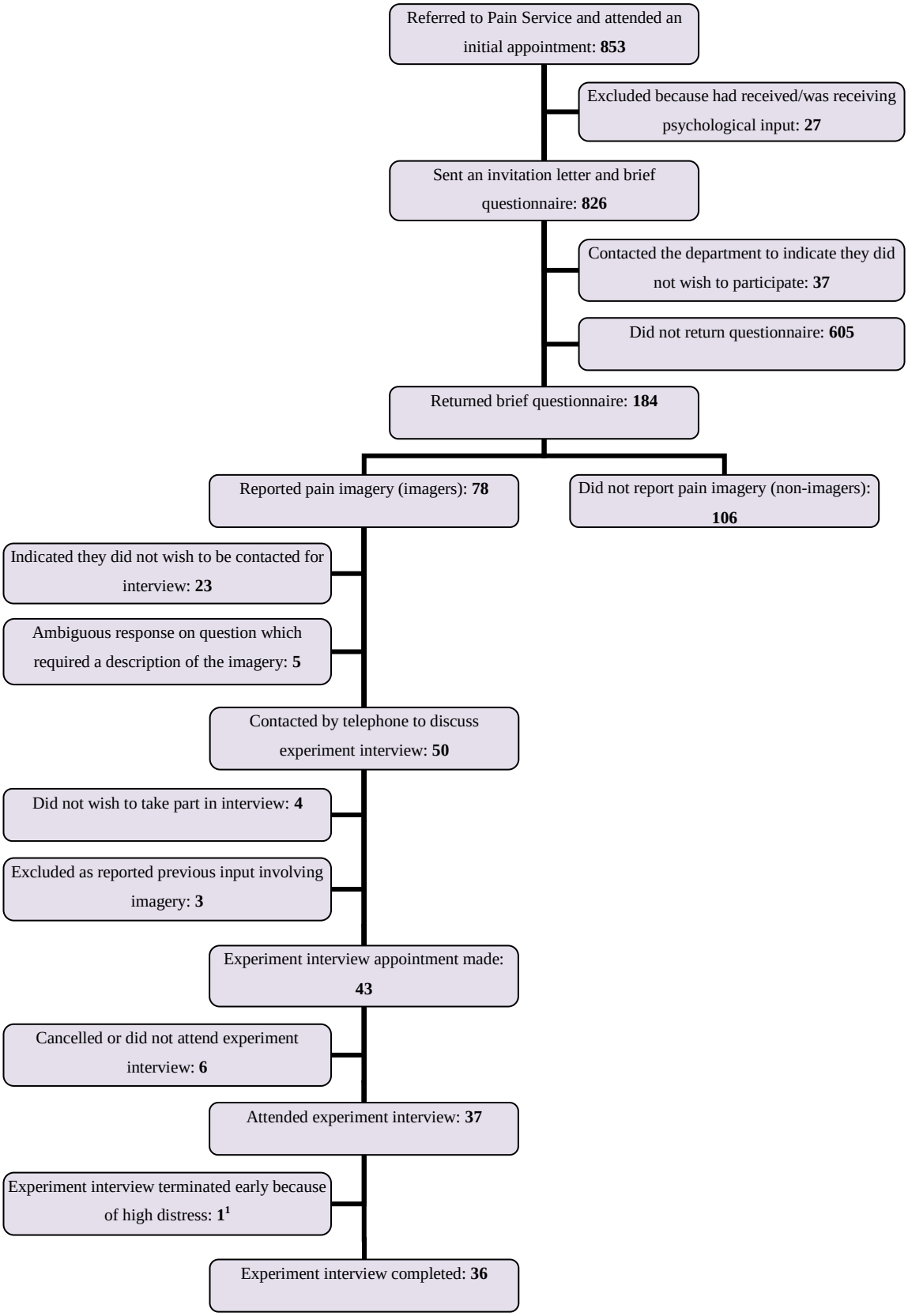

Figure 2: Overview of participants

[1] One experiment interview was not completed because the participant became highly distressed when asked to describe their pain imagery. In accordance with ethical duty within research, the interviewer therefore terminated the experimental procedure early and instead focussed on comforting the participant to help calm them down.

The experimental sample was compared to both the remaining recruitment sample and the remaining imagers to ascertain how representative the sample was of these groups. The experimental sample did not significantly differ from the recruitment sample in age, history of mental health problems, duration of pain, number of pain locations or knowledge of the cause of their chronic pain. However, the experimental sample did contain a significantly higher proportion of females than the recruitment sample. The experimental sample did not significantly differ from the rest of the imagers in the recruitment sample in terms of sex, history of mental health problems, duration of pain, number of pain locations or knowledge of the cause of their chronic pain. However, the experimental sample were significantly older than the remaining imagers.

The group who reported experiencing pain imagery (henceforth referred to as imagers) were compared to those who did not (henceforth referred to as non-imagers). The imagers did not differ from the non-imagers in sex, duration of chronic pain, number of pain locations or whether they knew the cause of the chronic pain. However, imagers were younger and had experienced significantly more mental health problems than non-imagers.

4.2.3 Procedure

People who returned their brief questionnaire, reported having mental images associated with their pain and opted into the interview study were contacted by telephone by the experimenter. They were provided with some basic information about what they could expect in the experiment interview and also asked a few questions relating to the presence of the exclusion criteria outlined above. They were given the opportunity to ask questions about the nature of the research, and also informed that their participation was entirely voluntary and they had the right to withdraw at any time and without providing a reason. If they were eligible and happy to take part in the experiment, an interview appointment was made and they were sent a second participant information sheet (see **Error! Reference source not found.**). They were also asked for their

consent for the experimenter to contact their GP to inform them that they would be taking part in the study (see **Error! Reference source not found.**). As an incentive for participants to come to a scheduled interview, all participants who attended (whether or not they fully completed the experiment) were entered into a second separate prize draw for another £25 shopping voucher. The funding for this was provided by the University of Edinburgh. Participants were asked whether they wanted to opt into the second draw over the phone after they had made the appointment.

At the start of the interview, each participant was asked to read and sign a consent form (see **Error! Reference source not found.**). Each experiment interview (see **Error! Reference source not found.** for the interview schedule) lasted around forty minutes and was conducted by the experimenter alone within the pain service hospital clinic. After signing the consent form, participants were asked to complete a baseline primary questionnaire (see **Error! Reference source not found.**), described further below. Depending on their experimental condition order, following this the participants were next either asked to describe their pain to the experimenter using single descriptive words (verbal condition) or to evoke and describe their pain imagery (imaginal condition). Each condition lasted four minutes (timed by the experimenter) and immediately afterwards the participants were again asked to complete the primary questionnaire. Half of the participants completed the verbal condition followed by the imaginal condition and half vice versa, to control for order effects.

In the verbal condition, participants were asked to list single, stand alone words they would use to describe their pain on a piece of paper. If they struggled with generating words they were reminded of the first three descriptive words they used on the brief questionnaire. Following this they were asked to read out their list and put each word into a short sentence to describe their pain (see **Error! Reference source not found.**). If this exercise had not taken four minutes they were further asked to select up to three key words from their list which they thought best described their pain. In the imaginal condition, participants were asked to recreate their pain image in their mind's eye, closing their eyes if it helped. If they struggled with this, they were prompted with a reminder of their image description on the brief questionnaire. They were asked to

describe the image to the experimenter, who also asked open questions about sensory modalities, namely sights, sounds, smells, tastes and physical sensations (other than pain).

In between the two conditions, the participants were asked to complete four straightforward 'filler' tasks, designed to interrupt any cognitive processing and to provide a temporal separation between the experimental conditions. The tasks involved generating a list of as many animals as they could think of (within a minute) and listing the different uses that a paperclip, brick and newspaper could be put to. These tasks were designed to distract them and encourage creative thinking to minimise carryover effects between the conditions.

Finally, the participants were asked to complete a secondary questionnaire (detailed further below), thanked for their time and given a brief explanation of the aims and hypotheses of the study.

4.2.4 Primary measures

During the experiment interview the participants were asked to complete a primary questionnaire (see **Error! Reference source not found.**) three times, specifically once at baseline and then immediately following each of the two experimental conditions.

4.2.4.1 A visual analogue scale rating of pain intensity

Visual analogue scales (VASs) have been used extensively with both acute and chronic pain and provide a reliable and sensitive measure of the intensity of a person's perceived pain (Tyrer, 1992; Williamson & Hoggart, 2005). Following the instruction of 'Please mark the line below to indicate how **intense** your pain has been *over the last four minutes*' a 10cm VAS was presented, with a left hand anchor point of 'no pain' and a right hand anchor point of 'worst pain imaginable'. A 10cm length was used for

convenience and because this has smaller measurement errors than 5cm or 20cm lengths (Seymour *et al.*, 1985).

