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Memory for Pain –

Recalling the quality and intensity of expected acute pain

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Abstract

This thesis reports a series of studies designed to assess the extent to which the intensity and qualitative nature of expected acute pain events can be recalled. The first preliminary study assessed recall of the intensity and quality of postoperative pain following day surgery for varicose vein removal. Twenty four participants reported their expectations of pain, their actual pain experiences and their retrospective ratings of pain using the Short Form McGill Pain Questionnaire (SF-MPQ) and a VAS to report pain intensity. In line with prior research, recollections of pain quality appeared to be less accurate than the retrospective ratings of pain intensity. In the second preliminary study, 50 participants who had never experienced vascular surgery were required to provide estimates of the likely nature of postoperative pain following varicose vein removal, based on the information provided in one of two patient information leaflets. Although both groups of non-patient participants overestimated the intensity of the pain, both provided estimates of the qualitative nature of the pain that were similar to the reports made by the patient participants.

These preliminary studies highlighted the limitations of prior research which has inferred pain recall accuracy by simply by comparing descriptions of acute pain made whilst in pain with ratings made retrospectively, and demonstrated the need to employ a more direct method of assessing memory for pain. The preliminary studies also highlighted the need to consider the influence of the participants' expectations of the likely nature of a forthcoming pain and levels of anxiety on memory for pain. Finally, investigating the relative extent to which pain can be recalled relative to another sensory experience was deemed to be necessary.

The main study for this thesis assessed memory for experimentally induced acute pain using the remember/know research paradigm (see Tulving, 1985). In Part One of this study, Cold Pressor (CP) pain was induced in 97 participants who provided ratings of their expectations of the CP pain, followed by reports of their actual pain experiences using the MPQ and a VAS whilst using the CP. Participants also provided ratings of anxiety and used a list of 57 descriptors to report the taste of an unusual drink. In Part Two of the study, two weeks later, participants provided retrospective ratings of the CP pain using the MPQ and a VAS, ratings of anxiety, and the taste of the drink. Participants were then asked to make 'remember' or 'know' judgements about the MPQ pain and taste descriptors that they had selected, based on the level of conscious awareness accompanying their recollections.

The findings indicate that memory for the intensity of expected acute pain was reliable for at least two weeks. In addition, the data suggest that recollections of the broad defining aspects of the quality of acute pain can also be reliable, but may be more appropriately assessed at a 'type of pain' level rather than the fine-grained level of individual MPQ descriptors. Central to this investigation was the finding that participants were readily able to distinguish between whether their recollections reflected 'remembering' and 'knowing' about their prior experiences of both pain and taste. It is concluded that the use of the remember/know distinction allows for a more direct assessment of the participants' reports of their memories than inferring the likely nature of these recollective experiences, and that recollections of pain and of other sensory experiences are broadly similar. Expectations and anxiety were not related to pain recall accuracy.

Memory for Pain –

Recalling the quality and intensity of expected acute pain

PROLOGUE

Pain is known to us by experience and described by illustration (Lewis, 1942).

What do we remember about acute pain events which have been planned for and anticipated? My interest in this issue was sparked when, as an undergraduate, I carried out a small study to investigate the extent to which women are able to recall their labour pain. It is a commonly held belief that the pain of childbirth is quickly forgotten because of the positive outcome and the joy of having a new baby. If this were the case, I wondered, how is it that mothers, and grandmothers, are usually able to give such detailed accounts of their experiences of giving birth? I then began to speculate on the extent to which other kinds of expected acute pain events are remembered, such as dental pain or post-surgical pain and if the qualitative nature of these kinds of pain are less available to recall than the severity of the pain. Might these reports just be based on 'common knowledge' of the likely nature of the pain, without recollection of the pain experienced, or upon the previously held expectations of the event, or is it possible that we base our recollections of the pain on the event that we can clearly, consciously remember in our 'mind's eye'?

Some years later, in 2002, I began work on this PhD at the University of Plymouth's Faculty of Health and Social Work. The initial focus of the research was to investigate the way tailored preoperative information can influence memory of postoperative pain. In January 2004, there was a slight shift in the focus of the PhD, and a move to Stirling University to study under the direction of Kate Niven, and Eric Brodie, based at Glasgow Caledonian University. This change allowed me to re-consider my original research question of whether expected acute pain events are 'remembered' or simply 'known' to have occurred and to explore a number of issues surrounding this central line of enquiry, which are expounded in this thesis.

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CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW, PART ONE

1.1 Introduction

Most people will experience some kind of expected acute pain event at some time in their lives, which can be planned for and anticipated (childbirth, health screening procedures, surgery or pain arising from dental procedures are all examples of such). The memory of these episodes may, in turn, influence the individual's expectations of similar future painful experiences. Recollections of pain are also relied upon when an individual recounts his or her 'story' of the painful event to others. Such accounts become part of society's 'semantic knowledge' and, as such, may influence others' beliefs about events which they have not personally experienced. In this way, memories of painful episodes can have effects which go beyond the individual.

Previous investigations have not made a distinction between acute pain events which can be planned for and anticipated, and those which cannot. It is the intrinsic anticipatory aspect of expected acute pain events which sets them apart from other painful scenarios such as trauma, injury, illness and disease. Whilst acute pain is generally something one makes an effort to avoid, in cases of expected acute pain it is often possible to choose whether for example, to visit the dentist, to have children, to undergo health-related exploratory or screening procedures, or to undergo surgery. It is possible to imagine and think about one's likely responses to these forthcoming events, to weigh up the personal costs and benefits and to imagine what the pain will be like. Such rumination is likely to give rise to anticipatory anxiety which may, in turn, result in the individual then delaying or avoiding the given situation, and so perpetuating their (perhaps inaccurate) beliefs about what such an event might entail.

Previous research has employed diverse methodological and statistical techniques to assess memory for both chronic and acute pain. However, there is a lack of empirical research which is able to provide insights into the extent to which the quality and intensity of expected acute pain can be recalled, and many questions remain. For example, is the intensity of pain remembered more clearly than specific unpleasant and aversive sensory or affective aspects? As memory is a constructive process, to what extent do we fill in the gaps in our memory of the actual pain event with knowledge and expectations of the pain from before we experienced it? Do we subsequently 'remember' pain, or simply 'know' that pain was experienced? And does anxiety – which may occur as one mentally projects oneself into the future and imagines the likely nature of a to-be-experienced pain – affect the way the actual pain is subsequently experienced and recalled?

The validity and reliability of the various methods devised to assess the subjective experience of pain have been questioned, as has the extent to which the statistical techniques commonly employed to assess pain recall accuracy are able to provide an approximation of 'pain memory'. In addition, whether memory for pain is comparable with memory for other subjective sensory experiences, requires investigation.

The aim of this literature review is to examine prior research which has shaped our current conceptualisation of the way expected acute pain can be remembered. It is necessary to review this research within the context of our current understanding of pain and contemporary theories of memory. In order to provide a comprehensive review, prior research which has assessed memory for *non*-expected acute pain (for example, memory for suspected myocardial infarction) and those which have compared memory for acute pain with memory for chronic pain have been included where relevant.

Initially, electronic searches were made of databases including Medline, CIHAHL, PsychInfo and the Cochrane Library using initial search terms such as 'memory' and 'pain' together with combinations of key words including 'acute', 'McGill Pain Questionnaire' or 'MPQ' or 'SF-MPQ', 'expect*' and 'anxiety' and 'Kappa'. The reference lists and bibliographies of the obtained articles and books also provided valuable sources of additional literature which informed this review.

1.2 Theories of pain – a brief historical review

Early theories postulated that the experience of pain was essentially equal to the extent of injury and that specific pain systems carry messages from pain receptors to a 'pain centre' in the brain. However, the fact that it is possible to feel different qualities of pain could not be explained by such theories. The 'doctrine of specific nerve energies', proposed by Johannes Müller (1842), put forward the notion that differences in the quality of a pain experience are caused by the different nervous structures excited by the incoming stimuli. Towards the end of the nineteenth century, 'Pattern' theorists (e.g. Goldscheider, 1894) proposed that sensory information is summed at the level of the spinal cord and was only experienced as 'pain' at a certain intensity threshold. Subsequently, Livingston (1943) postulated that a reverberatory circuit in the dorsal horns could explain summation, referred pain and pain that persisted after injury had healed. Noordenbos (1959) proposed that large diameter fibres inhibited small diameter fibres and suggested that the substantia gelatinosa in the dorsal horn of the spinal cord plays a central role in summation and other processes described by Livingston (see Melzack, 1996; Melzack and Wall, 1996, for reviews of these earlier theories).

In all of these theories, the brain was considered to be a passive receiver of incoming messages and all of these theories failed to take into account the motivational-affective processes which accompany the experience of pain. In 1965, Melzack and Wall extended and developed the concept of modulation at the level of the spinal cord, postulated by Pattern theorists, and proposed the Gate Control Theory of pain (Melzack and Wall, 1965) which has provided a more comprehensive explanation of the complex phenomenon of pain.

The Gate Control Theory of pain demonstrates how the transmission of nerve impulses from afferent fibres to transmission (T) cells in the spinal cord is modulated by a gating system, located in the dorsal horn. This gating mechanism is influenced by the relative amount of activity occurring in large and small diameter nerve fibres. Activity in large (fast transmission) fibres tends to inhibit transmission ('closing the gate'), whilst small fibre activity (slow transmission) tends to facilitate transmission ('opening the gate'). The Gate Control Theory also demonstrates how the spinal gating mechanism is influenced by nerve impulses descending from the brain. A specialised descending system of large-diameter fibres activates selective cognitive processes that influence the modulating properties of a gating mechanism in the spinal cord. When the output of the spinal cord T cells exceeds a critical level, the neural system underlying the complex experience of pain is activated. Activation of different types of nociceptors results in the experience of distinct pain qualities. Central to this theory is that neural signals enter a nervous system that is already 'shaped' by past experience, culture, anticipation, anxiety and many other factors. The Gate Control Theory describes the experience of pain as being made up of sensory-discriminative, motivational-affective and cognitive-evaluative interacting categories of activity. The sensory-discriminative dimensions of pain focus on the spatial and temporal properties of pain; the motivational-affective dimensions relate to the experience of tension, fear and autonomic changes, whilst the cognitive-evaluative component involves the individual's appraisal of the situation. The intrinsic role of psychological variables involved in the perception of pain provides an explanation for the fact that the perceived intensity and quality of pain is variable and unique to each individual. Pertinent to the present investigation is the extent to which the expectations, and the anxiety arising from the anticipation of a pain event, subsequently influence recollections of the actual pain. It is these memories of pain which are implicated in the cognitive processing of painful stimuli (Leventhal and Everhart, 1979) and may influence behavioural responses to future pain stimuli (Rachman and Eryl, 1989).

Recent advances in pain theories and neurophysiological research build upon the Gate Control Theory and have provided evidence of additional processes described as peripheral and central sensitisation (Dickenson, 1995; Coderre *et al.*, 1993; Woolfe, 1991). Peripheral sensitisation occurs when the transduction properties of nociceptors are altered. The chemical responses that are produced following tissue damage alter nociceptor responses to innocuous or low threshold stimuli. Tissue damage also activates high threshold nociceptors. Repeated nociceptor input to the neurones of the dorsal horn following tissue damage can result in the neurones responding to normal nociceptor input in an abnormal way. Thus, the nerves which normally carry innocuous stimuli from joints or muscles start to produce pain. This 'central sensitisation' results in changes in response to neural activity and is referred to as 'neural plasticity' which can lead to the development of chronic pain syndromes (Woolfe, 1991).

1.2.1 Acute and chronic pain; differences and definition

Acute pain is a very different experience to that of pathological or chronic pain, which may arise after central and peripheral sensitisation. In cases of acute pain, there is usually a well-defined cause and a characteristic time course in which the pain disappears. Chronic pain, however, may occur in the absence of any obvious physical cause and has no set time course in which healing takes place. In spite of the differences between acute and chronic pain, the concept of 'pain' has been broadly defined as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage and described in terms of such damage' (Merskey, 1986). This definition, as used by the International Association for the Study of Pain (IASP), is not universally accepted and Melzack and Wall (1996) point out the limitations of referring simply to the 'unpleasant' nature of pain. They argue that this 'negative-affective' aspect of pain is comprised of multiple dimensions that have yet to be determined. However, despite its limitations, Merskey's definition is one which provides a reference to the complex, multidimensional and unpredictable nature of pain. In this thesis a further distinction is made between acute pain that is expected, and that which is not. Expected acute pain is different from other acute pain situations inasmuch as it may be planned for, anticipated and cognitively processed *before* the event occurs.

1.3 Investigating memory for pain

Studies which have assessed memory for pain are diverse in terms of their methodology, the pain type investigated, the method of pain assessment used, and the theoretical assumptions underpinning the research. Although current theories of pain focus upon the multidimensional nature of the experience, it is pain intensity that has been considered to be the most salient dimension of pain (Melzack and Katz, 1994). Previous research investigating memory for acute pain has very often only considered the extent to which the intensity of the past pain can be recalled. By comparing ratings of pain intensity made whilst in pain with those given at some later point when pain free, such research has inferred the extent to which acute pain can be remembered. Prior to reviewing this literature, it is first necessary to consider some of the techniques employed in such studies to assess the intensity of pain.

1.3.1 The measurement of acute pain intensity

In clinical settings and in research, the measurement of pain intensity usually involves the use of a numerical ratings scale (NRS) or visual analogue scale (VAS). Obtaining pain ratings from an NRS usually requires patients or participants to rate their pain from 0-10 (an 11 point scale) or perhaps 0-100 (a 101 point scale). A VAS generally consists of a horizontal line, each end representing two extremes of pain intensity with verbal descriptions such as 'no pain' on the left and 'pain as bad as it can be' on the right (Gracely, 1994). Such assessments are simple to administer and complete and allow for an expression of the severity of pain in a way that can be given a numerical rating. Jensen *et al.*, (1986) suggest that an NRS may be easier for patients or participants to use than the VAS, as the VAS requires a certain amount of visual and motor co-ordination which might be lacking in some situations where pain assessment is required. Where linear scales are used, an unmarked line running from left to right has been shown to provide a more unbiased method of assessment (Scott and Huskisson, 1976; Carlsson, 1983). This issue is important when assessing memory for pain, and the use of an unmarked VAS may be preferable to NRS in order to reduce the possibility that the patient or participant is simply recalling the numbers previously used to describe the intensity of their pain.

Alternatively, pain intensity is often measured using a Verbal Rating Scale (VRS), or a Category Rating Scale (CRS), which include adjectives to reflect degrees of intensity and a corresponding number. Thus, 'no pain' would be indexed with a zero, mild pain with a one and 'worst pain' indexed with the highest number in the scale. Although simple and quick to interpret and administer, some research has demonstrated that rating scales with less than seven response levels are less sensitive than VAS (Sriwatanakul *et al.*, 1983; Bolton and Wilkinson, 1998).

1.3.2 Studies investigating memory for pain intensity

Typically, studies which have investigated memory for pain intensity have required patients or participants to provide intensity ratings (using a VAS, NRS or VRS, or some combination of such scales) whilst in pain and have then later compared these to a retrospective rating made when pain free. The following section of this review discusses research which has investigated memory for pain in this way, using the intensity measures described above.

In a comparatively large study of memory for labour pain (n=238), Rofe and Algom (1985) assessed pain recall accuracy using a 5 point VRS. The intensity of labour pain was recorded immediately after delivery and 1–2 days later. *T* tests found no significant differences between the two rating times. However, the authors' conclusion that recall was 'fairly accurate' may be somewhat optimistic, given that less than half of the participants gave a rating that was the same as their original rating. In addition, the assessment of pain intensity only involved the use of a single 0-4 rating scale. As such a scale could only give a broad indication of the pain intensity, the lack of significant differences between the global intensity ratings made immediately after birth and two days later may be due to a lack of sensitivity in the scale used.

Norvell *et al.*, (1987) also investigated how accurately the intensity of labour pain could be recalled two days postpartum. In their study, a VAS was used to assess pain at three points during labour (cervical dilation 2–4 cm, 5–7 cm and 8–10 cm) and recalled pain and discomfort two days after delivery. The three ratings of pain made whilst in labour were compared with the retrospective ratings of pain and discomfort. Correlations were generally stronger between retrospective ratings of pain and discomfort and pain ratings made at 8–10 cm dilation, suggesting that participants were recalling later stages of labour rather than the earlier ones. However, *t* tests revealed significant differences between the in-labour ratings and the ratings of pain and discomfort made retrospectively. This finding runs counter to Rofe and Algom's study which utilised a perhaps less sensitive assessment method and compared only a global rating of pain made shortly after birth with one made two days later.

Sisk *et al.*, (1991) investigated memory for a different type of expected acute pain in their study which assessed recollections of pain intensity following impacted third molar extraction. Fifty-eight participants gave hourly and global pain intensity ratings of two separate surgical episodes using a VAS and a category rating scale (0; no pain – 4; severe pain). Thirty-nine participants were then contacted 5–36 months later and asked to report their recollections of maximum pain intensity between seven and eight hours postoperatively. The relationship between actual pain reports of maximum pain and retrospective reports of maximum pain was assessed, using Spearman's Rank Order correlation for the CRS, and Pearson's correlation for the VAS. Sisk *et al.*, (1991) found significant, (but not particularly strong), correlations (Spearmans's Rank Order correlation $r = .58$, Pearson's Product Moment correlation, $r = .51$, $p<0.00$) between actual pain reports and retrospective ratings using the VAS and the CRS for the first surgical procedure. However, for the second surgical procedure, a significant relationship was only observed between the original and retrospective ratings using a CRS (r = .38, p<0.05).

Case by case analyses of actual pain intensity and remembered pain intensity were also performed to obtain data regarding the frequency of recalled pain ratings that were more, less or the same as their previous ratings. Sisk *et al.*, suggested that pain intensity memory was accurate with both the CRS and the VAS for the pain arising from the first surgical procedures, but reported that participants tended to overrate the pain of the second procedure. They also found that mild and moderate levels of pain intensity were more accurately recalled than severe pain intensity. The authors reported a 'positive correlation between experienced and remembered intensities of post surgical pain for up to 3 years after surgery' (p 353). However, correlations emerging with r values of no more than .58 suggest that the relationship between actual ratings and those made at some later point might be actually quite weak and indicate a considerable amount of the variance remains unexplained by the actual pain ratings. In addition, these correlations were only consistently significant on the five point rating scale. These scales, as discussed above, may not be adequately sensitive to demonstrate deficits in recall ability.

In a more recent study, Singer *et al.*, (2001) carried out a study to investigate how accurately patients could recall acute pain whilst in the emergency department (that is, acute pain which was *not expected*). Pain intensity was assessed using a 101 point NRS, an 11 point NRS and a VAS. Participants (n=50) made pain ratings whilst in pain, 24 hours and seven days later. VAS ratings could not be obtained retrospectively, as the ratings made at one and seven days later were provided by telephone and therefore no assessment of the agreement between VAS was possible. Very high correlations between the initial pain ratings and those obtained 24 hours and seven days retrospectively for both the NRS100 and the NRS10 (r>0.9) were reported. The authors concluded their results showed that patients' assessment of acute pain events remains stable over a time period of at least a week, and that retrospective assessments made within a week after an acute pain episode may be valid substitutes for real time pain ratings. However, as three very similar ratings were obtained, which included requiring the patients to specify a number between 0 and 10 and between 0 and 100 to express the intensity of their pain, it is possible that the patients were simply recalling the numerical rating verbalised whilst in pain. The authors themselves concede this possibility and note in their Methods section that patients were not asked whether they remembered their initial pain scores.

In studies assessing memory for pain intensity comparing linear, numerical or verbal rating scales, made at one or two points whilst in pain, and comparing these to a rating made some time later, it is impossible to know whether the level of pain indicated by the patients or participants reflects a recollection of pain ratings given, rather than recalling the pain *per se*. In the study by Singer *et al.*, this issue may have been exacerbated by obtaining two very similar ratings at the same time and then requiring participants to recall their pain after a short interval (24 hours and seven days).

Everts *et al.*, (1999) investigated the accuracy of pain intensity recollections following suspected acute myocardial infarction (AMI). On arrival at the Coronary Care Unit (CCU) patients (n=177) were asked to rate their maximum pain experienced at home. Participants were then asked to make 23 subsequent pain ratings before, during and after receiving intravenous Metoprolol or intravenous morphine over the next 24 hours whilst in the Coronary

Care Unit. Pain ratings were made using an 11 point Numerical Rating Scale (NRS) which was indexed by the words 'No pain' at one end and 'intolerable pain' at the other.

Six months later, participants were asked to recall their pain experienced at home and the maximum pain experienced in hospital, again using an NRS, as well as to estimate the pain relieving effect of treatment. The differences in ratings were observed by subtracting the level of pain experienced from the pain remembered. The authors found that patients recalled their maximum pain at home as being significantly higher than their initial ratings ($p<0.001$). In addition, 83 of 173 patients who reported complete pain relief during hospitalisation were unable to recollect this pain relief at the six month assessment.

In spite of the patients' significant over-estimations of pain 6 months after suspected AMI, Everts *et al.*, concluded that pain intensity due to suspected or actual AMI was recalled with 'reasonable accuracy' (p. 120). The design of this study to assess memory for pain can be viewed as methodologically superior to the Singer *et al.*, (2001) study, as pain recall was assessed several months (rather than days or weeks) after the pain event. In addition, because 24 ratings of pain were provided whilst in hospital, patients would be unlikely to simply be recalling a previously made pain rating. Unfortunately, no correlation analyses were performed between actual and retrospective ratings, which prevents a direct comparison to the findings of studies that have used r values as an indication of recall accuracy.

1.3.3 The measurement of acute pain distress or unpleasantness

Gracely and Dubner (1981) proposed a number of properties that an ideal pain measurement system should possess. One of these is that the measurement should be able to distinguish between the sensory-discriminative aspects of the pain experience and its affective qualities.

There are a number of methods of assessing pain affect using rating scales which are similar to those used to measure pain intensity. For example, a VAS for pain affect is anchored at one end with the words 'Not bad at all' and at the other with 'the most unpleasant feeling possible for me' (Price *et al.*, 1987). Prior research has used combinations of VAS or other unidimensional assessment methods in order to assess the sensory-intensity and affective scales concomitantly (Johnson and Rice, 1974; Gedney *et al.,* 2003; Gedney and Logan, 2004). Duncan *et al.*, (1989) compared a verbal and non-verbal scale in a study measuring the intensity and unpleasantness of experimental pain. Participants rated heat stimuli using a VAS to report pain intensity and unpleasantness and by choosing phrases from lists of intensity or unpleasantness descriptors. The relationship between the perception of the intensity of the temperature and the stimulus was found to be very similar whether calculated from the VAS or verbal descriptor scales. However, the verbal descriptor data showed that more painful levels of temperature were rated as relatively more 'intense' than 'unpleasant' in comparison to the corresponding VAS. Duncan *et al.,* therefore concluded that verbal descriptors may provide a more sensitive tool for separating intensity and unpleasantness.

The Descriptor Differential Scale (DDS; Gracely *et al.*, 1978; Gracely and Kwilosz, 1988) contains 12 descriptor items for each pain dimension assessed (e.g. the 'sensory' nature of pain or pain 'unpleasantness'). Descriptor items for sensory intensity (faint to extremely intense) or unpleasantness (slightly unpleasant to very intolerable) are each presented at the central point of a 21 point – to + continuum. Patients or participants rate their experienced sensation in relation to each word (Figure 1.1).

FAINT

-\-----------|-----✓------+

VERY WEAK

-\------------|------✓-----+

WEAK

-\------------|---------✓---+

SLIGHTLY INTENSE

-\--------✓----|------------+

Figure 1.1: *Example of four of the twelve sensory intensity descriptors from the DDS*

The DDS is based on the verbal descriptors used extensively in experimental pain research. Gracely and Kwilosz (1988) tested the psychometric properties of the measure (reliability, objectivity and homogeneity) in a study in which 91 patients completed the scale one and two hours after surgical extraction of a lower third molar tooth. They found that the DDS satisfied standard psychometric criteria and reported that the DDS was found to be a reliable instrument with which to assess pain magnitude and scaling behaviour.