4.2.4.2 Visual analogue scale ratings of the strength of the five emotions

As discussed in 2.1.2, research with both clinical and normal population samples across a number of cultures has established that there are five basic emotions: sadness, fear, anger, disgust and happiness (Power & Dalgleish, 2008). VASs were selected to measure the intensity of these emotions at baseline and immediately after the experimental conditions as this type of scale is more sensitive to subtle changes in emotion which may occur within the short time period employed by this study. The order of presentation of the scales was varied, with each participant completing three of 15 different randomly generated presentation orders of 'sad', 'angry', 'fearful', 'disgusted' and 'happy'. The following instructions were provided: 'This scale consists of five words which describe different feelings and emotions. Please read each item and then mark the line to indicate to what extent you have felt this way during the last four minutes.' Again, 10cm VASs were used, with the a hand anchor point of 'very slightly or not at all' and a right hand anchor point of 'extremely'.

4.2.4.3 Rating of imagery vividness

This single item (adapted from The Vividness of Visual Imagery Questionnaire) was included to provide a measure of condition fidelity, and asked participants to rate the vividness of their picture or mental image of what their pain is like. This was to ascertain whether the participants experienced a difference in the vividness of their pain imagery under the two experimental conditions, and consequently this item did not appear on the primary questionnaire completed at baseline.

4.2.5 Secondary measures

At the end of the experimental interview, participants were asked to complete a secondary questionnaire pack which was composed of the four measures described below.

4.2.5.1 Hospital Anxiety and Depression Scale

The HADS (Zigmond & Snaith, 1983) is a measure designed to detect adverse anxiety and depressive states. It is a 14 item Likert scale (7 items per subscale) with four possible responses on each item. A higher score indicates a greater number of symptoms and greater severity of the emotional state. For both scales, a score of 0-7 is 'normal' or below caseness, 8-10 is mild or borderline and 11 or above would imply caseness (moderate if 11-14 or severe if 15-21) (Snaith, 2003). The HADS is used extensively in clinical practice and research, has established validity and a good factor structure, intercorrelation and homogeneity (Bjelland *et al.*, 2002; Bramley *et al.*, 1988; Moorey *et al.*, 1991). As it was originally intended for use in non-psychiatric hospital departments it does not rely on symptoms which may be present in people with physical illness alone (e.g. sleep disturbance, weight loss, pain). A literature review of the HADS (Bjelland *et al.*, 2002) found an acceptable average internal reliability coefficient (Cronbach's alpha) of .83 for the anxiety subscale (range .68 to .93) and .82 for the depression subscale (range .67 to .90). In the present study, Cronbach's alpha was .79 for the anxiety subscale and .83 for the depression subscale.

4.2.5.2 Vividness of Visual Imagery Questionnaire

The VVIQ (Marks, 1973) (see **Error! Reference source not found.**) was included to provide a measure of general visual imagery ability. It is a 16 item Likert scale in which the participant is invited to consider the image formed in thinking about four elements of four different scenes, for example 'the contours of the landscape' in 'a country scene which involves trees, mountains and a lake'. The participant is asked to rate the

vividness of each image item on a 5 point scale twice, first with their eyes open and then with their eyes closed. A total score is calculated (range 32-160); with a lower score reflecting better imagery ability. Scores have been found to correlate with objective variables such as functional magnetic resonance imaging (fMRI) data on activity in the early visual cortex relative to the whole brain (Cui *et al.*, 2007). Marks (1973) reports this measure has a test-retest reliability coefficient of .74 (N = 68) and a split-half reliability coefficient of .85 (N = 150). Other internal consistency calculations have reported acceptable alpha levels ranging from 0.91 to 0.94 (Childers *et al.*, 1985). In the present study, Cronbach's alpha was .96, however as this measure has a large number of questions this calculation of internal reliability should be interpreted with caution as it may be misleadingly inflated (Cortina, 1993). However, the VVIQ is the most widely used measure of imagery vividness (McAvinue & Robertson, 2007), with factor analysis data indicating that the VVIQ items all load onto a single factor (Childers *et al.*, 1985). Overall, the VVIQ has been established as a reliable and valid instrument (Campos, 1995; McKelvie, 1995).

4.2.5.3 Spontaneous Use of Imagery Scale

The SUIS (Reisberg *et al.*, 2003) (see **Error! Reference source not found.**) is a 12-item self-report measure of use of imagery in everyday situations. Items such as, 'when I think about a series of errands I must do, I visualise the stores I will visit.' are rated on a five-point scale from 'never appropriate' to 'always appropriate'. A total item score is calculated (range 12-60); with a higher number reflecting more frequent use of imagery. Reisberg *et al.* (2003) report an internal consistency coefficient of .98 (N = 150), and in the present study the internal reliability (calculated using Cronbach's alpha) was .87. Although test-retest reliability of this scale has not been established, it has been used in imagery research (Holmes *et al.*, 2006; Mast *et al.*, 2003) and it correlates significantly with the more established VVIQ (Reisberg *et al.*, 2003). It was included to provide an indication of how frequently the participants use imagery in everyday life.

4.2.5.4 Custom-designed imagery questionnaire

As no suitable measure of pain-related mental imagery currently exists, a one-page questionnaire with four questions (see **Error! Reference source not found.**) was designed specifically for this study, based on Gosden's (2008) questionnaire. The first question asked participants to identify how often they experienced the pain image on a 5 point scale from 'many times a day' to 'almost never'. 11 point scales were provided for the remaining three questions, which asked how distressing or pleasant the image was, how much it interfered with daily life and how controllable it was.

4.3 Ethical considerations

A number of ethical considerations were taken into account in the design of this study.

4.3.1 Informed consent

With regards to ensuring participants were able to provide informed consent, they received information about the study within the participant information sheets enclosed with the brief questionnaire and provided before they attended an interview. Additionally, they were offered the opportunity to discuss the study and ask questions of the experimenter over the telephone and then in person prior to deciding whether to take part in an experiment interview. Participants were informed at several stages of this process that their participation was entirely voluntary, and that they could withdraw from the study without giving a reason at any time without negative consequence. Interview participants read and signed a written consent form to confirm their awareness of these issues.

4.3.2 Participant distress

A further ethical issue that was considered in this study design was the possibility that participants might become distressed during interviews as a result of describing their pain experience or evoking pain imagery. This issue was discussed with a qualified clinical psychologist who supervised the project and it was agreed that the experimenter had the appropriate skills and knowledge (developed through training and clinical experience of working with distressed individuals) to be able to adequately assess and manage such situations. If the experimenter became aware that a participant may have been currently experiencing a significant mental health problem they were offered appropriate treatment either through the NHS pain service itself or referred to a suitable alternative service. A further ethical consideration was the potential that a participant might have made a disclosure to the experimenter which had implications for the safety of the participant, or the safety of other people. Again, it was agreed that the experimenter possessed the suitable risk assessment and management skills to appropriately respond to such situations. In order to ensure participants were aware of the limits of confidentiality with regards to risk assessment and management, they were asked prior to interview to give consent for the experimenter to contact their GP should she have any concerns regarding their safety or the safety of others. Additionally, when the participants made their interview appointments their GPs were informed by letter of the fact that they were due to take part in the research.

4.3.3 Anonymisation of data

The data collected from each participant during recruitment and the experiment interview was anonymised via allocation of an identifier (a number) which was used throughout the data collection, summary and analysis. The contact information returned on the initial brief questionnaire was detached from the data and shredded once it had been used (for the prize draw or to contact the person to discuss an interview). Any identifiable information pertaining to the experiment interview participants was stored separately from the participant responses, in a secure location (separate to the data

itself) and will be destroyed on completion of the project. As an employee of the NHS, the experimenter acted in accordance with the NHS Code of Confidentiality.

4.3.4 Ethical approval

Ethical opinion for this project was sought prior to commencing data collection, and the study was assessed and approved by the University of Edinburgh Clinical Psychology Doctorate Research Ethics Group, a local NHS Research Ethics Committee (see **Error! Reference source not found.**) and local NHS Caldicott Guardian (see **Error! Reference source not found.**). Additionally, approval to conduct the research was granted by NHS Management/Governance (see **Error! Reference source not found.**).

4.4 Method of analyses

All data were analysed using the statistical package SPSS (version 13.0 for Windows). Exploratory data analysis methods were used to ascertain whether the data met the assumptions of parametric statistical methods. The assessment of the normality of distributions was particularly important because many inferential statistics are not robust to violations of this assumption (Tabachnick & Fidell, 2001). Therefore box plots and histograms were examined, the Kolmogorov-Smirnov test was conducted to assess normality and (where appropriate) Levene's test was used to assess homogeneity of variance. Where necessary, transformations were attempted using square root, base 10 logarithm or reciprocal functions and if these were unsuccessful equivalent non-parametric tests were used.