Jensen and Karoly (1992) suggested that possible deficits and limitations of the DDS have not been fully explored and that the DDS has not yet been used widely enough in clinical settings. There is some evidence that suggests that some patients require a certain amount of training to use the scale (Good *et al.*, 1991). In addition, like verbal rating scales and visual analogue scales, the DDS is not designed to record any qualitative descriptions of pain.

1.3.4 Studies investigating memory for acute pain distress

In a recent study, Gedney *et al.*, (2003) investigated the extent to which a number of factors could predict short- and long-term memory of pain intensity and pain unpleasantness arising from root canal therapy (RCT). Hierarchical multiple regression analysis was conducted to determine predictors of the dimensions of pain intensity and pain unpleasantness recalled at week one and 18 months after RCT. VAS were used to assess pain intensity and unpleasantness immediately after treatment, one week and then 18 months later. They found that, after controlling for age, experienced pain intensity was a significant predictor of recalled pain at one week after surgery (adjusted R^2 .34 $p<0.1$), but not at 18 months. At the 18 month recollection, it was anxiety at the time of surgery which was the only significant predictor of pain intensity. Experienced pain unpleasantness was only weakly correlated with one week recall of unpleasantness and was not significantly correlated to ratings of pain unpleasantness at 18 months. This study highlights the need to investigate memory for pain in relation to other potentially related factors which may be involved in influencing pain recollection; these studies are reviewed in section 1.4 below.

1.3.4.1 An evaluation of studies investigating memory for acute pain intensity and distress using linear rating scales

In the studies reviewed above, there is considerable variability in the length of time between the original rating and later recall as well as in the type of pain assessed. However, the studies do demonstrate significant associations between ratings of pain intensity made whilst in pain and those made at some later time. But, these findings are limited in that correlations are only able to demonstrate the extent to which the participants are able to provide consistent ratings of their prior experiences of 'how much' pain they experienced. As current theories of memory highlight that the experience of pain involves much more than just intensity, it is necessary to consider studies which have assessed more than just this one dimension of pain.

Whilst the methods of pain assessment described above can be used to provide ratings of the extent of distress and the level of intensity experienced, they are not able to provide detailed qualitative information about another's pain experience. In some circumstances, either in research studies or to meet diagnostic requirements, it is often necessary for patients or participants to provide more information than an expression of pain intensity or unpleasantness. For example, the importance of measuring changes in the pain experience following analgesic treatments which may differentially affect the various qualities of pain has been highlighted (Jensen *et al.*, 2005). It is possible for 'relief' from pain to be reported, even in situations where the individual reports no change in the intensity of the pain experienced (Carlsson, 1983). In other situations, patients may wish to convey detailed qualitative information about their pain experience, and may be keen to express their experiences as fully as possible in the hope that this will lead to their problems being effectively addressed. In such cases, a more detailed multidimensional pain measure may be required.

1.3.5 Assessing memory for the multidimensional nature of pain

The Gate Control Theory of pain expanded the conceptualisation of pain as a purely sensory phenomenon to a model which integrated the motivation-affective and cognitive-evaluative components with the sensory aspects of pain. Before reviewing studies which have addressed the issue of memory for these components of a pain experience, it is first necessary to review the most widely used method of assessing the multidimensional nature of pain, the McGill Pain Questionnaire (MPQ; Melzack, 1975).

1.3.5.1 Measuring pain using the McGill Pain Questionnaire

The MPQ, conceptually grounded in the Gate Control theory, was designed to provide a generic instrument that would be able to measure all types of pain and to allow for the description of the different dimensions and qualities of a pain experience. In order to assess its use in research investigating memory for pain, it is first necessary to consider its development and construction, and to review those studies which have investigated the extent to which it is a valid and reliable method of assessing the experience of pain.

1.3.5.1.1 Construction of the MPQ

Melzack and Torgerson (1971) began to develop the MPQ in order to assess the three components of pain postulated by the Gate Control theory. Firstly, doctors and university graduates were required to classify 102 pain related descriptors, obtained from the clinical literature, into small groups of words to describe different aspects of pain. These descriptors were then grouped into 16 categories which were divided into three classes to describe the sensory, affective and evaluative dimensions of pain. The sensory descriptors were divided into ten categories, the affective dimensions into five categories, whilst the evaluative dimension contained just one category.

Melzack and Torgerson then attempted to determine the pain intensity implied by the words within the categories. In this part of the study, doctors, patients and students assigned intensity values to each descriptor, using a numerical scale of between one and five, anchored with the descriptors mild, discomforting, distressing, horrible and excruciating. These descriptors were found to be approximately equally far apart in terms of the intensity implied by the descriptor. A further four categories were added to the original 16 to provide a 'miscellaneous' subclass. The verbal section of the MPQ now consists of a set of 78 descriptors in 20 categories, divided into four dimensions or subclasses. Categories one to ten contain descriptors referring to the sensory nature of pain, categories 11-15 relate to the affective dimensions, category 16 is an evaluative category and categories 17-20 are defined as 'miscellaneous' pain descriptors; see Figure 1.2, below.

MPQ DESCRIPTORS AND CATEGORIES									
SENSORY									
Temporal	**Spatial**	**Punctate pressure**	**Incisive pressure**	**Constrictive Pressure**	**Traction pressure**	**Thermal**	**Brightness**	**Dullness**	**Sensory misc.**
Flickering Quivering Pulsing Throbbing Beating Pounding	Jumping Flashing Shooting	Pricking Boring Drilling Stabbing Lancinat- ing	Sharp Cutting Lacerating	Pinching Pressing Gnawing Cramping Crushing	Tugging Pulling Wrenching	Hot Burning Scalding Searing	Tingling Itchy Smarting Stinging	Dull Sore Hurting Aching Heavy	Tender Taut Rasping Splitting
AFFECTIVE					EVAL.	MISCELLANEOUS			
Tension	**Autonomic**	**Fear**	**Punishment**	**Affect. Misc**	**1**	**1**	**2**	**3**	**4**
Tiring Exhaust- ing	Sickening Suffocating	Fearful Frightful Terrifying	Punishing Gruelling Cruel Vicious Killing	Wretched Blinding	Annoying Troublesome Miserable Intense Unbearable	Spreading Radiating Penetrating Piercing	Tight Numb Drawing Squeezing Tearing	Cool Cold Freezing	Nagging Nauseating Agonizing Dreadful Torturing

Figure 1.2: Sensory, affective, evaluative and miscellaneous dimensions of the MPQ

The MPQ can be used to express the specific qualities of the different dimensions of a pain experience. Patients (or participants) are able to select descriptors from the MPQ to describe their pain, but should not select more than one descriptor from each category. Each MPQ descriptor is assigned a numerical value depending on its position in the category set. Originally the questionnaire was designed so that each descriptor was assigned a value depending upon its position in the category. So, for example, in the category containing the descriptors *tugging*, *pulling* and *wrenching*, the descriptor *tugging* is given a value of one, *pulling*, two, and *wrenching* given the value of three. The rank value of each descriptor chosen is summed to calculate an overall pain rating, or Pain Rating Index (PRI).

Theoretically, a higher PRI score should indicate that the pain experience is more severe. But it has been argued that calculating the MPQ PRI ratings using the rank scoring method (Melzack, 1975) fails to take into account the relative intensity of the verbal descriptors (Charter and Nehemkis, 1983). In the original version of the MPQ, descriptors in the same rank position in the different categories are assigned the same intensity value (for example, *throbbing* and *vicious* have a rank value of four), but had scale values of 2.28, and 4.26, as semantically, the descriptor *vicious* implies greater pain intensity than *throbbing* (Melzack and Torgerson, 1971).

Melzack *et al.*, (1985) proposed an alternative method of computing PRI values in order to compensate for any loss of sensitivity that may result from the use of rank values rather than the scale values to score the MPQ. As noted above, semantically, some of the descriptors imply greater intensity than others which are in the same rank position in their respective categories. To address this issue, Melzack *et al.*, calculated a weighting for each of the 20 MPQ categories and assigned each of the descriptors a number depending on its position in the descriptor category. The rank values for the descriptors are multiplied by the weight for its category. In this way, each MPQ descriptor has a different intensity value attached to it. In fact, the differences between the resulting weighted rank PRI values and the non-weighted rank values are small, but the resulting PRI scores may provide a better reflection of the intensity of a pain experience than the non-weighted PRI values (Melzack, 1985).

A further measure obtained from the MPQ is the Present Pain Intensity scale (PPI) which consists of a zero to five scale anchored with the descriptors 'No Pain', 'Mild', 'Discomforting', 'Distressing', 'Horrible' and 'Excruciating'. Melzack and Torgerson (1971) found that the mean scale values attached to these descriptors were approximately equally far apart, thus representing equal scale intervals.

The MPQ is also able to provide an additional measure, obtained by calculating the Number of Words Chosen (i.e. MPQ descriptors: NWC) by the patient or participant to describe their pain experience. Higher numbers of descriptors used to describe pain experiences are taken to reflect greater levels of pain. Some versions of the MPQ also incorporate a line drawing of the front and back of a human body, upon which the patient is asked to indicate the location of their pain. Shading of the area of the pain, and the letters E (external) and I (internal) can be used to indicate whether the pain is on the surface of the body or is a deep somatic pain.

An additional property of the MPQ is that it theoretically allows for distinctions to be made between pain types, which are characterised by distinct constellations of descriptors contained in the MPQ. The selection of distinctive sets of descriptors has been observed for post-herpetic neuralgia, phantom limb pain, metastatic carcinoma, toothache, degenerative disc disease, rheumatoid or osteoarthritis, labour pain and menstrual pain (Dubuisson and Melzack, 1976; Melzack *et al.*, 1986;). For example Leavitt and Garron (1980) presented back pain patients with a modified list of the MPQ, where the pain descriptors were presented in random order, thus allowing patients to select any descriptors which they felt were appropriate. The authors found that patients suffering back pain arising from a direct physical cause selected descriptors which were different from those selected by patients suffering back pain which did not have a detectable organic cause. The pain descriptors were able to be used to correctly identify 220 out of 253 cases. In a recent study, Mongini *et al.*, (2003) have shown that the MPQ descriptors can be used to discriminate between chronic migraine patients (n=29) and patients with episodic tension type headaches (n=11), independently of the pain intensity ratings (PRI and VAS ratings). Individual differences mean that some individuals may choose more or fewer descriptors than others, but there appears to be a general consistency in the choice of particular descriptors by patients suffering the same or similar pain syndromes (Graham *et al.*, 1980; Melzack and Wall, 1996).

Melzack and Katz (1994) review a number of studies providing evidence of the reliability and validity of the MPQ in a variety of contexts. However, studies which have assessed the construct validity of the MPQ have not unequivocally verified the three a priori factors (i.e. sensory, affective and evaluative dimensions) of the MPQ. Donaldson (1995), for example, established three underlying dimensions that were somewhat different from the theoretical organisation of the MPQ. Donaldson's *semantic* model (defined by Sensory Action, Sensory Evaluation and Affective Evaluation factors) fitted better than the a priori model and a single general pain factor model.

Melzack and Katz (1994) report evidence of a distinction between sensory and affective dimensions of the MPQ, but also note that the separation of affective and evaluative dimensions of pain has been debated (see Reading, 1989, for a review). Turk *et al.,* (1985) found evidence to support the three dimensional model of the MPQ but also concluded that the scales were highly inter-correlated and did not display adequate discriminative validity and are therefore not distinct. Turk *et al.,* suggest that perhaps only the total PRI scores, rather than the subscale scores should be used. Melzack and Katz (1992) refute this suggestion and argue that a high correlation amongst the variables does not necessarily imply that discriminant capacity is lacking, and argue that the MPQ is capable of discriminating amongst the three factors of the MPQ as originally proposed by Melzack (1975).

Wade and colleagues (Price *et al.*, 1988; Wade *et al.*, 1992; Wade *et al.*, 1996) propose a four stage model of pain processing consisting of pain intensity, pain unpleasantness (Stage One affect), suffering (Stage Two affect) and pain behaviour. Wade *et al.*, raise doubts as to whether the MPQ can assess second stage pain affect (the 'suffering' aspect of pain). Indeed, Melzack and Katz (1994) suggest that whilst the sensory-discriminative dimension of the pain is influenced primarily by the rapidly conducting spinal systems, the motivational drive and unpleasant affect are 'sub-served by reticular and limbic systems primarily influenced by the lower conducting spinal systems [and that] neocortical or higher nervous system process, such as evaluation of the input in terms of past experience, exert control over activity in both the discriminative and motivational systems' (Melzack and Katz, 1994 p. 338; see also Melzack, 1975). Wade *et al.*, (1996) suggest that the affective verbal descriptors of the MPQ refer much more to immediate threat and unpleasantness (i.e. Stage one affect) than to the second stage of pain affect and suggest that use of the MPQ might be more appropriate in acute pain situations, rather than for the assessment of chronic pain.

1.3.5.1.2 The Short Form McGill Pain Questionnaire (SF-MPQ)

Although the MPQ has been used in clinical and experimental situations to provide rich data about a pain experience, it is time consuming to complete, and may be too lengthy to be employed in some clinical and research settings. This potential limitation led Melzack (1987) to develop the Short Form MPQ (SF-MPQ). The SF-MPQ is made up of 18 descriptors (to describe the sensory and affective components of pain) which can be endorsed as being 'mild', 'moderate' or 'severe'. The SF-MPQ descriptors were selected from the MPQ based on the frequency with which they were selected by patients suffering acute, intermittent or chronic pain. In addition, the descriptor 'splitting' was included as it was previously reported to be a key discriminative word for dental pain (Grushka and Sessle, 1984). The SF-MPQ includes descriptors obtained from eight sensory categories, and four affective categories (see Appendix 1.3 for an example of the SF-MPQ, as used in the two preliminary studies). The evaluative category and the miscellaneous categories do not feature in the SF-MPQ.

Melzack (1987) reported high correlations between the SF-MPQ and the Long Form MPQ in ratings of postoperative pain, labour pain and musculoskeletal pain (r = .70 – .80). In a study of cancer patients, Dudgeon *et al.*, (1993) found that SF-MPQ sensory, affective and total scores correlated highly with the Long Form MPQ ratings. In a study of postoperative pain experiences, Zalon (1999) found SF-MPQ ratings to significantly correlate with VAS for pain at rest and pain on movement. The SF-MPQ has also been found to be sensitive to changes brought about by clinical therapies such as analgesic administration and the use of transcutaneous electrical nerve stimulation (TENS) (Melzack, 1987; Backonja, 1998; Rowbotham *et al.*, 1998). The construct validity of the SF-MPQ requires further investigation, and more research examining the reliability and validity of the SF-MPQ is required (Wright *et al*, 2001; Beattie *et al.*, 2004). But, like the MPQ, the SF-MPQ is able to provide a method whereby patients or participants can provide comprehensive reports of their pain experiences.

1.3.5.1.3 Evaluation of the MPQ and the SF-MPQ as a multidimensional assessment tool

The structure of the MPQ has been questioned and the three a priori factors underlying the original subclass construction have not been consistently verified. Confirmatory studies indicate that the a priori model can provide an acceptable fit to data obtained from acute pain (Lowe *et al.*, 1991) and chronic pain (Turk *et al.*, 1985), although it has been argued that other models might fit as well as the a priori model, or better (Donaldson, 1995). Pearce and Morley (1989) suggest that as the MPQ was developed by rating descriptors on an intensity scale, this common underlying dimension 'may over-ride any presumed differences between the descriptors on the other dimensions' (p. 120).

In summary, studies attempting to determine if the PRI assesses the underlying dimensions it claims to assess have been equivocal in their findings. Although Melzack and Katz (1994) and Holroyd *et al.,* (1992) point out that discrepancies may be explained by differences in statistical methods employed and the differences in patient samples across studies, the issue remains contentious. In its defence, the MPQ is unique in its ability to assist patients or participants to provide comprehensive information about the qualitative nature of pain, as well as to provide some measure of the intensity of the pain being experienced. In terms of studying *memory* for pain, the MPQ provides a useful measurement tool with which to assess extent to which the multidimensional nature of pain can be recalled. Although less widely assessed in terms of its psychometric properties, in clinical settings, the SF-MPQ may be an acceptable alternative to the use of the full MPQ.

1.3.5.2 Assessing pain using other multidimensional measures

Gaston-Johannson (1996) developed the Pain-O-Meter (POM), consisting of a plastic hand-held tool that provides two measures with which to assess pain. One measure is a 10 cm VAS with a moveable marker which can be used to report the intensity of pain. The other consists of a list of 15 sensory and 11 affective descriptors to express the qualitative dimensions of pain. However, a PsychInfo literature search with the word Pain-O-Meter yielded only five published studies which had used the POM to assess pain in clinical settings, none of which had used the POM to assess memory for pain. In fact, literature searches revealed no studies which have investigated memory for pain using measures other than the unidimensional rating scales discussed above, or the MPQ. There are a number of other methods of assessing the experience of pain taking into account aspects other than intensity. Most have been designed for use in chronic pain situations (e.g., the Wisconsin Brief Pain Questionnaire and the Brief Pain Inventory) to assess the impact of the pain on daily life and normal functioning (Daut *et al.*, 1983; see Cleeland, 1989). The Leeds Assessment of Neuropathic Symptoms and Signs Scale (LANSS; Bennett, 2001) is also being increasingly used to measure chronic pain intensity and quality (Jensen *et al.*, 2005). These assessment tools have not been employed to assess memory for pain.

1.3.5.3 Assessing memory for pain using the MPQ

In an early study using the MPQ, Hunter *et al.*, (1979) examined memory for acute postoperative pain following neurosurgery. Sixteen neurosurgical patients were divided into two groups and required to provide ratings of head pain following neurosurgical investigations, which lasted for approximately two to four hours after surgery. One group of patients then provided retrospective reports of their head pain one day later and five days after surgery, whilst the other group rated their head pain retrospectively only at day five. The authors reported that pain recall was 'very accurate', with significant correlations (*r* ranging from 0.65 – 0.94) between real time reports and retrospective ratings and that pain memory showed little decay over the five postoperative days. Their findings did not support their hypotheses, which were that pain would not be recalled accurately, that the accuracy of pain recall would decay over time and that memory for pain is improved by practice in recall. The PRI values for the sensory, affective and evaluative components of the MPQ were also reported. These ratings, made whilst in pain and retrospectively, were compared using rank order correlations, which ranged between 0.66 and 0.98.

In addition, Hunter *et al.*, investigated the extent to which the individual MPQ descriptors and categories chosen whilst in pain were subsequently chosen at recall. This analysis was broken down to compare the recall of the sensory and affective descriptors and categories. They report that a high percentage of retrospectively selected descriptors or categories (between 69% and 76%) matched those selected whilst in pain. Exact data for the affective dimension of pain were not reported explicitly but were shown graphically and appeared to indicate slightly less consistency between actual and retrospective assessment ratings.

Of the sixteen participants in this study, five were then identified as 'shifters', so defined if their reports of pain changed more than half a standard deviation above the difference score mean between assessment and recall scores. Unsurprisingly, the shifters were less consistent than the non-shifters in their choice of MPQ descriptors. The non-shifters recalled over 68% of sensory descriptors and 72% of affective descriptors, whist the shifters recalled only 30% of sensory descriptors and 45% of the affective descriptors.

One of the problems in assessing memory for pain is the difficulty in knowing whether the retrospective pain ratings reflect a recollection of the pain at the time of the last assessment or a recollection of pain experienced at some other moment during the acute pain episode. The pain assessed in the study by Hunter *et al.*, was relatively short in duration in comparison to other expected acute pain events such as labour pain, or longer-lasting postoperative pain. This study also benefits from the fact that it reports an analysis of the individual MPQ descriptors selected, which is able to demonstrate how correlation analysis can overestimate the participants' memory ability. In addition, the study indicates that different aspects of a pain experience are recalled with varying degrees of accuracy and that some aspects of a pain experience are more vulnerable to memory decay than others. However, the sample sizes in Hunter *et al.*'s study are particularly small. With such a small sample size, individual data could have been reported, which would have allowed for a more thorough appraisal of pain recall accuracy.

Roche and Gijsbers (1986) examined memory for experimentally induced (ischaemic) pain – one group, (n=11), using TENS as a pain relief method and one group, (n=12), experiencing the ischaemic pain alone – and compared this to memory for chronic rheumatoid pain in 14 patients undergoing knee replacement surgery. Ischaemic pain was assessed two to three minutes after tourniquet removal, when circulation had returned to normal. Retrospective reports of pain were obtained one week later. Rheumatic pain was assessed one day prior to knee replacement surgery and six to eight days postoperatively, when the patients were either pain free or virtually pain free. Pain was assessed using the MPQ. The authors found that memory for acute ischaemic pain was superior to that of the rheumatoid group. For the ischaemic participants (using TENS) the authors observed correlations (Spearman's *rho*) between initial ratings and recall ranging between 0.71 and 0.75 for sensory and total PRI scores and Numbers of Words Chosen (NWC). A non-significant correlation (0.43) was observed between reactive PRI ratings. Correlations were lower in the ischaemic group which did not use TENS (between 0.55 and 0.60 for the sensory and total PRI scores) but in this group the correlation coefficient between the reactive ratings was 0.56. The weakest correlations were observed between ratings made by the rheumatoid participants (between 0.24 and 0.63).

The correlation analyses suggest that memory for the intensity of pain was better for ischaemic pain than for chronic rheumatoid pain. The authors suggest that these differences seemed to be limited to intensity ratings and that it was the non-sensory dimension of pain that seemed to be most vulnerable to distortions. Roche and Gijsbers also calculated the percentage of MPQ descriptors selected retrospectively which agreed with those chosen whilst in pain. At recall, all three groups used around 50% of the MPQ descriptors they had originally selected to describe their pain, whilst around 80% of the MPQ categories used retrospectively agreed with those selected whilst in pain.

1.3.5.3.1 An evaluation of studies investigating memory for pain using the MPQ

The majority of research investigating memory for pain has tended to rely upon correlation analysis and analysis of group means when assessing recall accuracy. A review of such studies concluded that there is a 'modest relationship' between the experience of pain and memory for that experience (Erskine *et al.*, 1990, p 263). The correlations, however, are only able to confirm the similarity between two numerical ratings of pain. It is also possible to have a reasonable correlation between variables which are spurious or to achieve significant correlations between two variables without the two distributions overlapping at all. In addition, correlation analysis of PRI ratings does not provide a measure of how well the qualitative nature of the pain is being recalled. Multiple regression analysis suffers from many of the same limitations as correlation analysis, although it can reveal the relative influences of a number of possible predictor variables and therefore, if sample sizes are adequate, offer some additional data about factors affecting pain recall accuracy.

Although the sample sizes are small, Hunter *et al.*, (1979) and Roche and Gijsbers (1986) demonstrated that further information can be gathered about memory for pain when the MPQ is used as an alternative, or in addition to, linear rating scales. For example, comparing the percentage of MPQ descriptors or categories selected at each rating time can provide a measure of how consistently MPQ descriptors and categories are being used to report actual pain and recollections of pain. But assessing memory for pain qualities by calculating the percentage of agreement between ratings is also problematic as the percentage of agreement between the descriptors or categories used may over-estimate the consistency between ratings. It is possible that some of the agreement reflected in the percentages may simply occur by chance. One way to control for agreement occurring by chance is through the use of Cohen's Kappa (Cohen, 1960). The use of Kappa to assess recall of the qualitative nature of pain is discussed below.

1.3.5.4 The use of Kappa to assess agreement between qualitative descriptions of pain

Cohen's Kappa (κ) provides a method of assessing the extent to which there is concurrence between two ratings, whilst controlling for chance agreement. In terms of assessing memory for pain, Kappa can be used to provide a stringent and systematic comparison of two verbal pain ratings. The value of Kappa lies between minus one and one. A Kappa score of zero indicates no agreement other than would be expected by chance, whilst a Kappa value of one represents perfect agreement. A Kappa of minus one is a theoretical concept referring to 'less than chance' agreement (for example, if on two occasions, there is systematic disagreement between ratings).

1.3.5.4.1 Calculating Kappa

Figure 1.3 below shows that the percentage agreement between the two assessment times (Time 1 and Time 2) is 91.5% (p= (61 +25)/94 = 91.5).

		Time 2		
		Yes	No	Total
Time 1	Yes	61	2	63
	No	6	25	31
	Total	67	27	94

Figure 1.3: Table showing hypothetical ratings at two assessment times

The proportion of units which would be expected by *chance* is Pe, and calculated as

$$\text{Pe} = \frac{(63 \times 67)/94 + (31 \times 27)/94}{94} = 0.57$$

Cohen's Kappa (κ) is calculated by

$$\kappa = \frac{P - P_e}{1 - P_e}$$

$$\kappa = \frac{0.915 - 0.572}{1 - 0.572} = 0.801$$

Fleiss (1981) recommended that the level of agreement should be categorised according to the Kappa values as follows: Kappa 0.75 to 1.0 – excellent; 0.6 to 0.75 – good; 0.4 to 0.6 – fair; and < 0.4 – poor. The section below reviews the studies which have utilised Kappa as a measure of agreement between qualitative ratings of pain, and discusses some of the advantages and limitations of using Kappa to assess memory for pain.

1.3.5.5 Studies utilising Kappa to provide a measure of memory for pain

The first study to utilise Cohen's Kappa statistic to assess the agreement between 'real time' and retrospective pain ratings was carried out by Beese and Morley (1993). In this study, in order to reduce the possibility of cueing from the categorisation of similar pain descriptors (Bower, 1969), the MPQ was presented as a single list of 78 pain descriptors, (listed in random order) from which participants could select words to express their pain experiences and their recollections. Participants (n=49) were randomly assigned to one of three memory conditions; a pain-cued recognition, a mood–cued recognition and word recognition group. All participants gave ratings of pain shortly after wisdom tooth extraction using the MPQ descriptor list and provided ratings of mood using the UWIST Mood Adjective Checklist (UMACL). At recall, two weeks postoperatively, patients in the mood-cued and pain-cued conditions were asked, before seeing the UMALC and the MPQ, to think back to the time when they gave their initial ratings whilst in pain. They were asked to remember either their mood or their pain experienced at that time. They were then instructed to complete the MPQ and UMACL on the basis of that recalled information. The word recognition group was instructed to select words which they recognised as having selected at the first interview. The accuracy of pain was assessed by Cohen's Kappa, and Fleiss' categorisation of Kappa was used when considering their findings. Kappa values for the pain cued and word recognition group were 0.49 and 0.51 respectively, whilst the mean Kappa score for the mood cued group was 0.37. The authors concluded that, when Kappa is used, the results do not provide support for Erskine *et al.*'s (1990) conclusion that memory for pain is reasonably accurate'. Rather, they assert that whilst the intensity of pain is generally accurate, memory for the specific qualities of a pain experience is unreliable.

In an exploratory study, Terry and Gijsbers (2000) assessed memory for labour pain four to seven weeks postpartum, using the MPQ and a VAS representing pain intensity. Expectations of labour pain were assessed in 18 primiparous women during the late stages of pregnancy. Actual labour pain ratings were made during the first stage of labour, shortly after birth (within 48 hours), and again retrospectively, some four to seven weeks later. Similarities between participants' expectations and retrospective reports were assessed, as were similarities between their real time (within 48 hours of delivery) and retrospective reports. Kappa values were generally poor or fair; those who had a difficult labour and birth had lower Kappa values than those whose childbirth experiences had been straightforward (0.27 sd 0.10 and 0.41 sd 0.25, respectively). However, the initial rating of labour pain was made within 48 hours of delivery and it might be expected that comparing this single rating of second stage labour with a retrospective rating summarising 'pain experienced in labour', would result in obtaining a relatively low Kappa value between the two ratings.

1.3.5.5.1 An evaluation of the use of Kappa in studies investigating memory for pain

The advantage of using Kappa to assess agreement between pain ratings is that it can provide a more stringent assessment of inter- or intra-rater agreement than the calculation of proportions alone, because of its correction for chance. One drawback in using Kappa to assess memory for pain is that there is no established Kappa value which can be universally considered to be 'good' agreement between assessments. For example, slightly differently to Fleiss' (1981) categorisation of Kappa, Landis and Koch (1977) suggested that values of Kappa represent the level of agreement as follows: Kappa 0.81 to 1.0 – almost perfect; 0.61 to 0.80 – substantial; 0.41 to 0.60 – moderate; 0.21 to 0.40 – fair; 0 – 0.20; poor. Although studies employing Kappa frequently use Landis and Koch's (1977) or Fleiss' (1981) classification of the relative values of Kappa, when interpreting their findings Altman (1991) asserts that the decision of whether agreement is sufficiently high must depend upon clinical judgement.

Kappa has only been used to assess memory for pain in four published studies (Beese and Morley, 1993; Terry and Gijsbers, 2000, and see Niven and Brodie, 1995 and Brodie and Niven 2000, below). There is a need to extend this sample by utilising Kappa to assess memory for pain in other settings and using other forms of the MPQ, such as the Short Form MPQ. Two of the studies using Kappa have presented the MPQ as a single list of pain descriptors (Beese and Morley, 1993; Brodie and Niven, 2000). Perhaps if provided with a shorter pain assessment instrument, (ie, the SF-MPQ), patients or participants would find it easier to provide retrospective reports of pain more in line with those made whilst in pain.

In addition, Melzack and Katz (1994, p. 339) point out that some of the descriptors contained within the MPQ are 'undoubtedly synonyms...while many provide subtle differences or nuances (despite their similarities)...'. If the MPQ contains a number of words which are analogous to one another, these may be used interchangeably, which would result in a low Kappa value being obtained, although the extent to which this could be used to infer deficits in pain memory may be questioned. The use of Kappa to investigate the agreement between the MPQ category used might be more appropriate.

Although Kappa can offer a method of assessing the extent to which two qualitative pain ratings agree, over and above that which might be expected by chance, it is by no means clear how chance affects the choice of MPQ descriptor choice to express previous experiences of pain. There is a need to consider the recollective experience which leads to the production of these verbal ratings. Previous research has pointed out that requiring participants to rate their previously experienced pain using the MPQ is a cued recall task (Brodie and Niven, 2000), and as such, qualitatively different from requiring participants to provide self-generated descriptions of pain. However, it is possible that when required to report prior pain experiences, individuals attempt to provide descriptions of the pain experience itself, rather than to reselect the descriptors previous used, as in a word recognition task. If this is the case, assessing pain memory by comparing individual MPQ descriptors selected or not selected using Kappa, which controls for 'chance' selection, might be inappropriately stringent.

1.3.6 Application of memory theories in the assessment of acute pain

Studies investigating memory for pain have seldom considered how their findings fit within current theoretical frameworks of memory and have assumed instead that comparison of the measures obtained whilst in pain with those obtained at some later point reflect 'memory' for pain. However, there is little evidence to refute the suggestion that these retrospective ratings simply reflect the participants' ability to provide ratings of the likely nature of a particular pain, without any recollection of the pain at all. Previous investigators have alluded to this problem (Clark and Bennett-Clark, 1993; Niven and Brodie, 1995), and Morley (1993) suggests that retrospective descriptions of prior pain might be based on recollections of circumstances surrounding the event upon which estimates of the likely nature of the pain are based (recalling for example, the need for analgesic medication). In order to assess memory for pain properly, it is necessary first to consider contemporary theories of memory. The section below reviews some of the current theories of memory, and how some recent research has made some headway towards understanding memory for pain based on hypothetical constructs of memory.

1.3.6.1 An overview of long-term memory

A theoretical distinction between two types of long-term memory has been defined; explicit or 'declarative' memory, and implicit, 'non-declarative' memory, often referred to as procedural memory. Semantic and episodic memory are considered to be two aspects of declarative memory that share many features and are easily distinguishable from non-declarative implicit memory (Tulving, 1985). Because of the similarities between episodic and semantic memory, some researchers have assumed that the two systems are essentially the same (Donaldson, 1996).

However, it is possible to identify numerous theoretical differences between episodic and semantic memory. Episodic memory is conceptualised as the highest level of the three memory systems (that is, episodic, semantic and procedural) and appears to facilitate the conscious re-experiencing of past experiences. Wheeler *et al.*, (1997, p. 331) defined episodic memory as 'the kind of memory that renders possible conscious recollection of personal happenings and events from one's personal past, and mental projection of anticipated events into one's subjective future'. Episodic memory involves a particular kind of awareness which is experienced when thinking back and 'remembering' a specific moment in one's personal past; the conscious recollection of some prior episode or state as it was previously experienced.

Tulving (1985) maintains that episodic memory is dependent on and supported by semantic memory. Semantic memory is the memory system responsible for recollection of facts about the world, although these may also include facts which directly involve the person remembering. The individual retrieves knowledge from semantic memory from the point of view of an 'observer' rather than as a participant. Semantic memory does not possess any personal veridicality; an individual may 'know' about an event which occurred or which they personally had previously experienced without consciously recollecting or remembering the event. In the same way that episodic memory relies upon semantic memory, semantic memory in turn is supported by procedural memory. Semantic memory can function independently of episodic memory but not independently of procedural memory. Procedural memory can operate independently of the other systems, if the situation does not require the use of the higher systems.

Each of the systems of memory can be characterised by different kinds of consciousness. Procedural memory can be associated with anoetic ('nonknowing') consciousness. Semantic memory is associated with noetic consciousness. Noetic consciousness makes possible introspective awareness of the internal and external world. Autonoetic (self-knowing) consciousness is necessary for episodic memory and allows an individual to be aware of his or her self in the past, present and future (Tulving, 2002 and see Figure 1.4 below).

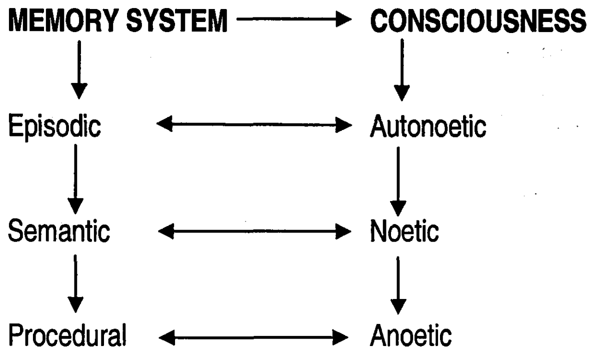


Figure 1.4: Schematic arrangement of memory systems and consciousness theorised by Tulving (1985)

1.3.6.2 Prior research considering memory theories when assessing memory for pain

Morley (1993) identified three possible components of pain memory: pain event memory (remembering the circumstances surrounding the event, but not aspects of the pain itself); pain experience memory (remembering the intensity and quality of the pain experience) and sensory re-experiencing of pain (as in the case of phantom limb phenomena), analogous to what Katz and Melzack (1990) have termed 'somatosensory memory'. In Morley's study, participants were asked to recall prior pain experiences or situations and to provide a series of ratings about the vividness of their memories. As might be expected, none of the participants reported 're-experiencing' the sensory aspects of the pain described. Forty-one percent of the participants were unable to recall any sensory qualities of the pain (i.e., pain experience memory). Distress associated with the pain was associated with the reported frequency with which the pain event was rehearsed and with ratings of emotional and activity change induced by the pain event. Intensity and sensory quality ratings were associated with the reported vividness of the pain memory. Morley (1993) concluded that his findings indicated that vivid memories of the painful *events* are readily retrievable; memories of painful events (versus non painful events) were rated as being more surprising, with greater degree of negative emotional change and change in ongoing activity. Unfortunately, this study is limited in that it was not possible to verify the retrospective accounts of the pain with original reports of the recalled event and was not couched within the more contemporary theories of long term memory described above.

Niven and Brodie (1995) considered the role of semantic and episodic memory in their assessment of memory for labour pain three or four years after birth. Participants used the full MPQ presented in its standard categorised format to provide ratings of labour pain within the first 48 hours after delivery, and three or four years later, again using the MPQ to describe the pain of labour as they remembered it. The authors constructed Pain Profiles (e.g., Melzack, 1975) made up of the most frequently selected pain descriptors to compare the individual MPQ descriptors and categories used by participants at each pain assessment time. Kappa was used to compare the agreement between the two ratings. The participants also provided unstructured accounts of other aspects of labour which were qualitatively analysed. The authors found that participants displayed very good memory for events surrounding childbirth when the retrospective reports were compared to data from around the time of birth. On the other hand, when Kappa was used to analyse the similarity between real time and retrospective reports of pain using the MPQ, descriptors were not reliably chosen at recall, and Kappa values were generally low (0.29 ± 0.19). Kappa values to assess MPQ category reselection were similarly 'poor' (0.36 ± 0.34). These Kappa values suggest that there was generally low agreement between the descriptions of labour made soon after delivery and those made some years later.

Niven and Brodie discuss their findings in the context of Tulving's conceptualisation of semantic and episodic long-term memory (e.g., Tulving, 1985) and question the extent to which the women's recollections depend on episodic memory. Alternatively, they postulate, the descriptors used by the women to report their labour pain might reflect a more general semantic memory for labour pain which is common to all, not just those who have experienced childbirth. The lack of consistency between the women's descriptions – and a lack of episodic involvement in the women's recollections - might be expected given the time delay between ratings and given the fact that the original pain ratings were made a day or two after delivery.

In a more recent study, Brodie and Niven (2000) investigated differences between ratings of menstrual pain made by 34 women who regularly experienced dysmenorrhoea (the 'Pain' group) and 15 women who had never experienced dysmenorrhoea (the 'No-pain' group). Both groups completed the MPQ pain questionnaire during menstruation (Time 1) and two weeks later (Time 2). The MPQ was presented as a single list of descriptors consisting of an amalgamation of all the words from each of the 20 MPQ categories. Thus, participants could select any of the words on the list, rather than being constrained to selecting just one descriptor from each MPQ category. The 'Pain' group participants were told to assess their period pain at its most severe using the list of MPQ descriptors. The 'No-pain' group was asked to choose words from the MPQ descriptors that they thought would best describe period pain. Two weeks later, again using an amalgamated list of MPQ descriptors, the Pain group was asked to recall their period pain and the No-pain group was asked to try to remember their previous estimate of period pain.

Cohen's Kappa was used to assess the similarity of pain descriptions made between Time 1 and Time 2 for both the Pain and the No-pain groups. Brodie and Niven (2000) suggested that there should be a greater consistency between actual pain ratings and retrospective pain reports, made by the 'Pain' group, than between repeated 'estimates' of pain given by the 'No-pain' group. The mean Kappa value obtained for the Pain group was 0.53 (sd 0.24) which is considered to reflect 'fair' recall accuracy, using Fleiss' (1981) categorisation of Kappa values. For the No-pain group, mean Kappa was 0.43, which also reflects 'fair' accuracy. Although the No-pain group participants were less consistent in their estimates of pain than the Pain group, a *t* test revealed that there were no significant differences between these Kappa values ($p>0.05$). Moreover, the pain estimates were very similar to the actual pain ratings given by the dysmenorrhoea sufferers, with core descriptors of menstrual pain being the same for both the Pain and No-pain groups. Brodie and Niven concluded that the role of episodic memory may be limited in pain recall and that non-experiential (semantic) knowledge of pain may augment subsequent retrospective reports. They suggested that the similarity between the descriptions of dysmenorrhoea by both the Pain and the No-pain groups may 'reflect the bi-directional effects of episodic and semantic memory' (Brodie and Niven, 2000, p. 93).

There is a need to add to the types of pain event which have been investigated using Kappa statistics, in order to further understand the way in which people are using the MPQ to describe their memories of pain. In addition, although previous memory for pain research has made a distinction between semantic and episodic memory, the phenomenological awareness that accompanies recollections of pain has not been investigated.

Tulving (1985) suggested that the states of awareness which accompany recollection could be assessed by making a distinction between 'remembering' and 'knowing'. Remembering refers to the recollective experience that accompanies episodic (or autonoetic) memory and occurs when previous experiences or events come back to mind in some detail, accompanied by 'an image of oneself in relation to time and place' (Gardiner *et al.*, 2002, p. 84). Tulving describes remembering as the ability to mentally travel backwards in time to re-experience past events and episodes (Tulving, 2002) and for Tulving, it is the episodic memory system and autonoetic consciousness which facilitates such 'mental time travel', also allowing individuals to project themselves into some imagined or anticipated future. Knowing, on the other hand, refers to a feeling of familiarity and a recollection of events which, although we may know happened, their occurrence cannot be consciously remembered. This distinction between remembering and knowing has given rise to substantial amounts of research and it has become established that reports of remembering and knowing can be affected differentially by numerous experimental manipulations (see e.g., Gardiner *et al.*, 2002 for a review). The application of the remember/know paradigm to investigate the extent of conscious awareness which accompanies recollections of prior pain experiences is required in order to further understand the extent to which acute pain can be recalled and is discussed further in Chapter 4 of this thesis.

1.4 Factors affecting memory for pain

The preceding sections have described how the multidimensional nature of pain, the type of pain assessment and the statistical tests employed all need to be considered when interpreting data obtained from studies investigating memory for pain. It is also necessary to consider factors which may be involved in influencing memory for expected acute pain and that may be able to account to some degree for the variation in recall ability. The Gate Control Theory highlights that the perception of pain is influenced by a combination of many psychological and physiological factors. Few of these have been considered as factors which may subsequently influence memory for pain. The available literature is reviewed below.

1.4.1 Expectations of pain and subsequent memory for pain

Unlike acute pain which is *not* anticipated, a considerable amount of effort is often spent in preparation for expected acute pain events, particularly in the cases of childbirth and postoperative pain, when cognitive interventions are frequently used and found to be beneficial (for a review see e.g. Devine, 1992). The Gate Control Theory of pain highlights the intrinsic role of expectations in the interpretation of a pain experience (Melzack and Wall, 1965). Much less widely investigated is the extent to which these expectations are related to subsequent recollections of pain. If, as prior research has suggested, recollections of acute pain are not consistent with ratings made whilst in pain, how are these retrospective reports being produced? Niven and Brodie (1995) suggested that long-term memories of specific episodes of labour pain may be influenced by non-experiential knowledge of labour pain, and, as a result, retrospective reports of labour pain might bear more similarities to reports given prior to childbirth than those given during or immediately after childbirth.

McFarland *et al.*, (1989) reported some persuasive evidence that recollection of pain might be influenced by prior beliefs of what the experience 'should' be like. In their study, women provided daily reports of 'distress' (water retention, pain and negative affect) before and during menstruation which were then compared with their reported memory for that distress. The daily reports prior to and during menstruation revealed little or no increase in distress due to menstruation. However, retrospectively, participants recalled less distress before menstruation and more distress during menstruation. Their memories of menstrual symptoms corresponded more closely to their theories of what menstruation 'should' be like, than to their actual experiences (i.e. their daily reports).

Terry and Gijsbers (2000) compared expectations of labour pain with immediate (< 48 hours after delivery) and delayed (4-6 weeks postpartum) reports of labour pain. They found that whilst memory for the qualitative nature of labour pain was not particularly good, these pain memories did not appear to be augmented by prior expectations of childbirth. Instead, they suggested that memory for the pain experience may be 'reconstructed' based on recollections of other aspects of the events, such as the recalled emotional and behavioural consequences of the pain. However, the sample size and the complex nature of labour pain mean that their study requires replication.

1.4.2 Anxiety and memory for pain

Anxiety and fear are intrinsic characteristics of acute pain (Melzack and Wall, 1996), and in cases of expected acute pain, these kinds of negative emotions will occur *prior* to the pain experience. The relationship between anxiety and the experience of acute pain has been widely investigated, although there is no clear positive association between anticipatory anxiety and subsequent pain experiences (Taenzer *et al.,* 1986; Weisenberg, 1994). The relationship between anxiety and *memory* for pain has received little attention in previous research and the available literature is reviewed below. Before doing this, however, it is first necessary to consider the ways in which anxiety is assessed and measured.

1.4.2.1 Assessing anxiety

Eysenck and Eysenck (1987) define personality traits as 'group of correlated behavioural acts or action tendencies' and personality types as 'a group of correlated traits'. Traits are essentially dispositional factors that tend to determine an individual's conduct in many types of situations, and trait anxiety is one aspect of personality. The distinction is often drawn between various personality 'traits', and 'states' (or moods), which are more singular occurrences. There are numerous measures and assessment tools designed to assess anxiety and other aspects of mood and affect. Whilst many of these measures are designed to assess mood disorder, depression and anxiety (for example, the Hospital Anxiety and Depression Scale (HADS); the Brief Symptom Inventory (BSI) and the Beck Anxiety Inventory (BAI: Beck *et al.*, 1988)), the Speilberger State-Trait Anxiety Inventory (STAI, Spielberger, 1983) provides a method of separately assessing situational anxiety and trait anxiety and is widely used in research and in clinical settings. Trait anxiety refers to individual differences in anxiety proneness which are relatively stable; that is, the individual's disposition to perceive certain stimulus situations as dangerous or threatening. Those with higher trait anxiety scores tend to perceive a larger number of situations as dangerous or threatening than do those with low trait anxiety. There is substantial evidence to suggest that anxious individuals process threat-related information in a biased manner (Beck *et al.*, 1985; Beck and Clark, 1997; Williams *et al.*, 1997). Beck (1985) proposed a schema-based information processing model which suggests that stimuli are interpreted in an erroneous or biased way, so as to perceive the stimuli as dangerous or threatening in some way. There is substantial evidence that anxious individuals often focus their attention towards threat-related stimuli at the expense of neutral stimuli (Mogg and Bradley, 1998) and interpret ambiguous information as dangerous (MacLeod and Cohen, 1993). 'State' anxiety, on the other hand, is characterised by subjective, consciously perceived feelings of tension, apprehension, and heightened autonomic nervous system activity. The STAI is designed to assess these two kinds of anxiety, and contains items relating to how people 'generally feel' (trait anxiety) and others dealing with how they feel 'right now' (state anxiety).

1.4.2.2 Prior research investigating the relationship between anxiety and memory for pain

In a widely cited study, Kent (1985) assessed the relationship between dental anxiety and memory for pain. In this study, 46 dental patients completed a four item Dental Anxiety Scale (Corah, 1969), and provided ratings of expected, experienced and remembered (three months after treatment) pain using a 10 cm VAS. The results indicated that participants with high anxiety remembered their pain differently to those with lower levels of anxiety. There was a strong association between experienced and remembered pain for the low anxiety group (n=15, $r = 0.786, p<0.001$) whilst there was no association for the high anxiety patients (n=8, $r = -0.110, p>0.1$). In addition, Kent found that participants with high dental anxiety were more likely to remember pain as being more similar to their expectations than to their real time experiences. Patients scoring high on the Dental Anxiety Scale (DAS) expected high levels of pain, and remembered high levels of pain, compared with the low anxiety group, who gave ratings more similar to those given immediately after the experience. Kent (1985) points out that patients' memories may change over time to be consistent with their anxiety, which will in turn influence their expectations regarding the prospect of any future similar pain episodes.

As described above, Everts *et al.*, (1999 p.120) found that pain could be recalled six months after acute chest pain with 'reasonable accuracy', although patients slightly overestimated their recalled pain intensity levels. Levels of anxiety were also estimated, based on the mean score of patients' ratings on the Minor Symptom Evaluation Scale (Dahlöf *et al.*, 1989) and a modified Subjective Symptom Assessment Scale (Dimenäs *et al.*, 1990), and Everts *et al.*, noted that the tendency to retrospectively overestimate pain intensity was more manifest in patients with higher anxiety scores at the time of the pain experience.

Gedney *et al*, (2003) assessed the extent to which a number of factors, including anxiety could predict the short- and long-term memory of pain arising from root canal therapy (RCT). Hierarchical multiple regression analysis was conducted to determine predictors of the dimensions of pain intensity and pain unpleasantness recalled at week one and 18 months after RCT. Prior to treatment, participants provided ratings of state and trait anxiety, and used VAS to report their expectations of the sensory and affective dimensions of pain. VAS were used to assess pain intensity and unpleasantness immediately after treatment, one week and then 18 months later. Pre-treatment affective state (measure by Speilberger's STAI) was found to predict memory of pain unpleasantness at week 1 and week 18, and to predict memory of pain intensity at 18 months following RCT.