After careful consideration of the experimental design and hypotheses it was decided that the primary research questions would be most logically analysed separately via a series of repeated measures *t*-tests rather than ANOVAs. Therefore repeated measures *t*-tests or (where appropriate) Wilcoxon signed-ranks tests were used to analyse the primary hypotheses. Pearson's and (where appropriate) Kendall's Tau correlations were

calculated to measure the associations between the variables identified in the secondary hypotheses. Scatterplots were first examined for outliers and to ensure relationships were linear. Because of the number of correlations calculated, a more stringent p value of $p < .01$ was adopted to protect against the possibility of Type I errors.

Chapter 5: Results

All data presented and analysed here came from the 36 experimental interview participants. There were no missing data from the measures collected therefore (unless otherwise specified) *N* is always 36.

5.1 Success of experimental manipulation

To ascertain whether the verbal and imaginal conditions had successfully managed to manipulate the experimental interview participant's experience of pain imagery, the image vividness ratings were compared. Figure 3 displays the frequencies of the vividness ratings under the two experimental conditions.

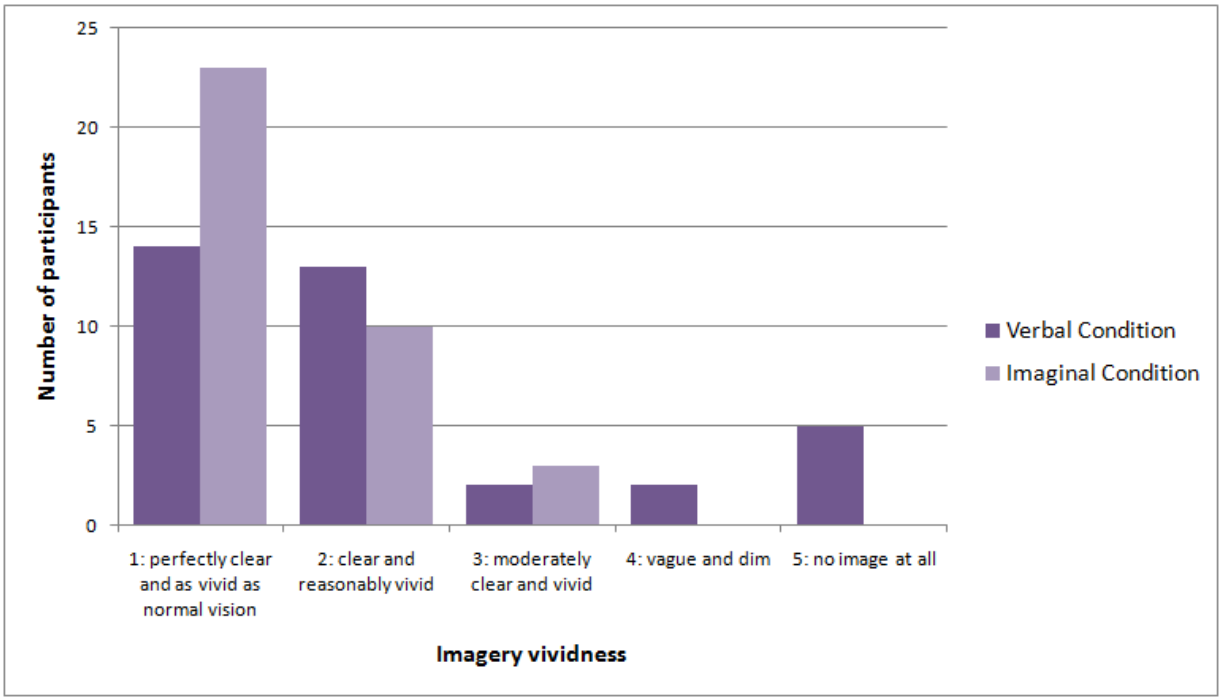

Figure 3: Pain imagery vividness ratings under verbal and imaginal conditions

The Kolmogorov-Smirnov test revealed that the vividness ratings in the verbal, D(36) = .31, $p < .01$, and imaginal condition, D(36) = .39, $p < .01$, were significantly non-normal. None of the transformations attempted resulted in both groups displaying normal distributions, furthermore when a Wilcoxon signed-ranks test was conducted this resulted in half of the ranks being tied, making the appropriateness of this test questionable. Following consideration of the distribution of the data, a decision was made to collapse the categories into dichotomous variables and compare the two conditions using a McNemar test. Ratings of 1 and 2 ('perfectly clear and as vivid as normal vision' and 'clear and reasonably vivid') were combined, as were ratings of 3, 4 and 5 ('moderately clear and vivid', 'vague and dim' and 'no image at all'). McNemar's test (see Table 2) indicated that the verbal and imaginal condition vividness ratings were significantly different, indicating more vivid imagery in the imaginal condition, $p = .01$. Thus the experimental manipulation appeared to be successful. However, from examination of the raw data it is questionable whether this statistical difference is also a clinically meaningful one (discussed further in 6.4.1).

Table 2: Dichotomised pain imagery vividness ratings cross-tabulation

		Imaginal Condition	
		More Vivid	**Less Vivid**
Verbal Condition	**More Vivid**	13	1
	Less Vivid	10	12

5.2 Primary hypotheses

Hypothesis 1: There will be a difference in the reported pain intensity (1a) and strength of emotions [fear (1b), sadness (1c), anger (1d), disgust (1e), and happiness (1f)] between the baseline and the experimental conditions.

Hypothesis 2: There will be a difference in the reported pain intensity (2a) and strength of emotions [fear (2b), sadness (2c), anger (2d), disgust (2e), and happiness (2f)] between the imaginal and verbal conditions.

See Table 3 for the means and standard deviations or medians and interquartile ranges (where appropriate) for the pain intensity and emotion ratings at baseline and during the two experimental conditions. Pain intensity and each of the basic emotions ratings will be discussed in turn.

Table 3: Measures of central tendency and dispersion for visual analogue scale ratings of pain and emotion intensity

	Baseline	**Verbal Condition**	**Imaginal Condition**
Pain Intensity Mean (SD)	38.5 (23.9)	39.9 (23.9)	46.5 (24.9)
Fear Median (IQR)	4.5 (32.5)	10.0 (28.0)	9.0 (29.5)
Sadness Median (IQR)	4.5 (19.0)	10.5 (28.0)	12.5 (22.0)
Anger Mean (SD)	11.2 (20.0)	20.9 (27.7)	18.5 (25.6)
Disgust Mean (SD)	6.9 (13.9)	18.1 (27.0)	16.2 (26.5)
Happiness Mean (SD)	46.8 (28.3)	33.7 (26.5)	33.6 (28.0)

5.2.1 Pain intensity

The Kolmogorov-Smirnov test revealed that the pain ratings displayed a normal distribution at baseline, $D(36) = .12$, $p > .20$, *ns*, in the verbal condition, $D(36) = .11$, $p > .20$, *ns*, and in the imaginal condition, $D(36) = .10$, $p > .20$, *ns*.

To ascertain whether there were significant differences in the pain ratings at baseline and in the verbal and imaginal conditions, two repeated measures *t*-tests were conducted. This revealed that there was no significant difference between the baseline and verbal condition ratings $t(35) = 0.54$, $p = .60$, *ns*, however there was a difference between baseline and the imaginal condition, with imaginal pain ratings being significantly higher than baseline pain ratings $t(35) = 2.56$, $p = .02$. Thus support for hypothesis 1a was found for the imaginal condition but not the verbal one.

To evaluate the evidence for hypothesis 2a, a repeated measures *t*-test was conducted which revealed that the imaginal condition pain intensity ratings were significantly higher than the verbal condition ratings $t(35) = 2.38$, $p = .02$. Thus hypothesis 2a was supported.

5.2.2 Fear

The Kolmogorov-Smirnov test revealed that the fear ratings at baseline, $D(36) = .30$, $p < .01$, in the verbal condition, $D(36) = .19$, $p < .01$, and in the imaginal condition, $D(36) = .23$, $p < .01$ were all significantly non-normal, with histograms indicating severely positively skewed distributions. None of the transformations attempted resulted in all three groups displaying normal distributions and so two Wilcoxon signed-ranks tests were conducted. These indicated that there were no differences between the baseline and verbal condition, $T = 222$, $p = .61$, *ns*, or between the baseline and imaginal condition fear ratings, $T = 145$, $p = .19$, *ns*. Thus hypothesis 1b was not supported.

Hypothesis 2b was also not supported, as a Wilcoxon signed-ranks test indicated that there were no differences between the verbal and imaginal condition fear ratings, $T = 153.5$, $p = .26$, *ns*.

5.2.3 Sadness

The Kolmogorov-Smirnov test revealed that the sadness ratings at baseline, $D(36) = .22$, $p < .01$, in the verbal condition, $D(36) = .24$, $p < .01$, and in the imaginal condition, $D(36) = .23$, $p < .01$ were all significantly non-normal, with histograms indicating severely positively skewed distributions. Transformations were again unsuccessful and so two Wilcoxon signed-ranks tests were conducted. These indicated that both the verbal condition ratings, $T = 91$, $p = .02$, and the imaginal condition ratings, $T = 98$, $p = .03$, were significantly higher than baseline sadness ratings, thus hypothesis 1c was supported.