In a slightly different context, Gedney and Logan (2004) recently investigated the extent to which 'negative emotions' (tension, anxiety, fear and anger) could predict memory for stress-associated acute pain. Using an experimental research design, participants rated pain in a stress and non-stress condition. Ratings of experienced pain did not differ across conditions, but the level of recalled pain in the stress condition was exaggerated at six months, whereas in the non-stress session pain was more accurately recalled. In reviewing the role of negative emotion in recollections of acute pain, Gedney and Logan (2004) suggest that the data indicate a 'positive and meaningful association'. Stress and anxiety seem to have some effect on the extent to which pain can be accurately recalled some months after the pain episode. However, further research is required to investigate whether the relationship between anxiety and pain recall is positive, or whether anxiety leads to decreases in recall *accuracy*, rather than a systematic over or underestimating of prior pain intensity levels. In addition, no prior research has considered the relationship between anxiety and qualitative ratings of pain.

1.4.3 Other factors affecting memory for pain

1.4.3.1 Peak and end pain

The fluctuating nature of pain in even short episodes of acute pain raises questions about what aspect of a pain is being recalled when retrospective ratings are made. Is it the worst moments of a pain that is recalled, an 'average' of the whole experience, or perhaps the final moments of the pain? Redelmeier and Kahneman (1996) investigated the relationship between actual pain reports and retrospective pain ratings made during and after colonoscopy and lithotripsy. Participants (colonoscopy n=154, lithotripsy n= 133) were prompted to make 'real time' ratings of pain every 60 seconds on a 19 cm computer generated VAS. All patients then provided retrospective evaluations of their recollections of total amount of pain experienced on a 10 point rating scale, in the recovery room within an hour of the procedure. Colonoscopy patients made ratings of pain one month later, whilst lithotripsy patients recalled their experiences and rated total amount of pain from the procedure one year later. The authors found that patients' retrospective evaluations were significantly correlated with the highest levels of real time ratings (peak pain) and with final pain ratings (end pain). Patients ratings of total pain in the recovery room was significantly related to real time 'peak pain' ratings and 'end pain' ratings (r = 0.43-0.64, p<0.05). Although the duration of both procedures varied greatly (1–47 minutes for colonoscopy, and 18–51 minutes for lithotripsy), there was no significant correlation between the length of the procedure and the patients' average pain intensity (r = >0.10 for both procedures). These patients' memories of an acute pain appear to primarily reflect the intensity of 'worst pain' and 'end pain' and are not particularly affected by the duration of the pain. Redelmeier and Kahneman point out that it would be unlikely for patients to accurately remember entire episodes of pain and suggest that remembering peak pain or pain in the final moments of the acute pain event are 'convenient moments of comparison' (p. 5). They suggest that other summary measures, such as average pain or total pain are much more difficult for the individual to cognitively construct.

In a more recent study, Redelmeier *et al.*, (2003) carried out a randomised trial to further investigate memory for pain during colonoscopy procedures. Patients scheduled for colonoscopy (n=682) were randomly assigned to one of two groups. In one group, patients had a short interval added to the end of their procedure during which the tip of the colonoscope remained in the rectum. This manipulation meant that for the extended procedure group, the final moments of the procedure were relatively less painful that the standard procedure. In the other group, the colonoscopy was carried out as normal. Patients rated their pain at 60 second intervals until the colonoscope was removed. Patients who underwent the extended procedure therefore experienced the final moments as less painful than those undergoing the standard procedure (1.7 v 2.5 on a 10 point VAS; $p<0.001$). The extended procedure group rated the procedure as less unpleasant (4.4 v 4.9, $p=0.006$) and ranked the procedure as less aversive when rating it with seven other unpleasant experiences (4.1 vs 4.6 with 8 as the worst, $p=0.002$). The findings from this study indicate that the final moments of an acute pain experience could be a major factor in influencing memory for pain. These findings were in agreement with an earlier experimental study by Kahneman *et al.*, (1993) which reported that participants apparently preferred a longer episode of pain to a shorter episode if the pain towards the end of the experience was less intense. The study required one group of student participants to submerse their hand in cold water (set at 14 ^{o}C) for 60 seconds and another to maintain their hand in the water for 90 seconds. In the longer condition, the water was slightly warmer for the final 30 seconds. The authors suggested that memory for pain is not based on the length of time of an aversive experience (a phenomenon which the authors termed 'duration neglect') but upon a more complex summarisation of the pain experience.

1.4.3.2 Gender and memory of pain

Both experimental and clinical research have reported gender differences in the perception and reporting of pain. Experimental studies have reported gender differences in responses to pain stimuli including differences in pain thresholds, differences in pain reports and differences in pain tolerance (Berkley, 1997; Riley III *et al.*, 1998). Research has also found gender differences in clinical settings, including postoperative pain (Morin *et al.*, 2000) and dental pain (Eli *et al.*, 2000).

Eli *et al.*, (2000) assessed the effect of gender on predictions of acute pain and memory of periodontal surgery. A group of 37 patients (15 men, 22 women, matched for age and education) completed the Dental Anxiety Scale (DAS) the visual analogue scale for anxiety, the Spielberger State Trait Anxiety Questionnaire (Spielberger *et al.*, 1983) and recorded pain using another VAS. Four assessments were made at the first appointment (T1), on the day of surgery prior to surgery (T2), one week postoperatively (T3), and four weeks postoperatively at a routine follow up (T4). There was a significant increase in anxiety between T1 and T2 and a decrease between times T2 and T3 and T3 and T4. Women predicted less pain than men prior to surgery, but reported remembering more pain post-surgery than men. Significant correlations were also found between state anxiety and pain parameters. Crucially, this study did not assess real time reports of pain. Moreover, although the study acknowledges the fact that pain perception and memory for pain is a complex and multidimensional phenomenon, no attempt was made to assess the pain other than its intensity, whilst three types of anxiety scale were utilised.

1.5 Chapter summary

The review of the literature presented in this chapter was contextualised with a brief summary of the evolution of our current understanding of the experience of pain. This was followed by a critical review of studies which have assessed memory for pain intensity, memory for pain distress or affect, and memory for the multidimensional nature of pain. In addition, methods employed to assess the experience of pain were reviewed, as were the limitations imposed by the types of pain assessment used and the methods of statistical analysis employed.

The literature reviewed in this chapter indicates that a comprehensive investigation of memory for pain must take into account its multidimensional nature. The methods employed to compare pain ratings and to estimate recall accuracy need to be able to assess recollections of the qualitative dimensions of pain, rather than reduce the data to intensity ratings only. A small number of studies have used the MPQ to assess memory for the specific qualities of the pain experience and have analysed the qualitative descriptors chosen by calculating the percentage of agreement between rating times or by using Cohen's Kappa as a more stringent method of assessing the agreement between ratings. Based on the data from studies employing Kappa, an assumption has been made that the qualitative dimensions of pain are recalled less well than the intensity of a prior pain. However, the generally low Kappa scores may be due to the type of pain being assessed and the way in which the MPQ descriptors have been presented in some of these studies.

Previous research suggests that patients' expectations of pain may influence the way acute pain, which can be planned for or anticipated (e.g. postoperative pain, childbirth or health screening procedures), is both experienced and recalled. In addition, anxiety may influence the expectations of an anticipated future pain, the actual experience of the pain and subsequent recollections. Tulving (1985, 2002) identifies episodic memory as being responsible for 'mental time travel'; recalling the past and interpreting the present in the light of previous experiences and an anticipated future. As memories of pain will, in turn, be instrumental in the formation of expectations of subsequent pain events, the relationship between anxiety, expectations and memory warrants further investigation.

By partially repeating and building upon previous research (Beese and Morley, 1993; Niven and Brodie, 1995; Brodie and Niven, 2000; Terry and Gijsbers, 2000), the following two chapters set out to explicate the current understanding of how the qualitative and quantitative dimensions of expected acute pain events are recalled. These preliminary studies 'set the stage' for the main study reported in Chapter Five and draw attention to a number of methodological issues which, it will be argued, have not been adequately addressed using the research paradigms employed in previous research.

CHAPTER TWO: STUDY ONE – A PRELIMINARY STUDY ASSESSING THE RECALL ACCURACY OF THE INTENSITY AND QUALITY OF ACUTE POSTOPERATIVE PAIN

2.1 Introduction

2.1.1 Memory for expected acute pain

The review of the literature in Chapter One highlights the debate concerning the extent to which the intensity and quality of acute pain can be recalled. Studies relying upon correlation analysis, difference scores or the comparison of group means have reported retrospective ratings of pain intensity to be fairly reliable (e.g. Everts *et al.*, 1999; Singer *et al.*, 2001). However, these studies tell us little about what is being recalled in terms of the qualitative nature of the pain experience. Studies that have used the MPQ as a pain assessment tool can provide more information about memory for the qualitative dimensions of pain (Hunter *et al.*, 1979; Roche and Gijsbers, 1984), but such research is sparse and the sample sizes are small.

The use of Kappa to assess agreement between pain descriptors selected from the MPQ whilst experiencing pain, and descriptors selected some time after the pain event has passed, can provide information about pain memory additional to that obtained through correlation analyses. Four published studies have used Kappa analyses to investigate recall of the qualitative dimensions of pain (summarised in Table 2.1 below). The generally low values of Kappa obtained in these studies have led researchers to suggest that the qualitative nature of pain is not recalled as accurately as pain intensity (Beese and Morley, 1993; Niven and Brodie, 1995).

Author	Pain type	Assessment	Recall conditions	Kappa values (sd)
Beese and Morley, 1993	Postoperative pain (dental) n = 49	78 MPQ descriptors listed in random order	Immediate postop period and two weeks. Three Groups: Pain-cued, mood-cued and word recognition	Pain-cued: 0.49 (0.22) Mood-cued: 0.37 (0.20) Word Cued: 0.51 (0.25)
Niven and Brodie, 1995	Labour pain n = 33	MPQ standard presentation Kappa calculated for MPQ descriptors and categories	Reports around the time of birth and 3-4 years later	MPQ descriptors 0.29 (± 0.19) MPQ categories 0.36 (± 0.34)
Brodie and Niven, 2000	Dysmenorrhoea n = 34	78 MPQ descriptors listed in random order	Pain ratings whilst in pain and two weeks later (pain free)	0.53 (0.24)
Terry and Gijsbers, 2000	Labour pain n = 18	MPQ standard presentation (non-weighted ranked)	Reports within 24 hours of birth, retrospectively at six weeks post delivery	0.36 (0.21)

Table 2.1 Summary of previous research using the MPQ and Kappa

However, the generally low Kappa values observed could be due to the type of pain event being investigated and/or the method and presentation of the pain assessments used. Two of the four studies using Kappa analyses have attempted to gauge memory for labour pain, which is a complex and difficult type of acute pain to assess. One study considered memory for dysmenorrhoea, which differs from other sorts of expected acute pain events in that it is experienced regularly. Only Beese and Morley's (1993) study assessed memory for acute postoperative pain, and participants in two of the three groups were cued in different ways to recall their pain and the sample sizes for each group were small.

In terms of the type of pain assessment tool used, two of the studies described above presented the MPQ as a single list of 78 pain descriptors, whilst two presented the MPQ in its standard format. Kappa has not been used to investigate agreement between pain ratings using the Short Form MPQ (SF-MPQ; Melzack *et al.*, 1985). The use of the SF-MPQ, which contains fewer pain descriptors to choose from and which may be more semantically distinct from one another, may result in participants being able to retrospectively select descriptors which are more consistent with those chosen whilst in pain.

2.1.2 Expectations, anxiety and recollections of pain

In clinical situations, it is thought that the provision of patient information will facilitate the formation of realistic and likely expectations of forthcoming pain, and allow patients to 'mentally prepare' for the event (Leventhal and Johnson, 1971). It is now widely assumed that it is beneficial to provide patients with as much information as possible and patients increasingly have access to a variety of information sources (Jones *et al.*, 2002). The provision of preoperative information has been found to have a positive effect on numerous postoperative outcome variables such as pain, anxiety, length of hospital stay and patient satisfaction (for reviews see Hathaway, 1986; Devine, 1992).

However, the extent to which the individuals' expectations of the likely nature of the forthcoming pain and their levels of anxiety (which may or may not be allayed by such information provision) influence subsequent *recollections* of the pain is not clear. Expectations of the probable nature and intensity of a pain which has not been personally experienced (presumably based at least partly on the information provided prior to surgery and other 'general knowledge') is assumed to be supported by the semantic memory system (Tulving, 1985). Niven and Brodie (1995) and Brodie and Niven (2000) suggest that the provision of retrospective reports of a previously experienced pain involves both the semantic and episodic memory systems. The relative extent to which expectations of pain (that is, semantic knowledge) and episodic memory influences recollections of the pain therefore requires further investigation.

Expectations of pain, and the resulting degree of anticipatory anxiety, are intrinsic aspects of expected acute pain events. The complex relationship between expectations, anxiety and memory for pain was demonstrated by Kent (1985) who obtained a high correlation between ratings of pain experienced during dental procedures and subsequent recollections from participants with low dental anxiety. However, no comparable correlation was observed between participants with high dental anxiety scores, whose recollections of pain were more closely associated with their expectations of pain than with their ratings of the actual pain experienced.

Using multiple regression analysis, Gedney *et al.*, (2003) found that expectations of dental pain intensity did not significantly predict ratings of pain intensity or unpleasantness one week after surgery or at 18 months following dental surgery. But they did find that anxiety prior to dental surgery was a significant predictor of memory for the unpleasantness of pain one week after surgery and pain intensity and unpleasantness 18 months later. Gedney *et al.*, (2003) and Kent (1985), however, only considered the relationship between participants' expectations of pain and subsequent retrospective ratings of pain *intensity*. The relationship between anxiety ratings and recollections of the qualitative aspects of pain also requires investigation. This could be addressed by examining the data for associations between anxiety and the Kappa values reflecting the consistency between actual pain reports and those made retrospectively. By investigating the relationship between anxiety and the Kappa values obtained when comparing expectations of pain and retrospective reports, the extent to which individuals with higher anxiety rely upon their expectations of pain may be further investigated.

2.1.3 Aims and objectives

The central objective of the present study was to add to the limited literature which has utilised Kappa to assess the extent to which the qualitative dimensions of pain can be recalled, and to employ the Short Form MPQ (SF-MPQ) as a method of pain assessment. Postoperative pain following surgery for varicose veins was considered to be a suitable type of expected acute pain as the procedure is routinely carried out and is normally straightforward in terms of procedure and recovery. In addition, the outcome is 'positive' in that it is generally assumed that after the surgery the problems arising from the varicose veins will be resolved. Furthermore, the procedure is not exploratory, i.e., not looking for the cause of a problem which is likely to mean that patients may be highly anxious until the results of the procedure are known. It is also a type of surgery which is not gender or age specific. The two aims of the study were:

1) To explore the inter-relationship between patients' Expectations of pain, their Actual ratings made whilst experiencing postoperative pain and their Retrospective reports of the intensity and quality of pain following day surgery for varicose veins, and to use Kappa to assess the agreement between the SF-MPQ descriptors selected at these different points in the care trajectory.

2) To examine the inter-relationships between measures of pain and measures of patient anxiety.

2.1.4 Hypotheses

This study set out to test the following hypotheses:

Hypotheses relating to Aim 1:

1) It was hypothesised that the patients' Expectations of pain, Actual pain ratings and Retrospective ratings of pain (reported using the SF-MPQ and a VAS) would be positively correlated. This hypothesis was based on Niven and Brodie's (2000) finding that non-experiential estimates of pain (which may be equated to Expectations of pain in the current study) were similar to ratings given by participants with actual experience of the pain.

2) It was hypothesised that the Kappa values reflecting agreement between the descriptors used to express Actual pain and Retrospective ratings of pain would be better than those obtained in previous studies, because of the use of a shorter questionnaire (the SF-MPQ containing fewer analogous words to the full MPQ) and the type of acute pain under investigation.

Hypotheses relating to Aim 2:

3) It was hypothesised that measures of anxiety would be negatively associated with pain recall accuracy. Participants with higher anxiety ratings would provide Retrospective ratings of pain which were less consistent with their Actual pain ratings and more consistent with their Expectations of the qualitative nature of

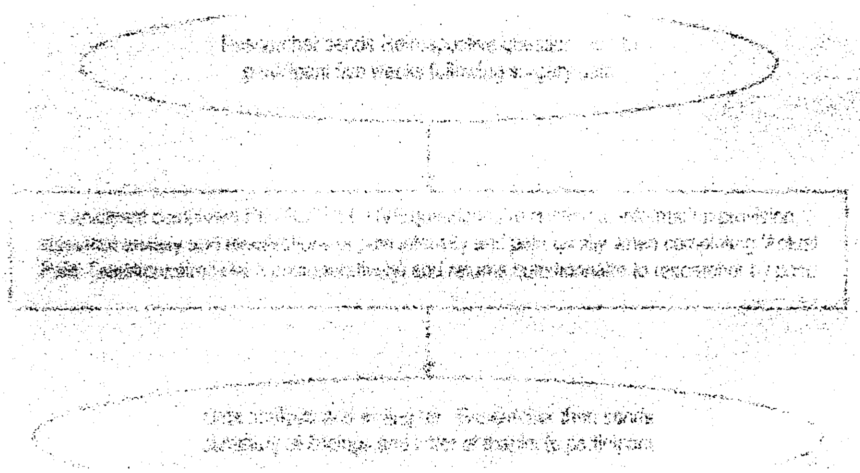
postoperative pain. That is, in line with Kent's (1985) findings, it was hypothesised there would be:

a) a positive relationship between anxiety measures and the Kappa values reflecting agreement between Expectations of pain and Retrospective ratings of pain, and;

b) a negative relationship between anxiety measures and Kappa values reflecting agreement between Actual pain and Retrospective ratings of pain.

2.2 Method

A flow diagram of the study design and procedure is shown in Figure 2.1 below.



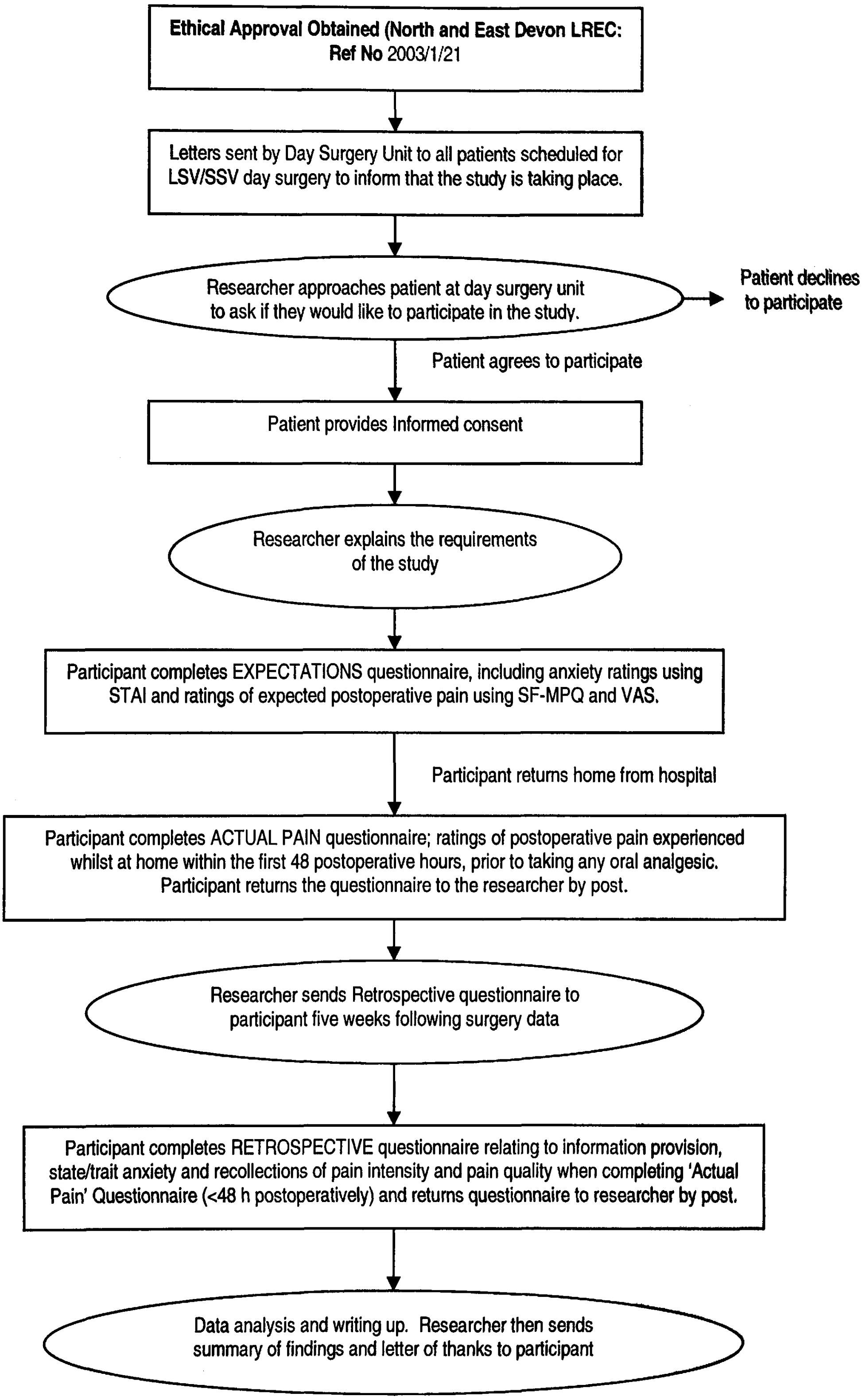


Figure 2.1: Flow diagram of Preliminary Study One procedure

2.2.1 Design

The study reported here was a within subject repeated measures design. Measures of pain and anxiety were obtained on three occasions from patients undergoing uncomplicated long saphenous vein or short saphenous vein (LSV or SSV) day surgery: 1) preoperatively, where patients' Expectations of pain were assessed along with state and trait anxiety; 2) postoperatively – in the 48 hours following surgery when Actual pain and anxiety were assessed; and 3) five to six weeks postoperatively – when patients' Retrospective ratings of postoperative pain intensity and quality, and measures of state and trait anxiety, were obtained again.

2.2.2 Participants

Participants were patients attending one of two day surgery units of a large general hospital in the South West of England for straightforward LSV or SSV surgery. Participants were aged between 26 and 72 years of age and all spoke fluent English. All patients had received an information leaflet from their consultant surgeon which provided a detailed explanation of varicose vein surgery. This leaflet (Campbell, 2002; see Appendix 1.2) provided a description of the likely sensory and affective nature of the postoperative experiences and included the descriptors 'aching', 'tender' and 'tired' to describe postoperative pain.

2.2.2.1 Contacting participants

Forty letters were initially sent by day surgery administrative staff to all patients scheduled for varicose vein stripping surgery to inform them that the study was taking place between one and eight weeks prior to their date for surgery. Enclosed with this letter was a patient information sheet, explaining the nature of the study. After a few weeks of data collection, it became clear that collecting data from the first patient scheduled for surgery was problematic due to a lack of time between admission and going to theatre. For this reason, two other consultant general surgeons were contacted who performed vascular day surgery within the same hospital but at another site. It was agreed that a further 24 letters should be sent, using the same procedure as before.

2.2.3 Materials

2.2.3.1 The questionnaires

As described above, participants were asked to complete three questionnaires, the first of which is shown in Appendix 1.3. The questionnaires were divided into three sections, relating to information provision and patient satisfaction, pain and anxiety. For the purposes of this study, only the sections pertaining to pain and anxiety were analysed.

The first questionnaire required participants to provide ratings of their Expectations of postoperative pain. In the second questionnaire, participants were asked to provide ratings of Actual postoperative pain within 48 hours of surgery, prior to taking analgesic medication. In the third questionnaire, completed five to six weeks later, participants were asked to provide Retrospective ratings of the pain that they recalled experiencing at the time of completing the Actual pain questionnaire.

In the first (Expectations) and third (Retrospective) questionnaires, participants were asked to provide ratings of both state and trait anxiety. In the second questionnaire, participants were only asked to provide ratings of state anxiety. The first questionnaire was returned to the researcher at the Day Surgery Unit, whilst stamped addressed envelopes were given to the participants to return the second and third questionnaires.

2.2.3.1.1 Measures

The Short Form McGill Pain Questionnaire (SF-MPQ) was used to obtain participants' Expectations of pain, Actual and Retrospective pain ratings. A VAS (a 100 mm line anchored by the words 'No Discomfort' and 'Worst Possible Discomfort' at each end of the line) was included in each questionnaire to obtain a rating of pain intensity. As this study and the other studies in this thesis set out to investigate *memory* for pain, the VAS was chosen as a measure of intensity to reduce the possibility of the numbers reminding participants of their prior pain ratings. These measures are discussed in Section 1.3.1 of the literature review.

The Spielberger State-Trait Anxiety Inventory (Spielberger, 1983) was used to assess participants' state and trait anxiety. Both state and trait anxiety was assessed prior to surgery (when participants provided their Expectations of pain) and five to six weeks after surgery (when participants provided Retrospective ratings of pain). In the immediate postoperative period, when participants provided Actual pain ratings, only state anxiety was reported.

2.2.4 Procedure

Local Research Ethics Committee approval was obtained (North and East Devon LREC; Reference Number 2003/1/21, shown in Appendix 1.1). Once at the day surgery unit, the researcher approached patients, usually after they had been admitted by the nursing staff. All of these patients had received the letter from the day surgery staff (referred to in section 2.2.2.1 above) to inform them that they may be approached by a researcher whilst at the day surgery unit. The nature and purpose of the study were explained and patients were offered an information sheet detailing the requirements of participation. Those who agreed to participate signed a consent form which was photocopied and given to both the patient and to hospital staff for their notes.

Participants completed the Expectations questionnaire immediately prior to surgery. Participants were then given the second questionnaire which they were asked to complete in the first 48 postoperative hours at home, and prior to taking any prescribed analgesic medication. Participants were asked to return this questionnaire to the researcher by post and were provided with pre-paid and addressed envelopes. Participants who returned this questionnaire were sent the third questionnaire five weeks after surgery. A covering letter instructed them to try to recall any pain or discomfort experienced at the time they had completed the previous postoperative questionnaire (< 48 hours after surgery), again using the SF-MPQ and VAS and to provide ratings of state and trait anxiety using the STAI.

2.2.5 Statistical issues

2.2.5.1 Power calculation

The number of participants needed for an adequately powerful study was calculated on the basis of finding a difference of 10% of the highest possible SF-MPQ PRI rating (i.e. 4.5) between the pain rating times. This was based on a previous finding by Pakula and Milvidaitė (1983) who found a 10% error rate when requiring participants to mark a VAS at two predetermined positions: this variation was used in their study to set the estimate of inherent unreliability in VAS ratings at 10%. In this study, an internet-based tool for power calculations was used (*http://calculators.stat.ucla.edu/powercalc/normal/n-1/*) to calculate the required number of participants by entering the mean PRI ratings and standard deviation reported by McDonald and Weiskopf (2001), who used the SF-MPQ to assess postoperative pain, as the mean under distribution under the null hypothesis. McDonald and Weiskopf obtained a mean PRI rating of 14.6 (sd 9.1). The mean of the distribution under the alternative hypothesis was entered as 19.1. Using these figures, a sample size of 34 would be required (2-sided test). A total of 34 participants agreed to participate in this study, but complete data were obtained for only 24. Prior to a further round of data collection, a post-hoc power analysis was carried out using the data obtained from the varicose vein surgery participants (mean 8.0, sd 5.1). Using these figures, a sample size of just 12 was necessary for adequate statistical power. For this reason, no further participants were recruited in addition to the 24 participants already taking part in the study.

2.2.5.2 Data analysis

The relationships and differences between ratings obtained from the SF-MPQ, the VAS and the anxiety scores at the three assessment times were examined using repeated measures Analysis of Variance (ANOVA), Pearson's correlation statistics and related sample *t* tests as appropriate. The prevalence and relative frequency of words selected by participants to describe their Expectations of pain, Actual pain ratings and Retrospective ratings of pain were collated and compared. A comparison of 1) Expectations of pain and Actual pain ratings, 2) Actual pain ratings and Retrospective ratings and, 3) Expectations of pain and Retrospective ratings was also conducted using Pain Profiles and Cohen's Kappa (κ). In line with previous studies, Fleiss' (1981) categorisation of the level of agreement indicated by the Kappa values was used.

2.3 Results

2.3.1 Data screening

A total of 38 patients were approached at the day surgery units. Of these, a total of nine men and 25 women agreed to take part. Six participants did not complete the first or second questionnaire either because they were taken to surgery before they had the chance to complete the Expectations questionnaire, or because of complications during the surgery which resulted in a longer than expected stay in hospital. One participant did not appear to understand the requirements of the study, and one completed only the first questionnaire. Eight men and 18 women completed the first two questionnaires. A total of seven men and 17 women all three questionnaires.

Twenty-four participants provided complete sets of pain data regarding their Expectations of pain, Actual pain experiences and Retrospective ratings. One participant did not complete the state and trait anxiety on the Expectations questionnaire, and one participant did not provide complete trait anxiety data on the Retrospective questionnaire. For these participants, mean anxiety scores were used. Data were then screened for outliers by converting pain ratings and anxiety scores to *z* scores and examining these for any which were greater than 3.3 and were detached from the histogram for that variable (in accordance with screening guidelines detailed in Tabachnik and Fidell, 2001). No outliers were found and all 24 participants' data were used in the analyses. Appendix 1.4 contains descriptive statistics relating to pain and anxiety data.

2.3.2 Pain intensity – Expectations, Actual pain, Retrospective ratings

Mean PRI ratings to describe Expectations of pain (9.5, sd 5.5) and Retrospective PRI ratings (9.1, sd 6.5) were slightly higher than ratings of Actual pain (8.0 sd 5.1). This pattern was observed for the other two measures of pain, the Number of Words Chosen (NWC) from the SF-MPQ and the VAS.

Table 2.2 shows PRI ratings of Expectations of pain, Actual and Retrospective ratings of pain, VAS ratings and Number of Words Chosen (NWC). A repeated measures ANOVAs revealed no significant differences across the three times of assessment for any of the pain intensity measures (PRI total scores: $F(2,46) = 1.49$, $p>0.05$, sensory scores: $F(2,46) = 1.96$, $p>0.05$, affective/evaluative scores: $F(2,46) = 0.12$, $p>0.05$, NWC: $F(2,46) = 0.23$, $p>0.05$ and VAS: $F(2,46) = 1.46$, $p>0.05$).

	Expectations of pain	**Actual pain ratings**	**Retrospective ratings**
Total PRI (sd)	9.5 (5.5)	8.0 (5.1)	9.1 (6.5)
Sensory Score (sd)	8.4 (4.3)	6.8 (4.5)	8.1 (6.2)
Affective/Eval. (sd)	1.2 (1.4)	1.2 (1.6)	1.0 (1.5)
NWC	5.9 (3.0)	5.6 (3.1)	5.9 (3.6)
VAS	33.8 (17.5)	28.1 (16.2)	30.1 (17.3)

Table 2.2 Mean SF-MPQ PRI, NWC and VAS ratings(sd) to report Expectations of pain, Actual pain ratings and Retrospective ratings (5-6 weeks following surgery)

2.3.2.1 Comparison of correlation coefficients

Table 2.3 contains the correlation coefficients between PRI ratings and between the VAS ratings. Correlations between all PRI ratings and between all VAS scores were significant ($p<0.05$).

	Expectations of pain/ Actual pain	Actual pain/ Retrospective ratings	Expectation of pain/ Retrospective ratings
PRI	0.69**	0.82**	0.64*
VAS	0.41*	0.70*	0.50*

p = <0.05; **p = < 0.01

Table 2.3 Correlations between PRI ratings and VAS pain intensity ratings

Table 2.3 shows that the correlations between Actual pain and Retrospective ratings of pain were stronger than those between Expectations of pain and Actual pain and those between Expectations and Retrospective ratings of pain. In order to investigate whether there were significant differences between the strengths of these correlations, SPSS was used to transform *r* values to *z* scores (Fisher's *r* – *z* transformation). The following formula was then used to compare the *r* values:

$$X^2 = (n_1 - 3) z_1^2 + \quad (n_2 - 3) z_2^2 \quad \frac{[(n_1 - 3) z_1 + [(n_1 - 3) z_2]^2}{(n_1 - 3) = [(n_2 - 3)}$$

A chi-square table (Howell, 1994) was used to check significance levels of the X^2 values obtained (with $df = 1$). None of the differences between the *r* values for PRI or VAS comparisons were significant (PRI comparison between $r = .64$ and $.82$; $X^2=1.68$, $p>0.05$, VAS comparison between $r = .50$ and $.70$; $X^2=1.08$, $p>0.05$).

In order to further examine the relationship between Expectations of pain and Retrospective ratings of pain, two partial regression analyses were carried out, where Actual Pain PRI ratings and VAS ratings were controlled for. When doing this, PRI and VAS ratings of Expectations of pain were no longer significantly associated with Retrospective ratings of pain (PRI ratings: $r = .17, p > 0.05$ VAS ratings: $r = .32\ p > 0.05$).

2.3.3 Expectations, Actual and Retrospective reports of pain quality

2.3.3.1 Pain Profiles

As in previous research (e.g., Reading, 1982; Niven and Brodie, 1995), a 'Pain Profile' was constructed to investigate the pattern of SF-MPQ descriptors selected at each of the assessment times. A similar pattern of descriptors was selected from the SF-MPQ to express Expectations of pain, Actual pain and Retrospective reports (Figure 2.2).

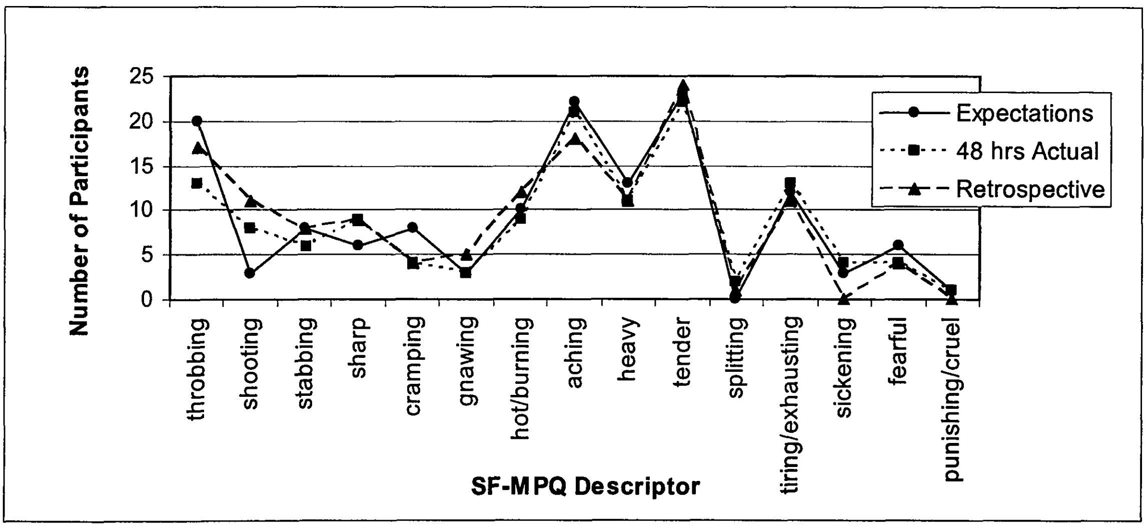


Figure 2.2: Pain Profiles showing number of participants selecting each of the SF-MPQ descriptors to express Expectations of pain, Actual pain and Retrospective ratings

2.3.3.2 Kappa analyses

Cohen's Kappa was used to investigate the agreement between the SF-MPQ descriptors selected at each assessment time. Specifically, comparisons were made between those selected to express i) Expectations of pain and Actual pain, ii) Actual pain and Retrospective reports, and iii) Expectations of pain and Retrospective pain ratings. Using SPSS, Kappa was calculated for:

1) SF-MPQ Descriptor selection: the consistency with which participants selected the same SF-MPQ descriptors (throbbing, shooting etc) across rating times, regardless of the intensity rating assigned.
2) SF-MPQ Descriptor and Intensity use: the consistency with which participants selected SF-MPQ descriptors *and* the same intensity level ('mild', 'moderate' or 'severe') at each rating time.

Although the pattern of SF-MPQ descriptors selected to express of Expectations of pain, Actual pain and Retrospective ratings of pain looked similar in the Pain Profiles, (see Figure 2.2), the Kappa values suggested less consistency in the participants' use of SF-MPQ descriptors. The Kappa values comparing Expectations of pain with Actual pain ratings, Actual pain ratings with Retrospective reports and Expectations of pain with Retrospective reports ranged from .24 – .34 for descriptors plus intensity selection consistency, and .42 – .53 for descriptor selection consistency (that is, 'poor' or 'fair', if Fleiss' categorisation of Kappa is used).

Two one-way ANOVAs with repeated measures found no significant differences between Kappa values reflecting agreement between SF-MPQ descriptor selection ($F(2,46) = 1.9$, $p>0.05$) or descriptor plus intensity selection ($F(2,46) = 0.7$, $p>0.05$). *T* tests were used to investigate whether the Kappa values reflecting agreement between Expectations of pain and Actual pain, between Actual pain and Retrospective rating and between Expectations of pain and Retrospective ratings were better for descriptor selection alone than for descriptor plus intensity selection. Descriptor only selection consistency was significantly higher than descriptor plus intensity selection consistency (Kappa comparing Expectations of pain and Actual pain ratings: $t(23) = 3.3, p = .003$; Actual pain and Retrospective ratings $t(23) = 4.7, p < .001$; Expectations of pain and Retrospective ratings $t(23) = 3.1, p = .006$, see Table 2.4 for mean Kappa values).

Kappa values reflecting agreement between:	**Expectations/ Actual**	**Actual/ Retrospective**	**Expectations/ Retrospective**
SF-MPQ Descriptors only	.42 (.28)	**.53 (.23)**	.49 (.29)
SF-MPQ Descriptors plus intensity (mild, moderate or severe)	.24 (.27)	**.34 (.35)**	.26 (.26)

Table 2.4 Mean Kappa values (sd) reflecting agreement between pain ratings for SF-MPQ descriptors only and for SF-MPQ descriptors endorsed as mild, moderate or severe

2.3.4 Ratings of state and trait anxiety

Table 2.5 shows the anxiety scores on the state and trait sections of the STAI before surgery, in the 48 hours after surgery and five to six weeks postoperatively when Retrospective ratings of pain were made.

	Preoperative (Expectations questionnaire)		**<48 h Postoperative**	**Anxiety 5-6 weeks (Retrospective questionnaire)**	
	State	Trait.	State	State	Trait
Mean anxiety rating (sd)	**41.0** (14.7)	**34.3**(9.9)	**29.4** (8.9)	**28.0** (8.3)	**33.1** (10.2)

Table 2.5 Preoperative state and trait anxiety ratings, state anxiety <48 hours postoperatively and state and trait anxiety five to six weeks postoperatively

Trait anxiety was stable across assessment times and positively correlated with Expectations of pain and Actual pain using the PRI. State anxiety ratings were not significantly correlated with PRI ratings. State and trait anxiety ratings assessed prior to surgery were significantly associated with Expectations of pain reported using the VAS. State anxiety was also positively associated with VAS ratings of Actual pain (r = .58, p<0.01). There were no significant correlations between state or trait anxiety and measures of recalled pain. Table 2.6 details the correlations between anxiety and pain ratings.

Anxiety:	**Preoperative**		**<48 h Postoperative.**	**Anxiety 5-6 weeks**	
	State	Trait	State	State	Trait
PRI Expectations	.23	**.42***	-	-	-
PRI Actual	.25	**.43***	.35	-	-
PRI Retrospective	.13	.25	.28	.19	.34
VAS Expectations	.30	.32	-	-	-
VAS Actual	**.52****	**.55****	**.58****	-	-
VAS Retrospective	.25	.16	.17	.13	.32

* Correlation significant at the 0.05 level (2-tailed) ** Correlation significant at the 0.01 level (2-tailed)

Table 2.6 Correlations between anxiety and pain ratings (PRI and VAS)

Measures of state and trait anxiety were all negatively correlated with Kappa values. It was hypothesised that Kappa values reflecting agreement between Actual pain ratings and Retrospective ratings would be negatively associated with anxiety. However, contrary to this hypothesis (Hypothesis Three), there was no evidence from the correlation analysis to indicate that anxiety levels were related to Actual pain and Retrospective pain rating consistency, as measured by the Kappa values. Also contrary to this hypothesis, Kappa values reflecting agreement between Expectations of pain and Retrospective ratings of pain were *negatively* correlated with anxiety; similarities between Expectations of pain and Retrospective ratings of pain tended to be observed when anxiety was low. Actual and

Retrospective ratings of pain tended to be more consistent if anxiety was lower, although none of these correlations were significant and therefore there was no statistically significant evidence to support the third hypothesis. State anxiety (but not trait) was related to the extent to which Expectations of pain were realistic; SF-MPQ descriptors to report Expectations of pain were more accurate if anxiety was lower (Table 2.7). On the other hand, no correlations between anxiety ratings and Kappa values reflecting the consistency of descriptor and intensity selection were found (Table 2.8).

Kappa comparisons MPQ Descriptors only	**Anxiety**				
	Preoperative		**<48 h Postoperative**	**Anxiety 5-6 weeks**	
	State	Trait	State	State	Trait
Actual/Retrospective	-	-	-.29	-.04	-.36
Expectations/Actual	**-.53****	-.37	**-.43***	-	-
Expectations/Retrospective	-.36	-.32	-	**-.42***	-.29

** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed).

Table 2.7 Correlations between anxiety and Kappa values (descriptors only)

Kappa comparisons MPQ descriptors and intensity	**Anxiety**				
	Preoperative		**<48 h Postoperative**	**Anxiety 5-6 weeks**	
	State	Trait	State	State	Trait
Actual/Retrospective	-	-	-.01	-.02	.08
Expect/Actual	-.01	-.20	-.16	-	-
Expectations/Retrospective	.19	-.02	.06	-.14	-.12

Table 2.8 Correlations between anxiety and Kappa values (descriptors plus intensity)

2.4 Discussion

2.4.1 Expectations, Actual pain and Retrospective ratings of postoperative pain

2.4.1.1 Ratings of postoperative pain: SF-MPQ PRI ratings and VAS ratings

The intensity of postoperative pain reported within 48 hours of varicose vein surgery was relatively low for day surgery patients, with a mean SF-MPQ PRI rating of 8.0 out of a possible rating of 45, and a mean VAS rating of 28.1 mm. McDonald and Weiskopf (2001) reported a mean SF-MPQ PRI rating of 14.6 to express postoperative pain following a variety of surgical procedures including breast augmentation, coronary artery bypass graft surgery, cholecystectomy and laminectomy. Melzack (1987) also reported postoperative pain PRI ratings using the SF-MPQ of around 15.

Prior research has reported overestimations of postoperative pain prior to surgery, using a variety of pain measures including visual analogue scales and verbal rating scales (Nay *et al.*, 1996; Carr and Thomas, 1997; Klages *et al.*, 2004). However, in this study, no significant differences between any of the pain assessment times were found. The PRI and VAS ratings are also somewhat at odds with a recent review of postoperative pain experiences after day surgery which concluded that 'severe pain continues to the third postoperative day and beyond' (Coll *et al.*, 2004, p. 61).

Although Retrospective ratings (PRI, NWC and VAS) were slightly higher than Actual pain ratings, this difference was not statistically significant. Significant positive correlations were also observed between Actual and Retrospective PRI and VAS ratings (see Table 2.3). Previous research has often interpreted such findings as an indication of reliable memory for postoperative pain intensity (Hunter *et al.*, 1979; Salovey *et al.*, 1993; Singer *et al.*, 2001).

The first hypothesis for this study, which proposed that Expectations of pain, Actual pain and Retrospective ratings of pain intensity would be significantly correlated, was supported. The results of this preliminary study suggest that the participants' Expectations of pain intensity were fairly accurate, and that the participants' Retrospective reports of pain were also in agreement with the ratings made to describe Actual pain experiences.

In order to further investigate the influence of Expectations of pain on Retrospective ratings of pain, partial correlation analyses was carried out, where Actual pain PRI and VAS ratings were controlled for. This analysis demonstrated that with Actual pain ratings partialled out, Expectations of pain were no longer significantly associated with Retrospective reports. This finding is similar to those of Gedney *et al.*, (2003) who found that although expected pain was significantly positively correlated to recalled pain, it did not enter as a significant predictor in multiple regression analysis.

2.4.1.2 The qualitative experience of pain

The patterns of SF-MPQ descriptors selected to describe Expectations of pain, Actual Pain and Retrospective reports of pain were similar (as shown in the Pain Profile in Figure 2.2). The quality of the pain was most commonly described as being throbbing, tender, aching, tiring, and heavy – descriptors which express the sensory qualities of the pain experience rather than its affect. Prior research has also found that patients tend to select affective descriptors less frequently than sensory ones in postoperative situations (Fortin *et al.*, 1992; Zalon 1999). Zalon pointed out that several postoperative patients mentioned that they tried not to let the pain impact upon their mood, which might help to explain the less frequent selection of affective pain descriptors in the present study.

However, the extent to which each of the participants was consistent in their descriptions of pain quality cannot be gauged from the Pain Profiles alone. In order to do this, Kappa was used to provide a measure of agreement between the three pain rating times by comparing descriptors chosen to express 1) Expectations of pain and Actual pain, 2) Actual pain and Retrospective reports, and 3) Expectations of pain and Retrospective reports. Kappa values reflecting consistency of the use of SF-MPQ descriptors at their corresponding levels of intensity were generally 'poor' ($\kappa \leq 0.4$) whilst the consistency of SF-MPQ descriptor use only was 'fair', (κ 0.4 - 0.6) if Fleiss' categorisation of Kappa values are used (Table 2.4).

The second hypothesis stated that Kappa values in the present study would be higher than those obtained previously because of the use of the SF-MPQ instead of the long version of the MPQ, and because of the type of pain being assessed. This hypothesis was not supported, as the Kappa values reflecting agreement between pain descriptions selected on the SF-MPQ to describe Actual pain and Retrospective ratings of pain are comparable to previous studies. Beese and Morley (1993) have reported the only other published study which has used Kappa to assess memory for postoperative pain. Presenting patients with a single list of 78 MPQ pain descriptors and cueing the patients to think back to their prior pain experience, or their prior pain ratings, Beese and Morley obtained 'fair' Kappa values of 0.49 and 0.51 respectively. The findings of the present study suggest that, regardless of the method of presentation or version of the MPQ used, the Kappa values reflecting agreement between actual and retrospective pain ratings remain similar.

On the basis of these Kappa values, previous research has concluded that memory for the qualitative nature of pain is not as accurate as recollections of pain intensity. However, this conclusion may be premature. Brodie and Niven (2000) suggest that a reductive process occurs when subjects recall the qualitative nature of pain, whereby only the defining qualities of the pain are experienced. It is possible, then, that pain qualities might be recalled more accurately at a 'type of pain' level, rather than at the very detailed individual descriptor level; whether or not, for example, the pain included 'thermal', 'incisive', or 'temporal' sensations and so on. In addition, although suggestions have been made as to whether Kappa values reflect, for example, 'fair' or 'good' agreement between ratings (e.g. Landis and Koch, 1977; Fleiss, 1981), Altman (1991) suggests that decisions on whether agreement is sufficiently high must depend upon clinical judgement, and the circumstances in which Kappa is used. An understanding of how accurately other sensory experiences can be recalled (for example, taste or smell), using Kappa as a measure of agreement between ratings, is required in order to further our understanding of the relative extent to which pain can be recalled. There is apparently no prior research which has compared the extent to which aspects of pain can be recalled with the extent to which the qualitative nature of other sensory experiences can be recalled.