There was no evidence found to support Hypothesis 2c as a Wilcoxon signed-ranks test indicated that there were no differences between the verbal and imaginal condition sadness ratings, $T = 235$, $p = .80$, *ns*.

5.2.4 Anger

The Kolmogorov-Smirnov test revealed that the anger ratings at baseline, $D(36) = .29$, $p < .01$, in the verbal condition, $D(36) = .23$, $p < .01$, and in the imaginal condition, $D(36) = .27$, $p < .01$ were all significantly non-normal, with histograms indicating positively skewed distributions. Consequently data were transformed using a base 10 logarithm, which corrected the skew and produced a normal distribution for the baseline, $D(36) = .11$, $p > .20$, *ns*, verbal condition, $D(36) = .12$, $p = .18$, *ns*, and imaginal condition $D(36) = .13$, $p = .10$, *ns*.

To ascertain whether there were significant differences in the anger ratings at baseline and in the verbal and imaginal conditions, two repeated measures *t*-tests were conducted on the transformed data. This revealed that there were significant differences between both the baseline and verbal condition ratings $t(35) = 2.65$, $p = .01$, and the baseline and imaginal condition ratings $t(35) = -2.09$, $p = .04$. The anger ratings for the verbal and imaginal conditions were both significantly higher than baseline, thus hypothesis 1d was supported.

No support was found for hypothesis 2d as a repeated measures *t*-test conducted on the log transformed data revealed that there were no significant differences between imaginal and verbal condition anger ratings, $t(35) = 1.13$, $p = .27$, *ns.*

5.2.5 Disgust

The Kolmogorov-Smirnov test revealed that the disgust ratings at baseline, D(36) = .31, $p < .01$, in the verbal condition, D(36) = .28, $p < .01$, and in the imaginal condition, D(36) = .30, $p < .01$ were all significantly non-normal, with histograms indicating positively skewed distributions. Consequently data were transformed using a base 10 logarithm, which corrected the skew and produced a normal distribution for the baseline, D(36) = .12, $p = .18$, *ns*, verbal condition, D(36) = .13, $p = .14$, *ns*, and imaginal condition D(36) = .14, $p = .07$, *ns*.

To ascertain whether there were significant differences in the anger ratings at baseline and in the verbal and imaginal conditions, two repeated measures *t*-tests were conducted on the transformed data. This revealed that there were significant differences between both the baseline and verbal condition ratings $t(35) = 3.37$, $p < .01$, and the baseline and imaginal condition ratings $t(35) = 2.63$, $p = .01$. The disgust ratings for the verbal and imaginal conditions were both significantly higher than baseline, thus hypothesis 1e was supported.

No support was found for hypothesis 2e as a repeated measures *t*-test conducted on the log transformed data revealed that there were no significant differences between imaginal and verbal condition disgust ratings, $t(35) = 1.14$, $p = .26$, *ns*.

5.2.6 Happiness

The Kolmogorov-Smirnov test revealed that the happiness ratings displayed a normal distribution at baseline, D(36) = .10, $p > .20$, *ns*, in the verbal condition, D(36) = .12, $p = .20$, *ns*, and in the imaginal condition, D(36) = .10, $p = .11$, *ns*.

To ascertain whether there were significant differences in the happiness ratings at baseline and in the verbal and imaginal conditions, two repeated measures *t*-tests were conducted. This revealed that there were significant differences between both the

baseline and verbal condition ratings $t(35) = 2.53$, $p = .02$, and the baseline and imaginal condition ratings $t(35) = 2.57$, $p = .02$. The happiness ratings for the verbal and imaginal conditions were both significantly lower than baseline, thus hypothesis 1f was supported.

No support was found for hypothesis 2f as a repeated measures *t*-test revealed that there were no significant differences between imaginal and verbal condition happiness ratings, $t(35) = 0.06$, $p = .95$, *ns.*

5.2.7 Hypothesis 1 Summary

Hypothesis 1 was partially supported. The experiment found that pain intensity in the imaginal condition but not the verbal condition was higher than at baseline. Of the negative emotions, sadness, anger and disgust ratings were all higher in both experimental conditions than at baseline, however there were no significant differences found for fear intensity ratings. For the positive emotion happiness, ratings were found to be significantly lower during both experimental conditions compared to baseline.

5.2.8 Hypothesis 2 Summary

Only hypothesis 2a was supported as the experiment found that only pain intensity ratings were higher in the imaginal compared to verbal condition. There were no differences found between the two conditions in fear, sadness, anger, disgust or happiness ratings.

5.3 Secondary hypotheses

5.3.1 Normality

The variables involved in the secondary hypotheses were explored through examination of box plots and histograms and assessed for normality. See Table 4 for the outcomes of the Kolmogorov-Smirnov test of the raw variables and any successful transformations utilised. As transformations were successful, Pearson's correlations were utilised for the majority of the relationships examined.

Table 4: Kolmogorov-Smirnov tests of normality (d.f. = 36)

Variable	**D**	**p**	**Distribution**
Pain imagery distress	.14	.07	Normal
Pain imagery interference	.14	.09	Normal
Pain imagery controllability	.14	.08	Normal
HADS anxiety score	.10	> .20	Normal
HADS depression score	.15	.03	Significantly non-normal
Transformed HADS depression score (square root)	.14	.09	Normal
VVIQ total score	.17	.01	Significantly non-normal
Transformed VVIQ total score (base 10 logarithm)	.14	.08	Normal
SUIS total score	.19	< .01	Significantly non-normal
Transformed SUIS total score (square root of reversed scores)	.12	> .20	Normal

Pain imagery frequency was not assessed for normality as it is an ordinal rather than interval measure, therefore the non-parametric Kendall's tau[1] correlations were calculated for relationships with this variable.

[1] As advised by Field (2005), this was chosen in preference to Spearman's because of the large number of tied ranks

5.3.2 Hypothesis 3

Positive correlations will exist between imagery frequency, distress and interference. Negative correlations will exist between pain imagery controllability and imagery frequency, distress and interference.

See Table 5 for the correlation matrix exploring the relationships between imagery frequency, distress[2], interference and controllability.

Table 5: Correlations between imagery characteristics

		Image Distress	Image Interference	Image Controllability
Image Frequency	**τ**	.09	.24	-.27
Image Distress	***r***	-	.41*	-.15
Image Interference	***r***	-	-	-.09

*Correlation is significant at the $p < .01$ level or better (2-tailed).

Thus minimal support was found for hypothesis 3, of all the imagery characteristics examined only distress and interference significantly correlated, with high imagery distress being associated with high imagery interference.

5.3.3 Hypothesis 4

Less controllable, more frequently occurring, more distressing and more interfering images will be associated with higher levels of self-reported anxiety and depression.

See Table 6 for the correlation matrix exploring the relationship between imagery characteristics and HADS anxiety and (transformed) depression scores.

[2] For simplicity, raw data were re-coded from 0 to 100 with higher numbers indicating higher distress

Table 6: Correlations between imagery characteristics and HADS anxiety and depression scores

		Anxiety	Depression
Image Frequency	τ	.35*	.11
Image Distress	***r***	.24	.02
Image Interference	***r***	.51*	.25
Image Controllability	***r***	-.03	-.05

*Correlation is significant at the $p < .01$ level or better (2-tailed).

Thus partial support was found for hypotheses 4 as more frequently occurring and interfering pain images were found to be associated with higher self-reported anxiety. No significant associations were found for image distress or controllability or between any imagery characteristic and self-reported depression.

5.3.4 Hypothesis 5

People who have more spontaneous and more vivid general everyday images will also experience pain images which are less controllable, occur more frequently, are more distressing and more interfering.

See Table 7 for the correlation matrix exploring the relationship between imagery characteristics and VVIQ and SUIS total scores (both transformed).

Table 7: Correlations between imagery characteristics and VVIQ and SUIS total scores

		VVIQ	SUIS
Image Frequency	***τ***	-.02	.49*[3]
Image Distress	***r***	-.36	.01
Image Interference	***r***	-.18	.05
Image Controllability	***r***	.10	-.24

*Correlation is significant at the $p < .01$ level or better (2-tailed).

Thus minimal support was found for hypothesis 5, of all the imagery characteristics examined only image frequency was associated with SUIS scores, with people who experience more spontaneously occurring general imagery also experiencing more frequent pain imagery.

[3] One outlier was removed from this analysis, therefore $N = 35$

Chapter 6: Discussion

This chapter first discusses the representativeness of the study recruitment and experimental populations and considers the differences found between the imagers and non-imagers in the recruitment sample. Following this, the outcomes of the analysis of the evidence for the primary and secondary hypotheses are reviewed within the context of the research and models presented in the first three chapters. Next the limitations and strengths of the study are examined and the theoretical and clinical implications of the results considered. Finally, potential ideas for areas of future research are explored.