2.4.1.2.1 The involvement of episodic and semantic memory in recalling expected acute pain

There were no significant differences between the Kappa values reflecting agreement between Actual pain ratings and Retrospective reports of the qualitative dimensions of pain, and the Kappa values reflecting other comparisons. Low Kappa values, together with the observation that there are few differences between pain reports made by people who have experienced pain and those who have not, led Niven and Brodie (2000) and Niven and Brodie (1995) to speculate that episodic memory of the qualities of a prior pain experience may be limited and augmented by information available from non-experiential information in semantic memory.

The findings of the present study could provide further justification for questioning the extent to which retrospective reports of pain can be assumed to reflect 'memory' of a previously experienced acute pain episode. But the fact that the Kappa values indicate that retrospectively selected SF-MPQ descriptors are different to those used whilst in pain may not discount the influence of episodic memory in pain recollections. The concept of episodic memory refers to the *conscious recollection* of events from one's personal past, and this cannot be adequately gauged by comparing verbal descriptors selected at each pain assessment time. In the same way, apparently 'correct' pain recollections (which have been inferred when Actual and Retrospective pain ratings match) cannot be assumed to reflect episodic memory of a prior pain event.

An investigation of the conscious awareness accompanying pain memories (whether recollections of the event involve episodic memory or semantic knowledge that 'pain occurred') needs to adopt a more direct approach. Cognitive memory research often relies upon a paradigm where participants judge whether a previously experienced event is 'remembered' or simply 'known' to have occurred (e.g. Tulving, 1985; Rajaram, 1993). This approach is discussed further at the end of Chapter Three and in the Literature review in Chapter Four.

2.4.2 Anxiety and Expectations of pain, Actual pain ratings and Retrospective ratings of pain

State and trait anxiety were assessed prior to surgery and retrospectively when pain free. State anxiety was also assessed in the first 48 postoperative hours when Actual pain was assessed (Table 2.5). Trait anxiety was consistent (mean ratings around 34), which is slightly lower than the norms reported by Speilberger (1983). As would be expected, state anxiety was quite high prior to surgery (41.0, sd 15) but much lower at each of the postoperative assessment times (less than 30). The low trait anxiety ratings may have resulted in the generally low affective/evaluative components of the SF-MPQ pain ratings observed.

The positive correlations between Expectations of pain and anxiety and between Actual pain and anxiety demonstrate that participants with higher levels of anxiety tended to expect and report experiencing greater levels of pain (Table 2.6). This finding is in agreement with previous research which has demonstrated that increased levels of anxiety are associated with increased pain reports (e.g., Pud and Amit, 2005; Gedney *et al.*, 2003; Kain *et al.*,, 2000). However, a positive association has not necessarily been found when the relationship between acute pain and anxiety has been investigated (Taenzer *et al.*, 1986; Weisenberg, 1994), and it was hypothesised that those with higher anxiety would result in Retrospective ratings of the qualitative nature of pain as being *less consistent* (rather than consistently higher or lower) than those with lower levels of anxiety. But contrary to this third hypothesis, the data analysis in the present study provided no evidence that anxiety is negatively associated with pain recall accuracy. There were no linear associations observed between measures of state or trait anxiety and the Kappa values reflecting agreement between Actual pain ratings and Retrospective ratings (see Table 2.7 and 2.8). On the other hand, the Kappa analyses do suggest that Expectations of pain were less likely to agree with Actual or Retrospective ratings of pain if anxiety was higher. This association provides some evidence that participants with higher anxiety tended to have less realistic expectations of the forthcoming pain, but these expectations do not significantly influence pain recall accuracy. Due to the exploratory and preliminary nature of this study, further research is warranted to more thoroughly investigate the relationship between pain recall accuracy and anxiety.

2.4.3 Limitations

This study has achieved its aims and has been able to provide data which either supports the study hypotheses or lead us to reject them. However, it has also confirmed a number of methodological problems and limitations which are discussed below.

2.4.3.1 Sample sizes

It could be argued that the lack of statistical differences found in both the correlation and Kappa analyses may reflect that this study is not powerful enough to detect them. In addition to the problems of power, smaller sample sizes do not permit more sophisticated statistical analyses such as multiple regression analysis. However, the sample size of the present study is comparable to previous studies employing this research paradigm (detailed in Table 2.1) and in a preliminary study such as this, the sample sizes were deemed acceptable in order to highlight the requirements of any subsequent studies.

2.4.3.2 Obtaining data in clinical settings

The data reported here may have been affected by the 'noise' inherent in clinical settings. For example, although great care was taken by the researcher only to approach participants at an appropriate time, inevitably, patients were sometimes distracted for a variety of reasons. It is unclear how such disturbances may have affected the participants' ability and motivation to complete the questionnaires according to the instructions provided. In addition, although there were no indications of any misunderstanding (such as missing data) with regard to the completion of the subsequent questionnaires, as the Actual pain and Retrospective questionnaires were completed at home, it is not possible to know the extent to which the guidelines given for their completion were followed.

2.4.3.3 *Peak pain, end pain and pain duration*

An additional reason for the lack of similarity between Actual and Retrospective reports of the qualitative nature of pain could be due to the fact that postoperative pain was not constant. If participants' pain fluctuated considerably during the postoperative period, it might be reasonable to expect to find discrepancies in Retrospective reports of pain intensity which might, in fact, be reflecting good memory for pain experienced at some point other than when the Actual pain ratings were obtained. Redelmeier and Kahneman (1996), for example, found that memory for the intensity of pain was influenced by 'peak' pain (pain at its most severe) and 'end' pain (where the final moments of the pain were being recalled). An attempt to minimise this possibility was made by requiring participants to think back to the time when the Actual pain questionnaire was completed. In addition, discrepancies due to fluctuations in pain may have been more likely to be reflected in intensity ratings rather than influence the choice of qualitative pain descriptors. The finding that intensity ratings were highly consistent suggests that the low Kappa values were not due to the participants recalling more salient moments of their postoperative pain.

2.4.3.4 *Inferring whether the previous assessment or the pain per se is being recalled*

Exploring the issue of whether retrospective ratings of pain are based on recollections of the prior pain *per se*, or upon previous pain *ratings*, is necessary in order to further an understanding of the way pain is remembered. Previous research investigating recall for both the intensity and quality of pain has made the assumption that correct endorsement of a previously selected verbal pain descriptor is a reflection of the participant's memory for pain. But the act of correctly endorsing pain descriptors selected whilst in pain cannot indicate whether prior pain events are being remembered, whether it is the prior pain descriptions which are being remembered, or if recollections are being constructed on the basis of other recalled information. An alternative and more direct method of assessing pain memory than those employed up to now would be to ask participants to make judgements about the nature of their recollective experience. A widely used experimental memory research paradigm is to require participants to make 'remember' and 'know' judgements about descriptors recalled as being previously presented in a word list (e.g., Tulving, 1985; Rajaram, 1993). A remember judgement is taken to reflect episodic awareness, whilst a know judgement is taken to reflect semantic and/or implicit recollection. This paradigm could be adapted whereby participants recalling a prior pain episode could be asked to decide whether their memory includes a recollection of the pain itself, or a recollection of using a particular word to describe the pain, or both.

2.4.3.5 Inferring the extent to which recollections rely upon episodic and semantic memory

Two previous studies (Brodie and Niven, 2000; Niven and Brodie, 1995) have investigated the relative involvement of episodic and semantic memory in the provision of retrospective ratings of expected acute pain. In these studies, ratings of pain experiences made whilst in pain and subsequent recollections of the pain were compared with estimates of the same kind of pain made by participants who had no episodic experience of the pain. The next chapter reports an extension of this study, which investigates the consistency of pain estimates made by participants with no first-hand experience of varicose vein surgery. A finding in agreement with Brodie and Niven's – whereby there are few differences in reports made by the participants who had experience of the pain and participants who only provided non-experiential estimates – would call into question the extent to which Retrospective reports can be considered to reflect 'memory' for pain. Moreover, such a finding would confirm the need to utilise an alternative method of assessing the recollective experience of pain to the ones previously employed. That is, one which employs a more direct method of investigating the phenomenological experience of recalling the quality and intensity of an acute pain event.

2.4.3.6 Are the sensory, affective and evaluative components of a pain experience differentially recalled?

This study did not investigate the relative consistency of the sensory, affective and evaluative components of pain. Kappa could not be calculated for the affective/evaluative dimensions of pain in the current study because of the small number of SF-MPQ categories and because participants relatively infrequently used these descriptors. Further research is required to investigate whether these aspects of pain are recalled differentially.

2.5 Conclusion

In agreement with previous studies, using a similar research design and methodology, and in line with the first hypothesis, the Retrospective ratings of pain using the SF-MPQ and a VAS reliably reflected Actual pain ratings made whilst in pain. However, a major limitation of this research design is that it is unable to tell us whether the Retrospective reports reflect memory for the pain experience, or whether recollections are based on other non-experiential knowledge, for example, of what the pain in question 'should' be like. In addition, there is a need to investigate whether the reasonably accurate Expectations are due to the comprehensive information provided about the likely nature of the postoperative experiences, or whether it is possible that such estimates can be made without such preparatory information. The study reported in the next chapter seeks to investigate this issue and to repeat and extend the work of Brodie and Niven (2000).

Central to this investigation was the question of whether the lack of agreement observed in the qualitative ratings observed in previous research is related to the type or presentation of pain assessment tool, or the type of pain being assessed. Contrary to the second hypothesis, our findings again concurred with those reported in prior research inasmuch as the qualitative dimensions of pain appeared to be less accurately recalled than intensity. However, the possibility that retrospective reports communicate the 'defining' qualitative nature of pain rather than the 'fine-grained' pain descriptors requires further investigation.

Finally, the data from the present study indicate that anxiety appears to be positively associated to the Expectations of pain, Actual pain ratings and Retrospective ratings of pain intensity, but contrary to our third hypothesis, there was no significant evidence to indicate that ratings of anxiety are associated with pain recall accuracy. However, due to the present study's small sample size and the limitations imposed by this, the relationship between anxiety and recollections of pain needs to be investigated further.

CHAPTER THREE: STUDY TWO – A COMPARISON OF NON-EXPERIENTIAL ESTIMATES AND PATIENTS' REPORTS OF THE QUALITY AND INTENSITY OF POSTOPERATIVE PAIN

3.1 Introduction

The previous chapter and prior research (Beese and Morley, 1993; Niven and Brodie, 2000; Terry and Gijsbers, 2000), have shown that verbal pain descriptors selected from the MPQ (or its Short Form) to express recollections of acute pain are often different to those chosen whilst in pain. It has been argued that this lack of consistency in pain descriptor use reflects that the qualitative nature of pain may be less well recalled than the intensity of a pain experience.

The issue of how accurately expected acute pain can be recalled is further complicated by the apparent similarities that have been observed between reports of an actual pain event, made by those who have experienced it, and estimates made by those with no personal experience of the pain (Niven and Brodie, 1995; Brodie and Niven, 2000). This finding has been interpreted to indicate that retrospective ratings of the qualitative nature of pain are not necessarily based solely on recollections of the pain experience. In fact, the similarities between ratings made by those who have experienced a particular pain and estimates made by those who have not, leads us to question the extent to which retrospective reports of pain can be taken to reflect 'memory for pain' at all.

However, this conjecture has been based on two relatively low-powered investigations of labour pain and menstrual pain, for which non-experiential general knowledge is widely available. It may be that the apparent similarities between pain ratings made by those with personal experience of the pain, and by those simply making estimates, are due to the type of pain being assessed. To further investigate this possibility, the study reported in this chapter sets out to assess the extent to which individuals with no personal experience of vascular surgery are able to provide estimates of the quality and intensity of postoperative pain following varicose vein removal and to compare these with the ratings made by the patients reported in Chapter Two. Finding no systematic differences between patients' reports and non-patient participants' estimates of this more 'unusual' type of pain event would call into question the extent to which retrospective ratings can be taken to reflect 'memory for pain'. Such a finding would not necessarily indicate a lack of episodic awareness when providing retrospective ratings of pain, but would suggest that the recollective experience involved in memory for pain needs to be investigated using a more direct method. The first aim of this study, then, was to compare estimates of postoperative pain following varicose vein surgery made by non-patient participants, with ratings made by the participants undergoing vascular surgery (detailed in Chapter Two) using a research methodology similar to that employed in Brodie and Niven's (2000) study.

3.1.1 Information provision and ratings of pain

In the first preliminary study, reported in the previous chapter, the patients undergoing surgery for varicose veins were able to give broadly accurate ratings of pain intensity and pain quality prior to surgery (that is, to provide appropriate ratings of Expectations of postoperative pain). Prior to describing their expectations, the patients had all received comprehensive written information about day surgery for varicose veins (shown in Appendix 1.2). Patients also had access to numerous other sources of information, including their anaesthetist, surgeon and other medical staff, in addition to other unknown sources such as that provided by friends, family and so on.

It might be reasonable to suppose that the extent of non-experiential knowledge or information about a particular pain event (i.e. semantic knowledge) will influence the content and consistency of pain estimates and the extent to which they are comparable with ratings given by patient participants. A further aim of this study, then, was to investigate the extent to which specific information about a pain event might influence expectations of the nature and intensity of pain. This may be investigated by manipulating the type of information given to non-patient participants, and comparing the estimates by non-patient participants with patients' ratings of their Actual pain experiences. More specifically, this study was designed to obtain estimates of pain made by participants given the same leaflet as the patient participants, and compare these to a further group of participants given very limited information about the nature of postoperative pain for varicose vein surgery. Thus, in the present study, one group of participants was provided with the same detailed written information leaflet about postoperative pain as was given to the vascular surgery patients. This information leaflet (referred to in this study as the 'Long Leaflet', shown in Appendix 1.2) contained comprehensive information about the surgery and postoperative experiences, including specific references to postoperative pain and its management. A second group of participants were provided with a very short information leaflet (the Short Leaflet group, shown in Appendix 2.1), which provided no specific information about the likely nature of postoperative pain.

Like the participants in Brodie and Niven's (2000) study, it was assumed that non-patient participants would draw on their previously held semantic knowledge of related events in order to provide estimates of postoperative pain following varicose vein surgery. Thus, whilst the Short Leaflet group was required to make estimates based on whatever previously held knowledge they had available to them, the Long Leaflet group had available to them new semantic knowledge on which they could base their estimates. By requiring participants in both groups to read their respective Long or Short Leaflets before making an estimate of pain and some weeks later to recall this estimate and provide a further rating, the stability of newly acquired semantic knowledge, may be compared to the stability of 'old' semantic knowledge. In turn, the consistency between the estimates can be compared to those provided by the patient participants, who had available to them a combination of episodic and semantic knowledge when providing their retrospective ratings of pain. It might be expected that participants making repeated estimates of pain for which they had no new episodic or semantic information (i.e. the Short Leaflet group) may be reasonably consistent in making repeated ratings of pain, but less likely to select appropriate descriptors to provide estimates of the qualitative nature of the pain. If the Long Leaflet participants read the leaflet prior to providing an estimate of the likely nature of the pain and were then required to provide a further estimate some weeks later without referring back to the leaflet, the stability of semantic memory may be less consistent.

3.1.2 Aims

1) To compare the estimates of the intensity and quality of postoperative vascular surgery provided by two groups of non-patient participants, with the pain ratings made by the patient participants in Study One. If, as Brodie and Niven (2000) found, there are few differences between patients' pain reports and non-patient estimates of pain, the extent to which the retrospective pain reports made by the patient participants can be taken to reflect 'memory' of the postoperative pain might be called into question.

2) To use Kappa to investigate the consistency of two repeated estimates of postoperative pain given by the non-patient participant groups and to compare these kappa values to

those reflecting agreement between the patient participants' Actual and Retrospective qualitative ratings of pain.

3) To investigate whether differences in information provision had any effect on pain rating consistency.

3.1.3 Hypotheses

Comparisons between Short and Long Leaflet groups:

1) It was hypothesised that the Short Leaflet group would be more consistent in their estimates of postoperative pain than the Long Leaflet group.

Comparisons between vascular surgery patients' ratings and non-patient participants' ratings:

2) It was hypothesised that whilst many similarities would be observed between the pain estimates given by the Long Leaflet participants and the patient participants (as found by Brodie and Niven, 2000 and Niven and Brodie, 1995), more differences would be found when comparing the ratings by the patient participants with the estimates made by the Short Leaflet group.

3.2 Method

A flow diagram detailed in Figure 3.1 details the methods and procedure of the present study.

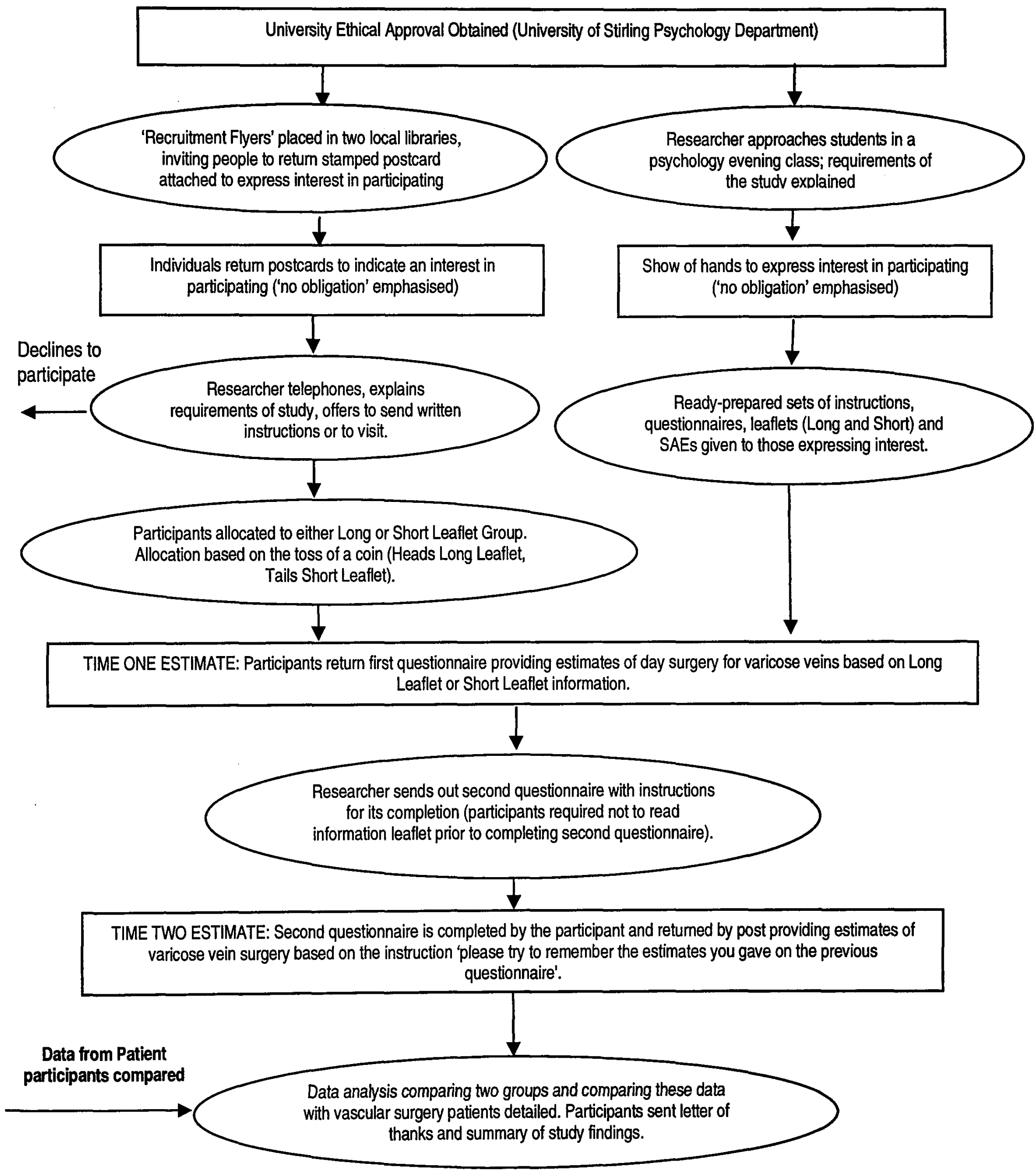


Figure 3.1. *Flow diagram of Preliminary Study Two procedure*

3.2.1 Design

The study employed a within and between subjects design. The study required two groups of non-patient participants to provide two estimates of the likely nature of postoperative pain following varicose vein surgery, based on the information provided by either a comprehensive information leaflet (the Long Leaflet) or on a shorter, less informative leaflet (the Short Leaflet). Both groups made two estimates of pain, an estimate at Time One, immediately after reading either the Long or the Short information leaflet, and a further estimate three weeks later at Time Two, when participants were required to provide estimates of pain without referring back to the information leaflet. The two estimates from each of the Leaflet groups were compared (within group and between groups) and were also compared with the data from patients with varicose veins patients.

3.2.2 Participants

Participants were adults aged between 26 and 84 years of age all of whom spoke fluent English. None of the participants had recently undergone any surgery, or were expecting to undergo surgery in the foreseeable future. None of the participants had ever had varicose vein surgery.

3.2.2.1 Participant recruitment

Participants were recruited through advertisements placed in two local libraries and from evening psychology classes at the University of Stirling. Library flyers were printed on yellow A4 paper inviting people to complete and return an attached stamped postcard to the researcher to indicate an interest in participating. One set of library flyers invited people between the ages of 26 and 72 to participate. Towards the end of the study a further set of flyers invited people over the age of 50 to reply, in an attempt to match the age of the vascular study participants. A further number of other university staff and students were recruited via participants indicating that they knew of other people who would be interested in the research (snowballing method). Participants were not offered any payment or incentive for participating. However, participating psychology students (n=8) earned a 'yellow card', which fulfilled part of their course requirements.

3.2.3 Materials

3.2.3.1 The questionnaires

The questionnaires to be completed at Time One and Time Two were almost identical. The questionnaires (shown in Appendix 2.3) were designed to be as similar as possible to those given to the vascular surgery participants. Although the questionnaire asked about issues other than pain (for example, about anxiety), only the data relating to pain were reported in this study. Changes in the wording were made as necessary to refer to the fact that the participants were required to make estimates of a non-experienced pain situation, based on the leaflet they had received.

3.2.3.1.1 Measures

As in the first preliminary study, the Short Form McGill Pain Questionnaire (SF-MPQ) was used to obtain estimates of pain quality and intensity at each assessment time. A VAS (a 100 mm line anchored by the words 'No Discomfort' and 'Worst Possible Discomfort' at each end of the line) was used to obtain an estimate of pain intensity.

3.2.3.1.2 Information leaflets

Participants were asked to read one of the two aforementioned leaflets. The Long Leaflet (also given to the vascular surgery patients by their consultant surgeon who was the author of the leaflet) was about 3,500 words in length and contained information about why varicose veins occur, what they are, options for treatment, surgery waiting times, anaesthetics, alternatives to surgery, expected length of time in hospital, pre and postoperative procedures, pain, wound and wound dressing management, coping at home following surgery, resuming normal activities, possible complications and problems. The Short Leaflet (around 500 words in length) contained information of a very general nature and did not cover in detail the topics discussed in the Long Leaflet. In relation to pain and pain management, the Short Leaflet indicated that pain killers may be required and would be provided, but no specific descriptions of any postoperative pain were given.

3.2.4 Procedure

Ethical approval was obtained from the University of Stirling Psychology Department Ethics Committee. All participants returning postcards from library flyers were telephoned and the study explained in more detail. Specifically, it was explained that the study was an extension to some previous work with patients who had undergone varicose vein surgery and that the aim of the study was to investigate the effectiveness of different kinds of health-related information. Once an opportunity for questions had been given and any queries discussed, the researcher asked if the participant would be happy to participate. This, together with the return of the first questionnaire, was taken as an indication of informed consent. Participants were given the choice of either having the leaflet and questionnaire sent to them, along with written instructions for its completion, or for the researcher to visit the participant and explain the study verbally, as well as leaving the written instructions for clarification. Only four participants opted for the researcher to visit. All other participants were sent the questionnaire by post and told that the researcher would phone again in the coming few days to ensure that the questionnaire had been received, and to check if there were any problems or queries raised. Written instructions were enclosed with the questionnaire along with a stamped addressed envelope in which to return the questionnaire. When the follow-up phone call was made most participants had either already completed the form, or said that there were no problems and that completion seemed straightforward. Prior to making contact with individuals returning the postcard from the library flyers, or individuals recruited by the snowballing method, these potential participants were allocated to a group by the toss of a coin. Evening class students were handed pre-prepared sets of instructions, questionnaires and leaflets, with alternate sets containing either the Long or the Short Leaflet.

The second questionnaire, to be completed at Time Two, was sent to the participants who returned the first questionnaire, about three weeks after the first questionnaire had been returned to the researcher. Prior to completing the questionnaire at Time Two, it was explained to participants that they should think back to the time when they provided their last estimate, rather than read the information leaflet again, and to base their second estimates on their recollections of the rating made at Time One.

3.2.5 Statistical analysis

3.2.5.1 Power calculation

The study was designed to obtain estimates of pain from the same number of participants as the study reported in Chapter One. Using the data relating to the patients' Expectations of pain, a similar sample size to that obtained in the study reported in Chapter Two was deemed adequate.

3.2.5.2 Data handling and specific analyses

Data were analysed using SPSS and Excel as appropriate. All raw data were entered into Excel spreadsheets which were set up to calculate the Number of Words Chosen (NWC), PRI ratings and the 2x2 tables (the numbers of words endorsed/endorsed, not endorsed/not endorsed, etc) required for the calculation of Kappa (which was carried out using SPSS). Data were then screened according to the guidelines given in Tabachnick and Fidell (2001).

The investigation of differences between participant groups and time was carried out using ANOVAs. Planned comparisons between patient and Leaflet groups were made according to the hypotheses outlined above. More specifically, when differences between the patients and non-patients had been hypothesised, planned comparisons (Helmert contrasts) were used to investigate these differences. In the first part of the analyses, differences between groups were investigated. In the second part of the analyses, the Long and Short Leaflet groups were compared with patient participants.

3.3 Results – Part One

This results section is reported in two parts. In Part One, data from the non-patient participants are analysed. In Part Two, these data are compared with those obtained from the patient participants detailed in the previous chapter.

3.3.1 Screening procedures and participant details

A total of 73 people initially agreed to participate in the study. Table 3.1 details the study sample sizes, and the participants' gender and age. Sixty people returned the first questionnaire, and 52 completed both questionnaires. The return rate for both questionnaires was just over 71%, comparable to the varicose vein study, in which just over 70% of the participants returned all three questionnaires. SF-MPQ and VAS data were screened for outliers according to Tabachnick and Fidell (2001), by transforming raw data to *Z* scores and screening for *Z* scores greater than 3.3 and detached from the histogram of other scores. In total, two participants were removed from the final analyses (screening details can be found in Appendix 2.4). The remaining 50 participants' age and gender according to Leaflet group are shown in Table 3.1 below. There were no significant differences between age of participant in each of the non-patient participant groups, and no differences in age between patient and non-patient participant groups ($p<0.05$). No differences between gender were observed in any of the pain ratings ($p<0.05$)

	Long Leaflet	Short Leaflet	All participants
Number contacted	38	35	73
Completing Time 1	32 (12M 20F)	28 (13M, 15F)	60 (25M 35F)
Completing Time 1 & Time 2	28 (10M 18F)	24 (11M 13F)	52 (21M 33F)
Removed final analyses	1 (1F)	1(1F)	2 (2F)
Final Data set	**27 (10 M, 17F)**	**23 (11M 12F)**	**50 (21 M, 29F)**
Age (sd)	46.2 (13.6)	47.2 (15.5)	

Table 3.1. Participants' age and gender details, assigned to read either the Long or Short Leaflet

3.3.2 Pain ratings using the SF-MPQ and VAS

Table 3.2 provides summary statistics for VAS ratings, SF-MPQ-PRI ratings and NWC on each questionnaire.

	Short Leaflet		Long Leaflet	
	Time 1	**Time 2**	**Time 1**	**Time 2**
100 mm VAS (sd)	47.6 (23.0)	48.5 (23.3)	47.7 (18.7)	57.1 (20.2)
Total PRI (sd)	13.0 (8.7)	11.8 (8.8)	14.8 (6.9)	16.1 (7.8)
Sensory (sd)	10.6 (7.9)	9.3 (7.5)	12.4 (6.4)	13.6 (6.6)
Affective/evaluative (sd)	2.4 (1.9)	2.3 (2.3)	2.4 (1.4)	2.6 (2.1)
NWC (sd)	6.9 (3.5)	7.4 (3.9)	8.3 (3.7)	9.6 (3.7)

Table 3.2. Mean estimates (sd) of postoperative pain using the VAS, SF-MPQ PRI (total, sensory and affective/evaluative) and NWC for the Long and the Short Leaflet groups.

VAS ratings:

A 2 (Time) x 2 (Leaflet group) repeated measures ANOVA, carried out for VAS ratings, revealed a significant main effect for Time ($F(1,48) = 6.102$, $p = 0.02$) and a significant interaction of Leaflet group x Time ($F(1,48) = 4.19$, $p = 0.05$). This was due to the intensity estimates for the Long Leaflet group being significantly greater at Time Two than at Time One ($t(1,26) = -2.91$, $p<0.05$) whilst for the Short Leaflet group, there were no significant differences between estimates; t (1,22) = -0.36, $p>0.05$). No main effect for Leaflet group was observed ($p>0.05$).

SF-MPQ ratings:

Total Mean PRI ratings ranged from 11.8 to 16.1. A 2 (Time) x 2 (Leaflet group) repeated measures ANOVA was carried out for MPQ PRI total, sensory, and affective/evaluative ratings. No significant main effects or interactions were observed for any of the ratings ($p>0.05$).

Number of SF-MPQ words chosen (NWC):

A 2 (Time) x 2 (Leaflet group) repeated measures ANOVA revealed a significant main effect for Time ($F(1,48) = 4.37$, $p = 0.042$), where participants used more words at Time Two (Long Leaflet 9.6; Short Leaflet 7.4) than Time One (Long Leaflet 8.3, Short Leaflet 6.9) and a marginally significant effect for Leaflet group ($F(1,48) = 3.1$, $p= 0.059$), where the Long Leaflet group selected more words than the Short Leaflet group. No significant interactions were found.

3.3.3 Correlations between pain estimates

Estimates of postoperative pain (measured by the VAS, PRI values, and NWC) given on the questionnaires completed at Time One and Time Two by both participant groups were significantly correlated ($p<0.01$) and are detailed in Table 3.3. The r values obtained from the Short Leaflet group ranged from .72 to .88. The correlations between estimates made by the Long Leaflet group were weaker but still statistically significant, with r values ranging from .47 to .64. The strengths of these correlations were significantly greater for the Short Leaflet PRI estimates than the Long Leaflet estimates (r = .47 for the Long Leaflet and r = .82 for the Short Leaflet: $X^2 = 4.5$, $p<0.05$) and for the Short Leaflet VAS estimates (r = .64 for the Long Leaflet and r = .88 for the Short Leaflet: $X^2 = 4.17$, $p<0.05$). The strength of the correlation between the NWC at Time One and Time Two for the Long and the Short Leaflet group were not significantly different ($p>0.05$).

	PRI Time 1 & Time 2	**VAS** Time 1 & Time 2	**NWC** Time 1 & Time 2
Long Leaflet	.47*	.64**	.57*
Short Leaflet	.82**	.88**	.72**

Table 3.3. Correlations between PRI and VAS estimates from Time One and Time Two for the Long and Short Leaflet groups (= $p<0.01$ ** $p<0.001$)*

3.3.4 Comparison of pain estimates made at Time One and Time Two using Kappa analysis

Kappa was used to investigate the consistency of SF-MPQ descriptor selection between Time One and Time Two. Kappa was also used to investigate the consistency with which SF-MPQ descriptors and the corresponding descriptor intensity values were selected at Time One and Time Two.

The mean Kappa values reflecting agreement between estimates made at Time One and Time Two (descriptors only) for the Short Leaflet group was .63, which Fleiss (1981) suggests reflects 'good' agreement between estimates. For the Long Leaflet group, the mean Kappa value (.51) fell into the 'fair' range of values. Kappa values reflecting agreement between descriptor plus intensity estimates were lower; .25 for the Short Leaflet and .36 for the Long Leaflet. Independent *t* tests found that there were no differences in Kappa values between Leaflet groups ($p > 0.1$) for the descriptor plus intensity Kappa values or for descriptors only.

	Descriptors only		**Kappa (descriptors and intensity)**	
	Short Leaflet	**Long Leaflet**	**Short Leaflet**	**Long Leaflet**
Mean κ (sd)	.63 (.28)	.51 (.28)	.25 (.29)	.36 (.28)

Table 3.4. Kappa values reflecting agreement between SF-MPQ descriptors selected at Time One and Time Two, and agreement between descriptor plus intensity selection for Long and Short Leaflet groups.

3.4 Results – Part Two

The results reported below compare the pain ratings from vascular surgery patient participants with the estimates made by non-patient participants.

3.4.1 NWC, PRI ratings, and VAS

Table 3.5 shows the PRI ratings, NWC and VAS ratings for Long Leaflet and Short Leaflet non-patient participant groups and for the patient participants. A series of 2(Time) x 3 (Participant Group: Long or Short Leaflet group or patients from Study One) ANOVAs were used to investigate differences between the PRI, VAS and NWC in each group.

		Participant Group		
Pain Measure	**Rating Time**	**Short Leaflet**	**Long Leaflet**	**Vascular patients**
Total PRI	Time 1/Expectations	13.0 (8.7)	14.8 (6.9)	9.5 (5.5)
	Patients' Actual ratings	-	-	8.0 (5.1)
	Time 2/Retrospective	11.8 (8.8)	16.1 (7.8)	9.1 (6.5)
NWC	Time 1/Expectations	8.3 (3.7)	6.9 (3.5)	5.9 (3.0)
	Patients' Actual ratings	-	-	5.6 (3.1)
	Time 2/Retrospective	9.6 (3.7)	7.4 (3.9)	5.9 (3.6)
VAS	Expectations/Expectations	47.6 (23.0)	47.7 (18.7)	33.8 (17.5)
	Patients' Actual ratings	-	-	28.1 (16.2)
	Time 2/Retrospective	48.5 (23.3)	57.1 (20.2)	30.1 (17.3)

Table 3.5. Comparison of PRI values, NWC and VAS ratings for non-patient participants and patients across each rating time

PRI Ratings: A 2 (Time) x 3 (Participant group) ANOVA found no main effect of time, but a significant effect of Participant group ($F(2,71) = 6.94$, $p=0.002$. There was no significant interaction between Time and Participant group. Planned comparisons (Helmert contrasts) and the plot shown in Figure 3.2 show that the patient participants reported significantly lower PRI ratings than the non-patient participants ($F(1,71) = 10.15$, $p<0.001$)

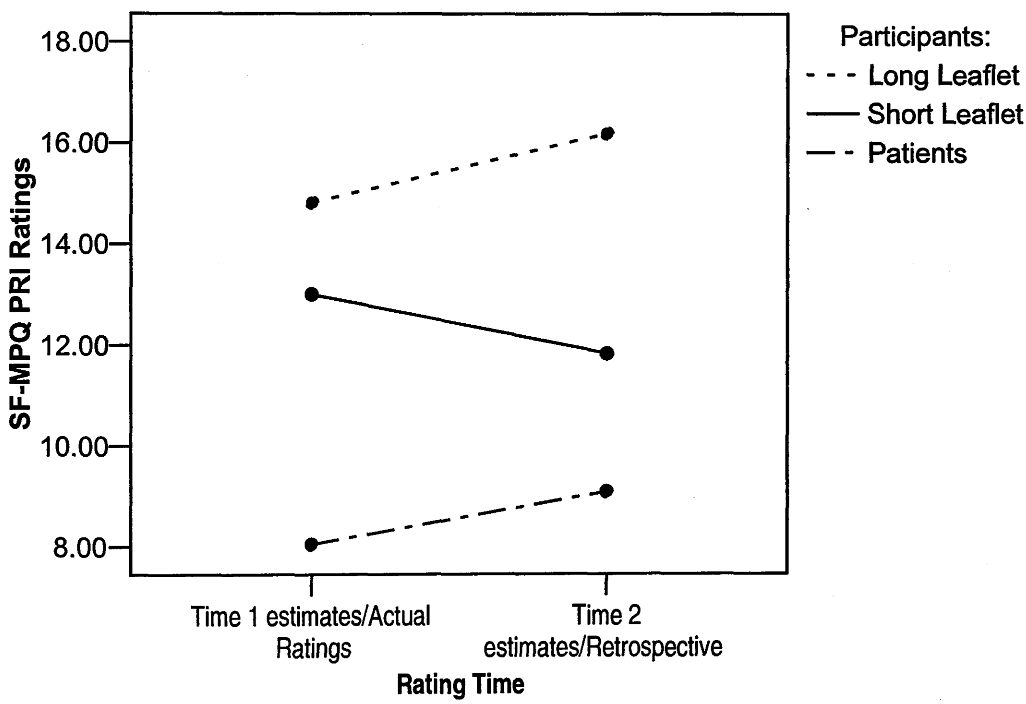


Figure 3.2. PRI Actual and Retrospective ratings of pain from patient participants and PRI estimates from non-patient participants at Time One and Time Two

NWC: A 2 (Time) x 3 (Participant group) ANOVA found a main effect of time ($F(1,71) = 4.9$, $p=0.029$) and a significant effect of Participant group ($F(2,71) = 6.09$, $p=0.004$). There was no significant interaction between Time and Participant group. As with the PRI ratings, planned comparisons (Helmert contrasts) show the differences between the patients and the non-patient groups to be significant ($F(1,71) = 7.82, p=0.004$; illustrated in Figure 3.3).

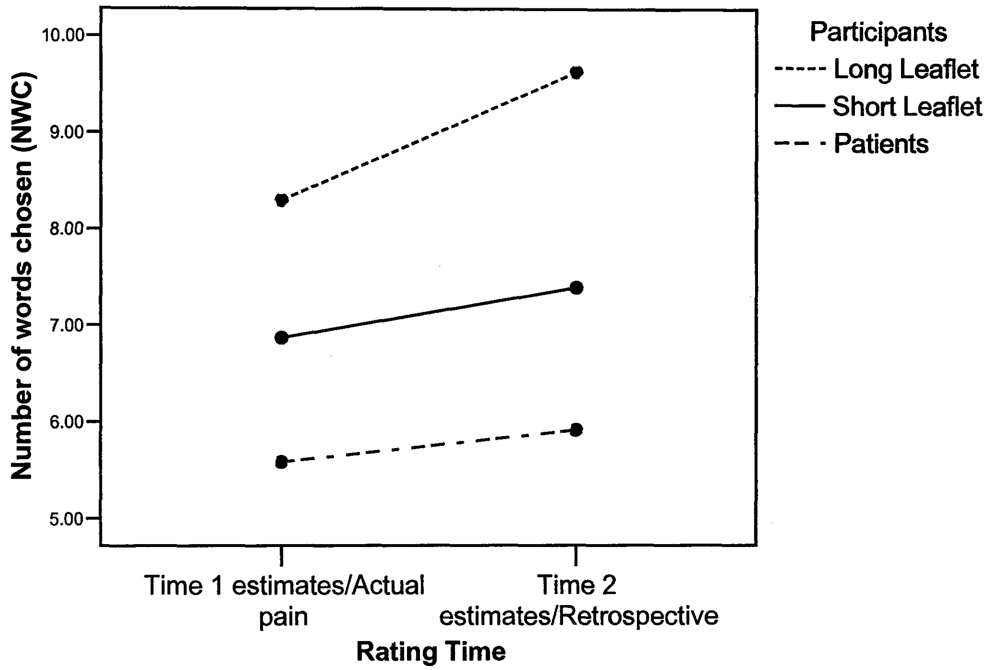


Figure 3.3. Numbers of Words Chosen for Actual and Retrospective ratings of pain by patient participants and non-patient participants at Time One and Time Two

VAS Ratings: A 2 (Time) x 3 (Participant group) ANOVA found a main effect of time ($F(1,71) = 6.91, p=0.01$) and a significant effect of Participant group ($F(2,71) = 10.522, p<0.001$). There was no significant interaction between Time and Participant group. Again, significant differences were found between the Patient participants and the Leaflet groups ($F(1,71) = 20.0, p<0.001$), as detailed in Figure 3.4 below.

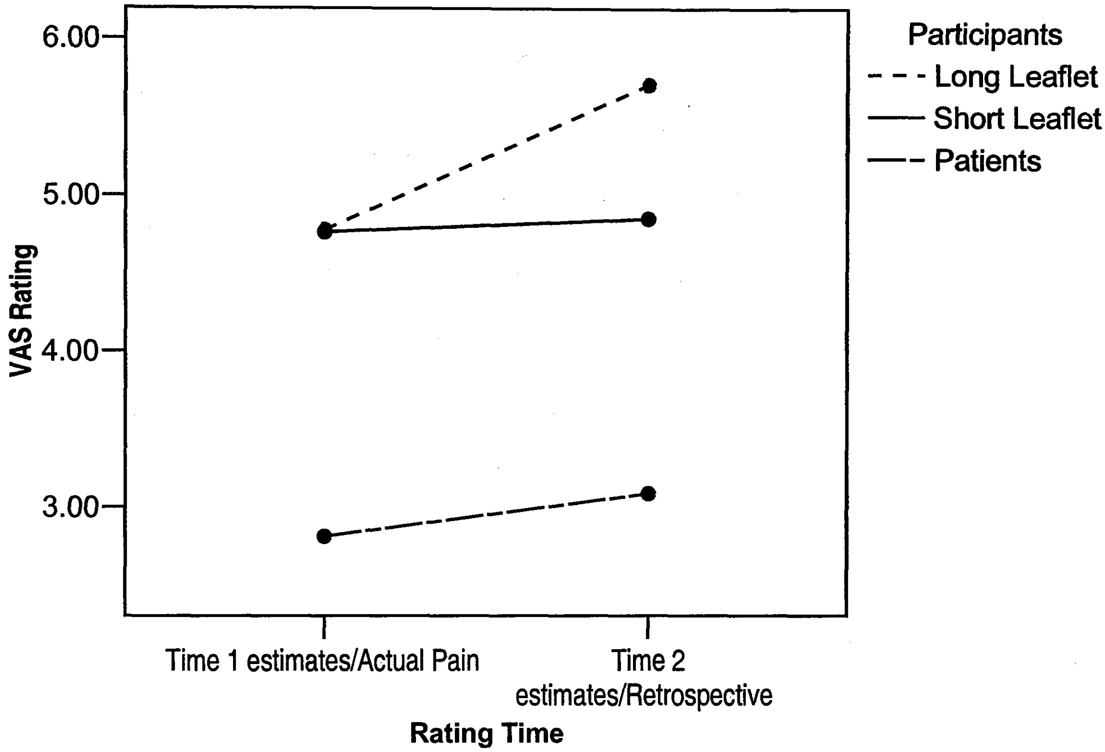


Figure 3.4. *VAS Actual and Retrospective ratings of pain from patient participants and VAS estimates from non-patient participants at Time One and Time Two*

3.4.1.1 Correlations between ratings by non-patient and by patient participants

There was a significant difference between the Patient participants and the Long Leaflet participants in the strengths of the correlations between PRI ratings. The Long Leaflet group was significantly less consistent in their PRI ratings between Time One and Time Two than the Short Leaflet group and the Patient participants (Long Leaflet r = .47; Short Leaflet r =.82, comparisons using X^2: $X^2 = 4.5, p<0.05$). No significant differences were found in the strengths of the correlation coefficients for the patients' VAS ratings and the correlation coefficients for the non-patients VAS ratings (correlations detailed in Table 3.6).

	PRI Ratings Time 1 & Time 2	VAS Ratings Time 1 & Time 2
Long Leaflet	.47*	.64**
Short Leaflet	.82**	.88**
Patient (Actual and Retrospective)	.82**	.70*

*(** p<0.01; * p<0.05).*

Table 3.6. Correlations between PRI and VAS ratings at Time One and Time Two for Long and Short Leaflet groups and between Actual and Retrospective ratings by patient participants

3.4.2 Pain Profiles: specific SF-MPQ descriptors selected by patient and non-patient participant groups

The pattern of SF-MPQ descriptors used by the Leaflet groups at Time One and the patient participants to describe Actual pain experiences are shown in Figure 3.5. The pattern of SF-MPQ descriptors used by the Leaflet groups at Time Two and the Retrospective ratings made by the patient participants are shown in Figure 3.6.

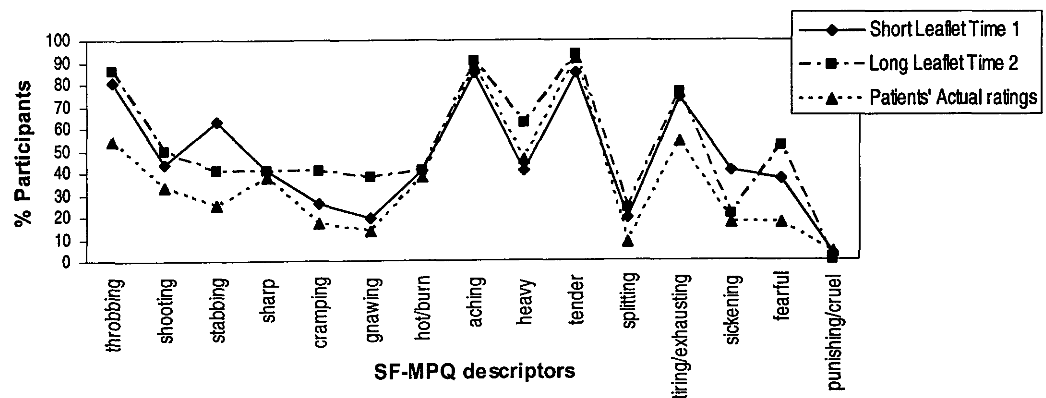


Figure 3.5. Pain Profile showing pattern of MPQ descriptors used by the Long and Short Leaflet groups at Time One and to express patient participants' Actual pain experiences.

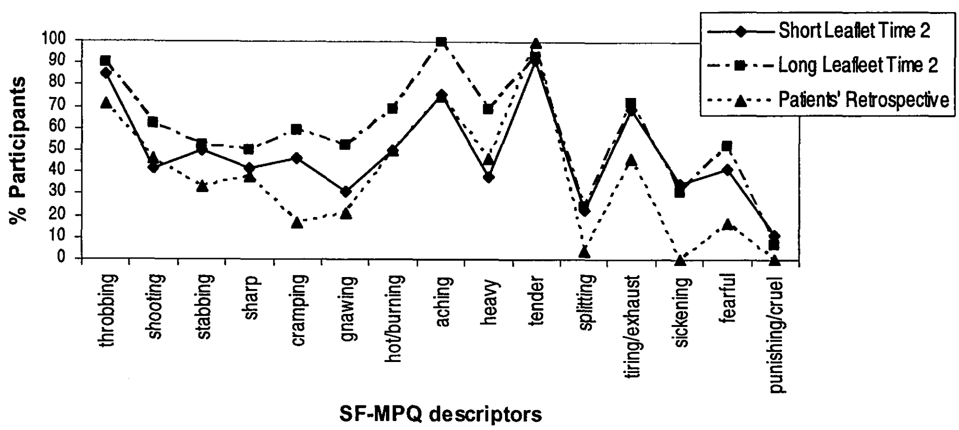


Figure 3.6. Pain Profile showing pattern of MPQ descriptors used by the Long and Short Leaflet groups at Time Two and to express patient participants' Retrospective ratings of pain.