6.1 Study population

6.1.1 Comparison to other chronic pain populations

Both the recruitment and experimental sample were heterogeneous groups, reflecting the nature of the chronic pain population seen in the specialist clinic. As previously mentioned, Fricker (2003) conducted a Europe-wide study of chronic, non-malignant pain. In comparison, the recruitment sample in this study had a slightly older average age (53 cf. 50) and higher proportion of females (69 per cent cf. 56 per cent).
The duration of chronic pain reported was slightly different to Fricker (2003), as the median duration was 6 years rather than 7, however similarly around one fifth of the sample said that they had been in pain for 20 years or more.

Overall it seems reasonable to assume that the sample recruited to the study were representative of the heterogeneous chronic pain population as a whole in terms of their age and pain duration. However, the fact that there is a higher proportion of females in this study's sample should be borne in mind when interpreting the presented results.

6.1.2 Representativeness of experimental sample

The experimental sample appeared to be fairly representative of the recruitment as well as the imagers sample, as no significant differences were found in the history of mental health problems, duration of pain, number of pain locations or knowledge of the cause of their chronic pain. However, the experimental sample contained a significantly higher proportion of females than the recruitment sample and were significantly older than the other imagers. The experimental sample being older than the other imagers is a concern as it suggests that results may not be generalisable to the whole age range of imagers. On the other hand, the age of the experimental sample did not significantly differ from the recruitment sample, therefore the experimental sample can be assumed to be representative in terms of age of the general population of people with chronic pain, which is perhaps more important. The overrepresentation of females in the experimental sample is a concern which should again be borne in mind when interpreting the presented results.

6.1.3 Differences between imagers and non-imagers

42 per cent of the recruitment sample reported experiencing imagery associated with their chronic pain. This is a slightly higher proportion than the 39 per cent reported by Gosden (2008), which used a very similar methodology with a comparable heterogeneous population. However, the difference is very small and a degree of chance variability is likely between studies, so it is probable that it does not reflect an important discrepancy. The fact that similar significant proportions of people reported imagery following the single question used by this study and Gosden (2008) (in two different locations) validates the phenomena of specific mental pain imagery as something that people can reliably report on with minimal prompting.

Comparisons between people who reported experiencing chronic pain images and those who did not revealed no differences in sex, duration of chronic pain, number of pain locations or whether they knew the cause of the chronic pain. However, imagers were

younger and had experienced significantly more mental health problems than non-imagers. The difference between imagers and non-imagers in terms of the number of mental health problems experienced warrants further discussion. Assuming that the presence of pain imagery indicates higher imagery ability in general, the higher prevalence of mental health problems in the imagers coincides with previous research which has found a close link between imagery and emotion (as discussed in 2.4). Furthermore, it also ties into the chronic pain specific studies which found that chronic pain imagery is associated with higher levels of depression (Gosden, 2008; Potter, 2007), anxiety and catastrophising (Potter, 2007).

None of the research into chronic pain imagery has thus far has specifically examined causality, and so the reason behind this association is currently unclear. It could be that pain specific or general imagery processes lead to diagnosable psychological disorder, or perhaps mental health problems can themselves lead to imagery. The relationship may work in both directions or alternatively imagery and mental health problems could be linked by a third associated variable, for example the personality trait neuroticism. This trait is well known as a risk factor for the development of both depression and anxiety disorders (Matthews & Deary, 1998), and as a general tendency towards greater awareness of aversive internal states it could conceivably also make people more aware of distressing mental imagery.

Another potentially important variable that may link pain imagery and mental health problems is arousal level. Bywaters *et al.* (2004a) suggest that arousal may have a key role to play in the link between anxiety and imagery vividness. They argue that people who have high levels of state or trait anxiety will consequently have a high level of physiological arousal and this may make their imagery more vivid. Indeed their research did find that higher state anxiety (STAI) was associated with higher imagery vividness for a set of pictures recalled after a 15 minute delay (Bywaters *et al.*, 2004a, also discussed in 2.4.1). However, as they did not specifically measure arousal they cannot conclusively provide evidence for their hypothesis. Additionally, the causality could work in the opposite direction to their proposal and so longitudinal research would be

necessary to tease out how imagery vividness, psychological disorder and arousal may interact over time.

Regardless of which comes first however, if imagery is found to be involved in the maintenance of a psychological disorder then it becomes a legitimate target for intervention. According to the evidence reviewed in 2.4.2, the way in which imagery becomes a problem depends on the specific psychological disorder. For example in social phobia distorted imagery of the self increases anxiety and distracts the person's attention away from relevant social information. Contrarily, in GAD it is the avoidance and suppression of imagery through verbal rumination which is thought to be key. Although there is not yet sufficient research to conclude exactly how specific chronic pain imagery may interact with emotion or psychological difficulties, the present study at least provides some much needed initial exploration of these relationships.

6.2 Primary hypotheses

Hypothesis 1 was partially supported. The experiment found that pain intensity in the imaginal condition but not the verbal condition was higher than at baseline. Of the negative emotions, sadness, anger and disgust ratings were all higher in both experimental conditions than at baseline, however there were no significant differences found for fear intensity ratings. For the positive emotion happiness, ratings were found to be significantly lower during both experimental conditions compared to baseline.

Only hypothesis 2a was supported as the experiment found that only pain intensity ratings were higher in the imaginal compared to verbal condition. There were no differences found between the two conditions in fear, sadness, anger, disgust or happiness ratings.

6.2.1 Pain intensity

Perceived pain intensity was expected to increase in both experimental conditions because the participant's attention was being specifically drawn to their pain as they were required to evoke their pain imagery or describe the pain itself. However, the majority of research discussed in 1.4.3.1 on which this hypothesis was based examined the intensity of experimentally induced acute pain, and so this study provides some indication of the effects of attention on chronic pain. The lack of change between the baseline and verbal condition could potentially be explained by the location of the experiment interviews, which took place in one of the clinical rooms used for the hospital pain clinic. Before the interview, the participants would have attended at least one appointment in the pain clinic, at which they would have described their pain verbally as well as possibly experienced a painful physical examination. Consequently the environment they were in may have already become a conditioned stimulus for increased pain intensity. Furthermore, given that the participants knew they would be asked to talk about their pain; this may have already naturally drawn their attention to it. It is possible that this priming effect was most powerful for the verbal condition because the instruction to describe their pain would have been a familiar task they were expecting and had done before. Although (because of the nature of the recruitment process) they would have also known they would be asked about their pain imagery, this would still have been a more novel request.

The difference between the verbal and imaginal conditions cannot be accounted for by a greater increase in emotion in the imaginal condition, as the results indicate that there was no difference between the experimental conditions in any of the five basic emotions. The increase seen in pain intensity in the imaginal condition instead suggests that being asked to evoke pain imagery is perhaps a qualitatively different type of paying attention to pain. Borkovec *et al.* (1998) propose that thinking about an emotional topic in verbal thoughts results in a drop in physiological response. A reduction in physiological arousal would be expected to reduce perceived pain intensity (as in relaxation interventions) and therefore this suggests a potential explanation of these results. It is perhaps also the case that providing a verbal description but not

evoking a pain image enables participants to detach from the pain itself and avoid engaging with it, in a similar way to how verbal worry in GAD is proposed to provide a method of avoiding distressing mental images which would otherwise intrude.

6.2.2 Fear

Given the extensive research on the role of fear in chronic pain (see 1.4.2.1) it is somewhat surprising that no differences were found in fear ratings between baseline and the two experimental conditions. There appears to be a trend towards fear being slightly elevated in the experimental conditions, however this difference did not reach statistical significance. Furthermore, the visual condition was expected to be more fear inducing than the verbal one because of the link between pain imagery and catastrophising found by Potter (2007). Examination of descriptive data indicates that the median fear ratings were very low, which suggests that the VAS measure used could have been confounded by a floor effect. However, the median sadness ratings were equally low, and this emotion did reveal a statistically significant difference between baseline and the experimental conditions, therefore floor effects cannot provide a full explanation. The descriptive data also indicates that the variance in fear ratings was very large (particularly at baseline), which is perhaps why no statistically significant differences were found. In comparison to the spread of the data in the sadness ratings, the fear ratings were much more widely distributed, and it is possible that the lack of statistically significant difference was due to confounding variability ('noise') in the data.

Initial anxiety and then subsequent habituation to the experiment interview environment could have potentially been a key source of this confounding variability. Anecdotally, the experimenter noticed that many of the participants appeared to be nervous when they first entered the clinic room and filled in the baseline questionnaire, however this anxiety decreased as the participant became more comfortable with both the experimenter and the experiment tasks. The elevated fear they felt at baseline may have been due to the associations of the clinic environment (as discussed above), not knowing what they would be asked to do or social anxiety about meeting someone new.

Meeting a psychologist for the first time in particular is thought to be anxiety provoking because many people assume they will 'read their minds and analyze their behaviour for deviancies' (Dovidio & Esses, 2007, p.5). This potentially confounding factor could perhaps have been addressed by a longer initial acclimatisation period which may have allowed habituation to occur, consequently reducing the variability in the baseline scores, allowing clearer effects of the intervention manipulation to be seen.

6.2.3 Sadness, anger, disgust and happiness

Sadness, anger and disgust ratings were found to increase from baseline to both experimental conditions and happiness was found to decrease. However, there were no significant differences between the verbal and imaginal conditions. Oatley and Johnson-Laird (1987) propose that emotions are elicited by significant junctures of plans or goals. Therefore it could be speculated that sadness increased when participants' attention was drawn to their pain because it may have reminded them of the impact of chronic pain on their life in terms of the loss of active goals. Similarly, anger may have increased because of the reminder of current goals being blocked by having to manage the pain. The increase in anger ratings from baseline to experimental conditions is also important to note because it does not fit with suggestions made by, for example, Braha and Catchlove (1986) and Kerns *et al.* (1994) that patients with chronic pain have difficulty recognising and reporting this negative affect.

Although the reason for the link with disgust is not as clear from Oatley and Johnson-Laird's (1987) framework, other research (see 1.4.2.4) indicates that talking about pain may have evoked disgust because of the associated negative societal stereotypes (Werner *et al.*, 2004). Happiness perhaps decreased between baseline and the experimental conditions because being reminded of the pain and therefore of its implications would have signalled that less progress could be made towards important goals.

There are a number of potential explanations as to why there were no differences between the verbal and imaginal condition emotion ratings. Specifically, the lack of differences can be understood through a SPAARS (Power & Dalgleish, 1997, 2008) perspective, in terms of links with autobiographical memory or are potentially the result of sampling bias or subtle demand characteristics. Each of these explanations is considered in turn below.

6.2.3.1 SPAARS

The SPAARS model (Power & Dalgleish, 1997, 2008) discussed in 2.2.2 and 2.4.3.2 suggests that imagery may have a direct link to emotion through the schematic level (route one) and associative level (route two), the latter because imagery commonly functions as an unconditioned or conditioned stimulus (Dadds *et al.*, 1997; 2004). In contrast, verbal representations are thought to be more like cognitions at the propositional level of meaning, which does not have a direct route to emotion. However, while this model provides a good account of the effects seen in experimental research which has used experimenter-generated scenarios to compare imaginal and verbal representations (such as the work of Holmes and colleagues), this study sought to explore the naturally occurring entirely participant-generated descriptive words and imagery in chronic pain. Thus the topics of the experiment interview were more personally relevant to the participants, and so consequently it may be that the verbal condition still activated a schematic level model of the self in pain which led to the generation of emotion via route one. It is also possible that the lack of difference between the experimental conditions is because both pain words and pain images would have already become associated with an emotional response via route two.

The association between pain words and emotion may have arisen from numerous experiences of undergoing pain inducing physical examinations while having to simultaneously describe the pain to a medical professional. Additionally, in an everyday scenario an increase in pain could cause a change of facial expression, which may produce an enquiry of concern from a nearby friend or relative. This enquiry may

naturally lead the person to use pain descriptive words to tell the enquirer about their experience. In terms of the association between pain images and emotion, Gosden's (2008) research indicated that mental imagery of pain is most often triggered by an increase in perceived pain. Thus with repeat pairings, both descriptive pain words and mental imagery may have become associated with an emotional response to the pain itself. Considering this possibility, the SPAARS model does not have any difficulty in accounting for these results as the verbal descriptive words can activate emotion through route two just as well as the pain imagery can.

The potential associative power of pain descriptive words was therefore perhaps underestimated when the hypotheses were composed. In support of this idea, some research in people who experience migraine has found that presenting pain descriptive words leads to an increase in physiological activity as measured through skin conductance (Jamner & Tursky, 1987). The magnitude of this increase was found to be significantly greater than it was with a control group, and was also accompanied by an increase in pain perception and anxiety.

6.2.3.2 Autobiographical memory

Holmes and Mathews (2010) propose that imagery causes a stronger emotional response than the equivalent verbal representation because mental images provide a direct link to autobiographical memory (see 2.4.3.3). It was hypothesised that evoking chronic pain mental imagery may also link to emotional autobiographical memories and therefore cause a stronger affective response than verbal descriptions of pain. In support of this idea some qualitative research into women's mental images of their breast cancer conducted by Harrow *et al.* (2008) indicated that mental images were influenced by scan images and verbal metaphors presented by health professionals, both of which may be linked to emotional autobiographical memories. However, perhaps the lack of difference between verbal and imaginal conditions in this research is because chronic pain imagery is not always connected to emotionally salient autobiographical events. Indeed, on reading Gosden's (2008) thematic analysis of the descriptions of pain

imagery it is not immediately obvious that these pain images should be linked to autobiographical memory, unlike the mental images in the recent study by Harrow *et al.* (2008). However, one theme (anatomical representation of damage) could be hypothesised to be linked to a memory of seeing a scan image or hearing an anatomical description from a health professional. Nevertheless, it is clear that this kind of link cannot be made with all of the themes identified and so this lack of autobiographical memory link may be another potential explanation of why no verbal-imaginal differences were found with emotional ratings.

6.2.3.3 Sampling bias

This study selected the experimental sample only from the 42 per cent of the recruitment sample who spontaneously reported experiencing imagery associated with their chronic pain on the recruitment brief questionnaire. It is possible that this element of the design contributed to the lack of verbal-imaginal differences, as it is potentially only for these individuals that both imagery and verbal processing of pain representations have similar emotional effects. Other research into verbal-imaginal differences has not selected people according to whether they are able to report imagery following only one enquiry on a questionnaire. It was thought important to use this method and select the experimental sample from only the imagers in this study to ensure that the pain images themselves were genuine and not the result of the greater demand characteristics present in a face-to-face interaction (a common criticism levelled at imagery research in general). It is potentially possible, however, that individuals who did not spontaneously report imagery could have been helped to evoke images through an interview and further description of the nature of the phenomena. Perhaps a proportion of the non-imagers may be (consciously or unconsciously) avoiding being aware of their pain imagery, like avoidance of imagery in PTSD and GAD. Although these ideas are all currently speculative, if it were possible to elicit images from the non-imagers through an interview it would be interesting to explore whether this non-spontaneous imagery group showed a similar pattern of results to the participants in this

study. Possibly it is only for this group (and not the spontaneous imagers) that a verbal-imaginal emotional difference exists.

6.2.3.4 Demand characteristics

A final potential explanation for the lack of verbal-imaginal differences found in the emotion ratings is demand characteristics. Experimenter expectancy can have exert a significant influence over people's performance and responses (Rosenthal, 1976; 2003), which is why double blind studies (where both the participant and experimenter are unaware which condition someone is in) are seen as the most methodologically rigorous (Sheldrake, 1998). Although the hypotheses state that a difference would be found, personally I have had some difficulty in understanding the research into imagery, as it is not something I experience myself. One study suggests that practitioners' personal internal experiences and imagery vividness are a key determinant of whether or not they are sympathetic to the imagery side of the analogical-propositional debate (Reisberg *et al.*, 2003). Taking this into account then, it is possible that because I do not experience imagery I did not truly expect to find any differences, which could have subtly influenced participants' ratings to confirm this expectation.

One possible way to address this concern could have been to conduct post-experimental interviews asking each participant what they though the experimental hypothesis might have been, a method often employed by Kosslyn (e.g. 2006). However, even if participants who guess correctly are excluded, many may intuitively understand the purpose of an experiment in a vague inarticulate way that they are not able to (or confident enough to) explain to an experimenter (Orne, 1962). However, on further consideration it seems unlikely that the lack of verbal-imaginal difference was entirely due to demand characteristics, as imagery vividness ratings indicated that the experimental manipulation was successful, additionally there was a difference found between the imaginal and verbal condition pain intensity ratings. There is no reason to suppose that experimenter expectancy would have operated differently for the pain

intensity and emotional ratings, therefore this explanation cannot fully account for the results.

6.2.4 Conclusions

In summary, it appears that drawing a person's attention to their chronic pain and eliciting either verbal or imaginal descriptions results in an increase in sadness, anger and disgust and a decrease in happiness. This could be because describing the pain reminds participants of the effects of their chronic pain in terms of the implications for important personal goals. Providing a verbal description of pain does not cause an increase in perceived pain intensity, although evoking pain imagery does. This is potentially because being asked about pain imagery results in paying attention to the pain in a qualitatively different way, which does not allow detachment from the pain itself which may happen with verbal descriptions. There were no differences found in fear ratings across the baseline or two experimental conditions, possibly because of the high variability in the ratings, particularly at baseline. This variability may perhaps have been caused by fear associations with the environment and the anxiety provoking effect of attending an unknown psychological experiment. There were no differences found in any of the emotional responses between the imaginal and verbal conditions. It seems likely that this is because, unlike other highly emotive imagery, naturally occurring idiosyncratic chronic pain images do not necessarily access emotionally salient autobiographical memories. Furthermore it is likely that over time, pain descriptive words will have become associated with an emotional response and so (as outlined in the SPAARS model) act through the associative or schema route and provide a direct route to emotion just as powerfully as pain imagery does.

6.3 Secondary hypotheses

6.3.1 Hypothesis 3

Only minimal support was found for hypothesis 3, of all the imagery characteristics examined only distress and interference significantly correlated, with high imagery distress being associated with high imagery interference. This was also found by Gosden (2008), and it is logical that someone who finds their mental image more distressing would also find that it interferes to a greater extent in their day to day life. However, the lack of significant correlations found between the other variables is surprising. It may be that the small sample size resulted in insufficient power to detect significant correlations, particularly given the more stringent *p* value adopted. Again, the process of developing and validating a pain imagery measure would clarify the nature of the potential relationships between these variables.

6.3.2 Hypothesis 4

Partial support was found for hypotheses 4 as more frequently occurring and interfering pain images were found to be associated with higher self-reported anxiety. No significant associations were found for image distress or controllability or between any imagery characteristic and self-reported depression. It therefore appears that anxiety is more closely tied to imagery variables than depression in this population. Given this, it is particularly surprising that the experiment did not reveal any differences in fear ratings, although as discussed these were possibly lost in the 'noise' of the data at baseline.

Unfortunately however, it is not clear exactly why higher image frequency and interference should be associated with higher anxiety. As discussed in 6.1.3, the directionality of any causal relationships can only be hypothesised. Does a frequent chronic pain image result from having a high level of arousal as a consequence of anxiety psychopathology? Or does the image cause anxiety? Likewise, is the imagery

interference a function of overall anxiety level or does a more interfering image cause anxiety symptoms? It does not seem unreasonable to suggest the relationship probably works in both directions, as in a number of psychological disorders where mental imagery can become part of a positive feedback maintenance cycle, as discussed in 2.4.2.

6.3.3 Hypothesis 5

Minimal support was found for hypothesis 5, of all the imagery characteristics examined only image frequency was associated with SUIS scores. Thus, as might be logically expected, people who experience more spontaneously occurring general imagery also experience more frequent pain imagery. Again, the lack of statistically significant correlation between the pain imagery characteristics and the vividness and degree of spontaneous general imagery could perhaps be attributed to the small sample size. Alternatively, it could be that as the sample in this study were selected on the basis of experiencing mental pain imagery, this could have resulted in an artificial attenuation of the variance of the vividness and degree of spontaneous general imagery. With most individuals being at the upper end of the scales, there would be less variance in the scores available to correlate. It is also possible that the questions used to measure the pain imagery characteristics do not individually capture the important aspects of pain imagery in a robust way, again highlighting the need for the development of a pain imagery measure.

6.4 Reflection on study methodology

6.4.1 Limitations

One potential limitation which should be discussed is the fact that some researchers and clinicians have commented that people with chronic pain may be unable to reflect and accurately report on emotional experiences as they ‘fail to recognise affective distress

and, instead, somatise their complaints using both pain and non-pain somatic complaints' (Craig, 2005, p.267). Consequently it may have been advantageous to take more objective measurements of physiological arousal or, for example, have independent blind raters classify the degree of distress exhibited in facial expressions viewed via silent video recordings. However, these measures often introduce their own sources of unreliability, and in the end the suggestion that people with chronic pain are unable to accurately report on their emotional state is not supported by the significant changes seen in four of the five emotions ratings.

Another potential limitation of this research is the method used to identify those people who experienced a mental image. Although the study aimed to enquire about images in any sensory modality, the wording of the identification question (see section 4.1.3) and in particular the phrase 'a picture in your head' may have resulted in a bias towards visual imagery. It is therefore possible that if interviews had been used (as discussed in 6.2.3.3) or if the identification question had been worded differently this may have captured a slightly different population which included more people with, for example, primarily auditory or tactile mental images. Unfortunately there is insufficient research in this area which could indicate the potential impact of a visual image bias, although any future studies should be mindful of this reflection and compose identification questions carefully.

The choice of visual analogue scales to measure the dependent variables could be questioned. In particular, the unidimensional nature of VASs has been criticised as unrepresentative way to measure pain (Skevington, 1995) as it is a complex, multidimensional experience as indicated, for example, by the variety of items on the McGill Pain Questionnaire (Melzack, 1975). Furthermore, a literature search revealed few studies which used repeated VAS measurements so close together in time, perhaps reflecting the concern regarding the genuine sensitivity of this kind of measure. However, despite their limitations VASs were chosen because they are still much more sensitive than other more established Likert scales commonly used to measure emotion. Furthermore, there is substantial literature on the reliability and clinical validity of VASs for pain sensation intensity as well as the affective dimensions in both

experimentally induced and clinical pain (Wade *et al.*, 1990; Williamson & Hoggart, 2005).

Another factor for consideration is the magnitude of the changes in pain and emotion ratings. The VASs provide a sensitive 100 point scale and the differences in average pain and emotion ratings represented only around 1cm change on the 10cm scale. It could be argued that these are statistically but not clinically significant differences. However, they still represent an approximately 10 per cent change and furthermore, given the time scales employed in the experiment interview it may be unreasonable to expect larger changes. Perhaps the magnitude of the differences could have been increased if the participants had been asked to rate the *strongest* the pain and emotions had been in the previous four minutes, rather than the *average* intensity rating implied by the wording used in this study.

The design of the experiment and method of the experimental manipulation is another potential limitation in this study. A repeated measures design was chosen as individual differences in both imagery and pain perception would make between group comparisons between verbal and imaginal conditions difficult. However, it could be argued that trying to elicit solely verbal representation and description in people who spontaneously experience pain imagery is ecologically false. Although the vividness ratings revealed a statistical difference between the verbal and imaginal conditions, it is clear that the verbal condition still evoked at least some mental imagery in most (86 per cent) of the participants. Therefore, is this statistical difference between the conditions a clinically meaningful one? Along a similar line of argument much of the research which makes imaginal vs. verbal comparisons is confounded by the fact that verbal descriptions of imagery are required to check for instruction adherence (as in this study). Additionally in this research, the words used to describe pain in the verbal condition were often evocative of mental images, for example ‘stabbing’, ‘burning’ and ‘twisting’. However, other research which has required verbal descriptions of internally generated imagery has still found differences between imaginal and verbal conditions (Holmes *et al.*, 2008) and so it would be reasonable to assert that the methodology employed by this study is still valid. Had the results revealed no differences between

verbal and imaginal conditions on any of the dependent variables these criticisms may have been particularly powerful. However, as the pain intensity ratings did exhibit differences, this implies that the experimental manipulation was successful in producing clinically meaningfully different conditions. Nevertheless, this discussion does highlight that creating reliable manipulations of independent variables in this kind of study that are not confounded by these issues will continue to be a major challenge for this field as it develops.

6.4.2 Strengths

Despite the limitations discussed above however, this study still represents a substantial piece of work which has shed some light on the immediate emotional and pain perception effects of asking people to describe their pain and evoke pain imagery. The main strength of this study is that it is an exploration of a previously little investigated phenomenon, and so represents an important contribution to a small but growing field.

Uniquely, this thesis brought together two areas of research: emotional factors in the chronic pain population and the clinical and academic study of the special relationship between imagery and emotion. Furthermore, this was an experimental study which could ask and answer different kinds of questions to the previous research into chronic pain imagery, which was primarily cross-sectional. It sampled a wide age range and heterogeneous clinical population drawn from a large geographical district covering both urban and rural areas and so is likely to be representative of the general UK population. It used a repeated measures design (with counterbalancing) to control for participant variability. Conditions were timed and distracting creative thinking tasks were employed to minimise carryover effects. Furthermore, vividness ratings were used to examine whether or not the experimental manipulation of the independent variable was successful. Two of the three pre-existing measures used were standardised, reliable and clinically valid. Multiple dependent variables were measured, with emotions presented in a number of randomly generated orders and selected on the basis of a

thorough understanding of the evidence-based categorical approach to the structure of emotion.

Imagery is a particularly difficult area to study because of its analogical nature (Gordon, 1972) which is perhaps why previous research into cognition in chronic pain has focussed almost exclusively on verbal representations and expressions. However, as this study proves, with a thoughtful design is possible to meaningfully investigate the effects of imagery and the fact that this is a little explored field provides a wealth of opportunity for further novel and stimulating research.

6.5 Theoretical implications of results

This study sought to identify verbal-imaginal differences in emotional response in a chronic pain population who spontaneously experience specific pain imagery. The fact that no differences were found could be used to argue that it should not be assumed that experimental results with normal populations (on which hypothesis 2 was primarily based) can be extrapolated to clinical populations, perhaps particularly in the idiosyncratic area of imagery research. When a topic is personally relevant to an individual, differences between verbal and imaginal representations may not be so clear-cut, which should be an important consideration for future theories and research.

The difference found in pain intensity ratings between the verbal and imaginal conditions was interpreted as indicating that evoking pain imagery represents a qualitatively different form of paying attention to pain than when providing a verbal description. Currently this is only a tentative suggestion, and it is unclear how this may be understood in relation to the existing research on attention in chronic pain, which has thus far not made any verbal-imaginal distinctions. Were this result to be replicated however, it is clear that this would provide a new perspective which should be integrated into attentional models and research.

Although the SPAARS model (Power & Dalgleish, 1997, 2008) can be used to provide an explanation of the present results, it could also have provided an account of the opposite results, had hypothesis 2 been fully supported. Although multi-level theories are commendable in their flexibility, this ability to account for apparently opposing data also makes the model somewhat non-falsifiable. The SPAARS account cannot specifically indicate which of the two routes to emotion are active with verbal descriptions and imaginal evocation, although the present results imply that they lead to the same degree of emotional change. While this model provides a useful heuristic for understanding and explaining observed effects, specific testable predictions are not easily generated, as highlighted by the present study.

6.6 Clinical implications of results

This study has replicated previous findings (Gosden, 2008) that a significant proportion of people with chronic pain (42 per cent) experience spontaneous mental images of their pain. Furthermore, for these people images are linked with both the level of perceived pain intensity and emotional responses. This is an important fact to publicise to professionals who work with this population, so that they are prompted to routinely enquire about chronic pain imagery during assessment. This is particularly important given that chronic pain imagery has not received much research attention and so may be neglected. It is possible that medical practitioners' choice of metaphor, use of scan images or explanation of anatomical features in consultations may have important implications for people's mental imagery of their pain. Although this was not specifically investigated by this study, potentially individuals may infer a variety of inaccuracies regarding pain nature, course and prognosis from their images.

This research also highlights to psychologists who work with people with chronic pain that pain imagery should be routinely enquired about and explored during assessment. Pain images and their meaning may potentially be a useful way to access representations at the schematic model level which may be inaccessible via purely verbal exploration. However, psychologists and other professionals should also be made

aware that if they do ask patients about pain imagery this may cause a temporary increase in the perceived pain intensity as well as temporarily increase sadness, anger and disgust and decrease happiness. Consequently, the assessment of imagery should be conducted with sensitivity and with the consent of the person involved.

The findings of this research also suggest that in people who spontaneously report pain images, the verbal and imaginal routes to emotion may be relatively overlapping, indicating that even talking about images may evoke them. Were these results reliably replicated, psychologists who work with people with chronic pain could use this in their practice to know that even without a procedure to directly evoke or express pain images (for example through artistic methods), asking people to describe their images would be sufficient to trigger an emotional response which could be enquired about.

The fact that evoking pain-related mental images increases pain intensity and also results in a negative emotional response provides a clear rationale for the exploration of imagery-based interventions which target these images. Simple prolonged exposure to the images, direct manipulation and modification, changes in the way in which images are viewed or how their meaning is interpreted (including verbal reattribution methods) could potentially provide pain relief for significant numbers of people with chronic pain. Aside from direct pain control effects, these kinds of intervention could also potentially help to moderate peoples' emotional, cognitive and behavioural responses to the pain images. As previously suggested, imagery work may directly access representations at the schematic model level and so could provide a powerful medium to help change distorted or unhelpful pain-related schemas.

Although there is not yet sufficient clinical research which indicates that imagery-based interventions are effective, imagery manipulation for therapeutic purposes could be a productive avenue to explore, and would not be contraindicated by this study's lack of verbal-imaginal emotional differences. This thesis is part of a small but growing body of literature (summarised below in 6.7) that suggests that these images are not trivial and so a logical next step for the further development of this field would be a controlled study of the clinical effects of manipulating mental images (further discussed in 6.8).

6.7 Summary of chronic pain imagery research

Thus far, three studies (Potter, 2007; Gosden, 2008 and this research) have provided a tantalising glimpse into this familiar yet under-researched phenomenon. We know that a significant proportion of people spontaneously report experiencing imagery associated with their chronic pain and those that do so also report higher levels of anxiety, depression and catastrophising and rate their pain as more unpleasant (despite having the same level of pain intensity). The mental images are primarily visual and tactile and can be evoked during clinical interview. For the majority of those who spontaneously report imagery, the images occur at least everyday and are distressing. However, a small proportion of people report that their pain images are pleasant. People report that they have varying degrees of control over the imagery, although most find it interfering. The images themselves are highly idiosyncratic, although on an initial analysis of their content, three dominant themes appear. These relate to the sensory qualities of the pain; the individuals' beliefs about the physical cause of the pain and personal meanings about the presence of pain. Within personal meanings, themes of victimisation or punishment are the most common. In day to day life, the images often co-occur with an increase in pain levels, and people commonly respond by attempting to reduce, avoid or suppress the image (Gosden, 2008). When these images are deliberately evoked this results in a temporary increase in pain intensity, sadness, anger and disgust and a decrease in happiness. Among people who spontaneously report images, in terms of emotional response there are no differences between evoking pain images and in describing pain in single words. However, describing pain in single words does not result in the increase in pain intensity experienced when images are evoked.

6.8 Areas of further study

As mental imagery in chronic pain is a largely unexplored area, there are numerous unanswered research questions and opportunities for progressing the emerging literature

base. This field would benefit from a full qualitative analysis of people's image contents and themes, and potentially this could contribute to the construction of a pain imagery measure. The function of these images is not yet fully understood, furthermore future research may benefit from focussing on the cognitive or behavioural consequences of the imagery, for example are they always suppressed and avoided? Does this coping technique have negative longer-term consequences? Do the images serve to prompt particular maladaptive behaviours? Does a lot depend on, as might be suggested by CBT theory, the meaning of the image for the person?

Further research could also be directed towards understanding the variables which are associated with chronic pain imagery. In particular, the directionality of the relationship between mental imagery and distress warrants further investigation. Longitudinal or prospective research may be key in understanding the temporal interaction between these variables. Alternatively, for example, an experimental study could examine changes in mental imagery prevalence or vividness before and after effective pain-relieving interventions. The potential involvement of arousal and trait neuroticism (as discussed in 6.1.3) could be further explored. For example, the effect of arousal on imagery vividness could be directly manipulated through exercise prior to imagery, although this may be complicated in this population by the potential temporary exacerbation of pain through activity. Determining whether the level of physiological reactivity to pain is influenced by imagery would be important, because higher levels of physiological reactivity to pain have been found to lead to poorer long-term outcomes in people with chronic pain (Verhoeven *et al.*, 2006).

However, the ongoing difficulty with pursuing this kind of research is that because of the variety of theoretical ideas about how psychological factors might interact with pain, there are an extremely large number of potentially interesting variables to investigate and so a coherent picture may be hard to maintain (Linton, 2000). Furthermore, there may be a danger of over analysing the phenomenon such that relationships are split into smaller and smaller parts and the purpose of the research is in danger of being lost. An alternative approach to take would be a more clinically focussed direction, with the investigation of imagery-based interventions.

As discussed in section 6.6, the systematic investigation of interventions which utilise imagery methods is warranted. Future research could also explore the nature of changes which may occur during intervention processes, which could enable their clinical effectiveness to be maximised. There are many potential hypotheses which could be investigated, as imagery-focussed work could involve, from a CBT perspective, the processes of extinction, habituation and reattribution of meaning. Alternatively, from an Acceptance and Commitment Therapy (e.g. Hayes *et al.*, 2003) perspective, working with images may promote the acceptance of them and distancing which could allow an uncoupling from hypothesised types of maladaptive behaviours promoted by imagery.

The investigation of any imagery interventions or associated variables would be well-served by the inclusion of more objective measurements such as physiological markers or perhaps brain imaging methods such as functional MRI. Furthermore, as discussed in previous sections, a well developed and standardised measure which captures the key elements of pain-related mental images would significantly contribute to the progression of this field. As a starting point, single case experimental designs may be a useful tool to begin to investigate differences between different methods of direct interventions with chronic pain imagery.

6.9 Conclusions

This study indicates that, for people who spontaneously report experiencing chronic pain imagery, evoking these images results in a temporary increase in pain intensity, sadness, anger and disgust and a decrease in happiness. While these emotional responses are no different from those elicited when people describe their pain in single words, this verbal task does not result in the increase in pain intensity seen when images are evoked. This represents an important contribution to the currently small but growing literature investigating these spontaneous pain-related mental images, which has important theoretical and clinical implications. Although a number of self-help and clinical texts recommend ways in which to intervene through the direct manipulation of

pain images, further systematic research is necessary to establish whether these are effective and if so, understand how these techniques lead to improvements. Because of its idiosyncratic and analogical nature, imagery is a challenging field in which to conduct research. However, as highlighted by Turk and Okifuji (2002, p.678): 'Although there remain obstacles, there are also opportunities for psychologists to contribute to improved understanding of pain and treatment of people who suffer from chronic pain'.

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List of Appendices

* Please note these documents were originally printed on NHS headed paper