In Figure 3.5, illustrating the pattern of the MPQ descriptors used by the Long and Short Leaflet group at Time One and Actual pain descriptors used by patient participants, it can be seen that the most frequently used SF-MPQ descriptors were aching, tender, tiring/exhausting and throbbing. The Short Leaflet group participants frequently selected the descriptor 'stabbing', and the Long Leaflet group frequently selected the descriptor 'fearful'. Figure 3.6 shows the pain descriptors most frequently selected by the non-patient participants at Time Two and the Retrospective ratings by the patient participants. This Profile shows that the most frequently used descriptors by each group were also aching, tender and throbbing. The descriptors hot/burning were frequently used, whilst the non-patient participants also frequently used the descriptors tiring/exhausting, shooting and stabbing. The affective/evaluative descriptor fearful was used by more than half of the Long Leaflet participants at both Time One and Time Two, but was not used to the same extent by the patient participants or the Short Leaflet participants.

3.4.3 Memory for pain and consistency of pain estimates using Kappa

Kappa values obtained for the non-patient Short and Long Leaflet groups were compared with patient participants' Kappa values reflecting agreement between the patients' Actual and Retrospective ratings of pain. Two one-way ANOVAs were used to investigate differences between the three participant groups' Kappa values. No significant differences in Kappa values were found between patients and non-patient participants for Descriptor Only selection consistency or Descriptor plus Intensity rating consistency. For comparison, mean Kappa values and standard deviations for both patients and non-patient Leaflet groups are detailed in Table 3.7.

Participants	**Kappa (sd)** **Descriptors only**	**Kappa (sd)** **Descriptors + intensity**
Long Leaflet	.51 (.28)	.36 (.28)
Short Leaflet	.63 (.28)	.25 (.29)
Patient (Actual and Retro)	.53 (.23)	.34 (.35)

Table 3.7. Kappa values for reflecting agreement between pain rating times/pain estimates by patient and non patient participants

3.5 Discussion

The central aim of this second preliminary study was to investigate whether participants who had no personal experience of a fairly unusual type of pain (that is, postoperative pain following varicose vein surgery) were able to provide estimates of its likely characteristics and intensity, comparable to the ratings made by the patient participants in the previous preliminary study. The study also aimed to investigate the extent to which two types of written information about varicose vein surgery may influence the nature and consistency of these estimates.

3.5.1 Comparisons between Short and Long Leaflet groups

In the section below, the data obtained from the Long and Short Leaflet groups of participants are discussed.

3.5.1.1 Comparisons of pain estimates between estimates using the VAS and the SF-MPQ

Similar ratings of pain intensity (VAS ratings) were obtained from both of the non-patient participant groups at Time One, immediately after reading their respective leaflets. However, the results suggest that, in line with our first hypothesis, participants given the Short Leaflet were more consistent in their ratings of pain intensity than those given the Long Leaflet (demonstrated by the relative strengths of the correlations between estimates provided at Time One and Time Two, detailed in Table 3.3). More specifically, at Time Two, the Long Leaflet group provided significantly higher pain VAS intensity estimates than at Time One and selected a greater number of descriptors from the SF-MPQ (NWC). Perhaps when providing the second pain estimate, if only certain salient aspects of the detailed information in the Long Leaflet were recalled out of context with the rest of the patient information (for example, details of the surgical process) this may have led participants to estimate the postoperative pain as being more severe than when estimates were made immediately after reading the leaflet, if other contextual (and perhaps less startling) information was not retained. It is widely observed that any factor (such as emotion) which increases the distinctiveness with which information is encoded results in that information being more easily recalled (Christianson, 1992; Rajaram, 1993; Bradley, 1994; Rajaram and Roediger, 1997).

On the other hand, the increase at Time Two from Time One for the Long Leaflet participants was not significant for the PRI estimates. That is to say, the differences in the estimates given by the Leaflet groups are reflected in the VAS intensity ratings and the NWC only. Further research is required to examine the influence of preoperative information on expectations with regard to the timing of the information provided. The data obtained in this study only allow us to speculate on the reasons for increase in intensity estimates for the Long but not for the Short Leaflet participants.

3.5.1.2 Comparisons between qualitative estimates of pain

Both the Long and Short Leaflet groups used a similar pattern of words to provide estimates of postoperative pain following varicose vein surgery (see Figure 3.5), although, as noted above, the Long Leaflet group tended to use more SF-MPQ descriptors than the Short Leaflet group (see Table 3.2). The Kappa values reflecting the consistency of descriptor plus intensity selection by the Long Leaflet group were better than the Kappa values for the Short Leaflet group (Long Leaflet group, Kappa = 0.36; Short Leaflet group, Kappa = 0.25). But the consistency of descriptor selection only was *poorer* for the Long Leaflet group (Long Leaflet group: Kappa = 0.51; Short Leaflet group: Kappa = 0.63). The data obtained in this study, then, provides little evidence that the provision of detailed information about the likely experiences of postoperative pain has a systematic influence on the consistency with which varicose vein pain was described.

3.5.2 <u>Comparisons between patients and non-patient participants</u>

3.5.2.1 Pain intensity ratings and qualitative descriptions

By comparing estimates of pain with actual pain ratings, Brodie and Niven (2000) suggested that the involvement of semantic and episodic knowledge in pain recollections could be examined. In the present study, finding few differences between ratings of pain given by the patient participants and the estimates of postoperative pain following varicose vein surgery given by non-patient participants, may call into question the extent to which ratings of previously experienced pain events can be assumed to reflect memory for that pain.

The numerical estimates of pain from the non-patient participants (PRI ratings, VAS ratings and NWC), were significantly higher than the comparable ratings made by the patient participants (see Figures 3.2, 3.3 and 3.4 above). One reason for the greater number of words selected by the non-patient participants might be that the patient participants were also given specific information by their consultant surgeon and other medical staff, in addition to the written information. Additional information would also have been available regarding options for postoperative pain management, which may have reassured patients that postoperative pain would be manageable and led to the more realistic expectations of pain demonstrated by the vascular surgery patients. Niven and Brodie (1995) and Brodie and Niven (2000) also found that participants who had not experienced labour pain or dysmenorrhoea tended to use more words and rate the pain as more intense compared to participants who had experienced the pain. These findings suggest that those who have actually experienced the pain may be more sure of what the pain is *not* like, whilst those with no first-hand experience of the pain provide estimates which include pain descriptors to express sensations which *might* be experienced, or 'worst case' scenarios. Of note, however, is that the non-patients' pain estimates were more in line with those reported by other studies which have assessed postoperative pain using the SF-MPQ. McDonald and Weiskopf (2001) reported mean SF-MPQ PRI ratings of 14.6, whilst Melzack (1987) reported two sets of postoperative pain ratings using the SF-MPQ of around 15.5. Perhaps the vascular surgery patients in the first study (Chapter Two) were fortunate enough to have a particularly skilled vascular surgeon and anaesthetists providing effective local anaesthetic blocks!

Although measures of pain intensity were higher for the non-patient participants than for the patient participants, a similar pattern of pain descriptors was used by both patient and non-patient participants (see Pain Profiles in Figures 3.5 and 3.6 above). Brodie and Niven (2000) and Niven and Brodie (1995) also observed many similarities when comparing qualitative ratings of labour pain and dysmenorrhoea with non-experiential estimates. Earlier research found that individuals in non-medicalised societies were able to rank the likely intensity of various pains which they had not personally experienced (Morse, 1989). The findings of the present study indicate that it is also possible for individuals with no personal experience of a fairly unusual pain to provide a detailed description of the likely qualitative nature of the pain, which closely matches the patients' reports of their actual experiences. Surprisingly, and contrary to our second hypothesis, the largest discrepancies between the qualitative descriptions of pain tended to appear between the vascular surgery patients and those given detailed written information (Long Leaflet group) about the procedure. Participants given very little information were able to provide descriptions which were surprising similar to those made by the patient participants.

3.5.3 Episodic and semantic memory in recollections and estimates of postoperative pain

Brodie and Niven (2000) found few differences between the estimates of dysmenorrhoea and the pain ratings made by women who regularly experienced dysmenorrhoea. This may have been due to the fact that generally, even women who do not experience menstrual pain still know enough about it to give 'plausible' estimates of what it is likely to feel like. In this study, greater differences between the Short Leaflet participants and the patients were expected as it is less likely that these non-patient participants would have the same level of semantic knowledge as young women might have about dysmenorrhoea. However, this study has shown that it *is* possible to provide estimates of a pain which is not widely portrayed or known about; the Short Leaflet participants were apparently giving ratings of pain which were more similar to those provided by the patient participants than the Long Leaflet group.

Niven and Brodie (1995) suggest that episodic recollections of labour pain may not play as crucial a role as might be expected in recalling the quality of labour pain, and that non-experiential information may need to be taken into account when measuring the ability to recall the quality of pain. However, as episodic memory refers to memory which is accompanied by a *conscious recollection* of specific aspects of the events, the differences between semantic and episodic memories are most salient if the states of awareness accompanying the recollection are taken into consideration. For example, a participant may 'remember' the aching pain experienced postoperatively, or may simply 'know' that an ache was experienced, due to a recollection of telling another person about the aching pain. The former reflects episodic memory, whilst the latter reflects semantic recollection. The findings of this study in conjunction with those reported in Chapter Two, demonstrate the need to take into account the distinction between 'remembering' and 'knowing' about previously experienced events if further advances towards understanding the phenomenon of 'memory for pain' are to be made.

3.5.3.1 Kappa reflecting agreement between estimates by the non-patient participants in comparison to Kappa reflecting agreement between pain ratings made by patient participants.

There were no significant differences in the Kappa values between the Long and Short Leaflet group and the patient participants. Recollections of semantic knowledge – on which the non-patient participants based their information – is apparently at least as stable as the combination of episodic and semantic memory on which the patient participants based their recollections of postoperative pain.

3.5.4 Limitations

3.5.4.1 Sample size

It can be argued that the lack of differences between the leaflet groups may be due to the study's low statistical power. The data obtained from this study may be more valuable if considered in relation to the findings of prior studies (e.g. those of Niven and Brodie, 1995 and Brodie and Niven, 2000). The relatively small sample size also limits the type of statistical analysis that can be carried out on the data. A study with a larger number of participants would allow for multiple regression analyses to be performed in order to investigate the relative influences of selected variables.

3.5.4.2 Randomisation

Participants were allocated to leaflet groups by tossing a coin. However, this was done each time a participant was recruited. Randomisation guidelines for medical research suggest that if this kind of randomisation technique is used, it should be carried out and a list of allocations produced, before participants are recruited (Bland 2000). Ideally, randomisation should be carried out using a computer-generated random number table. The extent to which expectations are influenced by information could be better investigated with a much larger sample and randomised controlled experimental design. For the purposes of the current study, the method of randomisation was considered to be acceptable.

3.6 Conclusion

In spite of the fact that general knowledge of varicose vein surgery is less widely available than general knowledge of dysmenorrhoea, and although some differences were observed between the patients and non-patient participants, this study has demonstrated that non-patient participants are able to provide estimates of postoperative pain that are similar to the ratings made by patient participants. The differences observed in the NWC and the intensity ratings suggest that non-patient participants may have attempted to 'cover all possibilities' of what the pain might be like. However, the pain estimates were surprisingly similar to those obtained in prior studies using the SF-MPQ to assess postoperative pain.

The similarities between the patients' and non-patients' qualitative ratings of pain call into question the assumption that retrospective pain reports reflect memory of previously experienced pain. However, whilst it can be argued that an individual who provides descriptions of a previous pain event may not be recalling the nature or intensity of that pain, the observed similarities between patients' and non-patients' reports do not necessarily mean we should dismiss the idea that patients are remembering their previous pain experiences. It is possible that recollective reports are accompanied by a conscious awareness of the past pain event, which would not accompany non-pain participant estimates. This phenomenological difference between episodic and semantic memory cannot be adequately investigated using the research design employed in this and prior research.

3.7 Summary of the preliminary studies reported in Chapter Two and Chapter Three

Using the SF-MPQ and Visual Analogue Scales, and a research design that has been employed in several previous investigations, the first preliminary study (reported in Chapter Two) assessed recollections of the qualitative and quantitative dimensions of pain. The findings obtained were largely in agreement with those reported in previous research in that whilst correlations between real time and retrospective ratings obtained from the SF-MPQ and the VAS were quite high, the Kappa analysis suggested that there was less agreement between the Actual pain and Retrospective descriptions of the qualitative dimensions of pain. It was argued, however, that the generally low Kappa values indicate that pain may be recalled or verbalised in such a way as to communicate only the broad defining qualities of pain.

In addition, in Chapter Three, the similarities between patients' ratings of pain and non-patients' estimates of pain following varicose vein surgery suggest that plausible descriptions of pain can be provided in the absence of *any* actual experience. Thus, the preliminary studies presented here demonstrate that it is impossible to ascertain the extent to which pain is being remembered and the extent to which participants are simply choosing appropriate words to describe a particular pain experience. For this reason, if memory for pain is to be adequately investigated, its assessment should be couched within theoretical models of memory and employ methods which have been developed to investigate the conscious experience that accompanies recollections of pain. As Tulving (1989) points out, there is no logical necessity for a relationship to exist between behaviour (or recall ability) and conscious experience. The literature review presented in the next chapter examines in more depth some of the key issues surrounding the assessment of memory and discusses some contemporary memory theories and in particular, the remember/know research paradigm, which may be used to investigate the phenomenological experience of remembering.

As expectations and anxiety are intrinsic aspects of expected acute pain events, their influence on subsequent recollections of such pain needs to be assessed. In the preliminary studies, a lack of statistical power prevented any firm conclusions being drawn about the involvement of expectations in forming recollections of a prior pain experience. It is possible that levels of anxiety are related to the ability to provide consistent reports of pain, and this needs to be investigated more systematically.

To reiterate, the issues raised in the preliminary studies which remain to be addressed in this thesis are summarised below.

Issue One. ***Is the intensity of acute pain recalled more accurately than the qualitative aspects of pain? In addition, how detailed or 'fine-grained' are recollections of the qualitative nature of pain?***

The extent to which pain can be recalled at a broader level, for example at the level of the MPQ categories which refer to specific 'types' of pain, rather than the extent to which the same pain descriptors are used at each assessment time, might be a more appropriate way in which to investigate pain recollection.

Issue Two. To what extent is previous pain 'remembered' or simply 'known' to have occurred and to what extent do retrospective ratings involve episodic and semantic memory?

An assessment of pain memory is limited unless the phenomenological awareness which accompanies the retrospective reports of the pain is considered. Distinguishing between what is consciously remembered about a prior pain experience and what is simply known to have occurred will allow advances to be made in our understanding of 'memory for pain'.

Issue Three. Do retrospective ratings reflect recollections of pain per se or prior pain ratings?

Extending the remember/know research paradigm should allow for an investigation of whether recollections of pain involve remembering the pain ratings previously given and/or remembering the pain sensation. This is discussed in depth in Chapter Five.

Issue Four. Are some aspects of the pain experiences, for example the affective or sensory components, recalled more accurately the others?

The use of the SF-MPQ prohibits an exploration of whether the affective or sensory components of pain are being recalled differentially. There is a need to examine whether pain recall accuracy is somehow being 'driven' by recollections of one or other of the different dimensions of pain.

Issue Five. ***To what extent are expectations of pain able to predict retrospective ratings of pain?***

Prior research has questioned the extent to which semantic memory and general knowledge (or previously held expectations) of what a particular pain should be like, augment retrospective ratings of prior pain events. A larger study is required which permits multiple regression analysis in order to investigate the relative extent to which expectations of pain and actual experiences are reflected in retrospective ratings of acute pain.

Issue Six. ***Is there an association between measures of anxiety and measures of pain recall consistency (i.e. Kappa)?***

Again, the small sample sizes in the first preliminary study did not permit an adequate investigation of the relationship between measures of anxiety and measures of recalled pain, and recalled pain consistency.

Issue Seven. ***Is pain recalled more or less accurately than the recollections of other sensory experiences?***

An understanding of how other sensory experiences can be recalled, for example, taste or smell, is required in order to further our understanding of the relative extent to which pain can be remembered. There is apparently no prior research which has compared the extent to which sensations of pain can be recalled with recall of other sensory experiences.

CHAPTER FOUR: LITERATURE REVIEW PART TWO – MEMORY

4.1 Overview

From the data reported in all of the studies investigating memory for pain, it is not possible to determine the extent to which the retrospective reports of pain actually reflect individuals' recollections of the pain experienced. This problem is highlighted in the preliminary studies, which found numerous similarities between patients' reports of the qualitative nature of acute pain following varicose vein surgery, and the estimates of pain made by non-patient participants. Thus, the relative extent to which retrospective ratings of pain reflect recollections of the pain, as opposed to recollections of non-experiential material relevant to the pain, remains open to question. In addition, it is also impossible to know whether retrospective pain reports obtained in previous research reflect the previously made pain assessment, or a recollection of some aspect of the pain itself (Clark and Bennett-Clark, 1993).

Clark and Bennett-Clark (1993, p.195) suggested that pain memory research 'is at least 30 years behind the knowledge and research techniques used by cognitive psychologists to study sensory and verbal memory'. Over a decade ago, Eich (1993) pointed out that patients or participants may be unable to consciously remember their previous pain 'with any degree of confidence, clarity or completeness… [and that] long term memory for pain may be more a matter of 'knowing' than of 'remembering'' (Eich, 1993, p.192).

Over the past two decades, cognitive research has focused extensively on the nature of subjective experience during the retrieval of information stored in long-term memory. This interest was sparked by Tulving's (1985) influential article which highlighted that conscious awareness is integral to the act of recalling past events. Tulving proposed that two distinct states of awareness accompany recollection: 'remembering' and 'knowing'. Remembering involves consciously recollecting specific aspects of an event, whereas knowing involves the awareness of a prior event having occurred, but without the conscious recollection of the event. For Tulving (1985, 2002) remembering is an expression of autonoetic consciousness whilst knowing is the expression of noetic consciousness. In turn, these levels of consciousness reflect the operation of two theoretical systems: episodic and semantic memory.

Originally, Tulving (1972) proposed the distinction between episodic and semantic memory to distinguish the recollection of personally experienced events (episodic) from recollections of generally known facts about the world (semantic). But self-related, or autobiographical memories, may be remembered, or simply be known to have occurred and thus may reflect episodic or semantic memory systems. Only two studies investigating memory for pain have considered these theoretical memory constructs in relation to memory for expected acute pain (Niven and Brodie, 1995; Brodie and Niven, 2000). These studies, reviewed in Chapter One, examined the relative influences of episodic and semantic memory in recollections of acute pain by comparing pain reports with estimates made by participants with no first-hand experience of the pain in question. This approach, however, cannot directly assess the role of these theoretical memory systems in providing retrospective reports. Rather, it was only possible for inferences to be drawn about the extent of conscious (i.e. episodic) awareness which accompanies recollections of pain, and the extent to which different memory systems may or may not be involved in pain memory. Unless the role of conscious awareness in pain recollection empirically explored, the extent to which these reports involve references to the actual pain experience remains unclear.

The review of the literature presented in Chapter One summarised the distinctions between the theoretical constructs of explicit and implicit memory and between the semantic and episodic components of explicit memory. The review presented in this chapter examines contemporary memory research, including studies concerning the phenomenon of false memory, and considers how contemporary memory theories can be useful in interpreting and carrying out pain memory research.

The extent to which, in terms of accuracy, pain memories are comparable with other memories, such as those relating to taste and smell, also requires consideration. Various statistics have been employed to provide some numerical rating of 'memory for pain'. Kappa, for example, has been used to support the conjecture that memory for specific qualities of pain is unreliable (Beese and Morley, 1993). It is not clear whether this observation is due to pain memory being some kind of 'special case' of recollective experience, or whether recall accuracy of the detailed qualitative aspects of other sensory experiences are similar. For this reason, this review will also consider studies which have assessed memory for two other sensory experiences; taste, and smell.

4.2 Semantic and episodic memory systems

List learning tasks have typically been used to assess episodic memory, where participants are required to learn a collection of verbal items and are then tested (by recall, recognition, or some kind of memory judgement) on what they have learned. In studies using these word list learning paradigms, successful completion of the task had been considered to imply the involvement of episodic memory (Hamilton and Rajaram, 2003). But in fact, performance on these tasks also relies upon other kinds of memory, such as semantic memory, and successful completion of such a test does *not* necessarily involve the conscious recollection of previously presented material (e.g. Tulving, 1985; Gardiner, 1988). It is possible for a person to 'know' (correctly) about past events, such as having previously been presented with a test word, without any episodic or conscious recollection of (that is, remembering) previously seeing the test word.

4.3 Assessing states of awareness: remembering and knowing

As described in Chapter One (section 1.3.6.1), Tulving (1985) distinguished between two different levels of explicit long-term memory: remembering, or the concrete awareness of oneself in the past (autonoetic consciousness, or episodic memory); and knowing, which refers to an abstract knowledge of the past (noetic consciousness), which may or may not refer to personally experienced events. Since the introduction of Tulving's remember/know distinction, the phenomenological experience of thinking about oneself in the past, present and future, and the awareness that accompanies recollections of personal experiences has been extensively explored.

The experience of remembering refers to the becoming aware of an episode which has occurred in one's personal past. These memories can include thoughts, emotional reactions experienced at the time and sensory experiences, such as the appearance of a face (see e.g., Tulving 1985; Wheeler and Buckner, 2004). For example, in a word recognition test (a typical memory research paradigm in a laboratory setting), a participant may correctly endorse a word as having appeared in a previous word list, and may remember its place in the list, and specifically recall its appearance. On the other hand, participants may make the same (correct) response to the task, but simply know that the word appeared previously without any conscious awareness of previously seeing the word in question (Rajaram, 1993). Traditional explicit memory tests such as those requiring recall and recognition have been assumed to tap conscious recollection of the studied event. However, convincing evidence has been provided to demonstrate that performance on explicit memory tests does not depend solely on the participant's conscious recollection of studied events (Gardiner, 1988, Gardiner and Java, 1991).

In remember/know research paradigms, rather than researchers assuming the involvement of conscious recollection (or otherwise) in memory tasks, participants are asked to judge their recollections as either 'know' or 'remember'. Thus, in a word list recognition task, participants would be asked to judge as 'remember' those words which they can consciously recall as having been previously presented, for example, remembering seeing the word in a particular position in a word list. On the other hand, participants would respond to a list item with a 'know' response if he or she does *not* have a conscious recollection of seeing the item on the study list, but which he or she feels they 'know' has been presented previously.

Tulving (1985) was the first to employ the remember/know research design to investigate the nature of conscious recollection. Participants studied *category name/instance* pairs (e.g. *musical instrument* (category name) – *viola* (instance)), and then completed three recall tests. The first of these tests was a free recall test, the second a cued recall test where the category name was provided and the third was a letter cued-recall test (for example 'musical instrument – v …'.). Participants were then asked to rate their recollections as either 'remember' or 'know'. As predicted, Tulving found that the proportion of remember responses declined as cues were provided. Furthermore, in a recognition experiment, he found that 'remember' responses declined with retention interval, over a period of eight days, relative to the overall recognition performance.

4.3.1 Evidence for remembering and knowing reflecting two types of long-term memory

The dissimilarities between remembering and knowing have been highlighted in studies which have shown that various experimental manipulations differentially affect one, but not the other. For example, whilst remember responses are sensitive to levels of processing effects, (Gardiner, 1988) and decrease with divided attention (Gardiner and Parkin, 1990), know judgements appear to be unaffected by these variables. On the other hand, know responses are enhanced by masked repetition priming (Rajaram, 1993) and by suppression of focal attention (Mäntylä and Raudsepp, 1996). Age appears to have a greater influence on the accuracy of remember responses than on know response accuracy (Parkin and Walter, 1992). A free recall task, where participants study word lists and are then asked to recall words on this list, had been considered to be a 'quintessential measure of conscious recollection' (Hamilton and Rajaram, 2003, p. 53). However, Hamilton and Rajaram found that only 66% of their participants in a free recall task judged their responses as 'remember', a finding which led them to suggest that remember responses are able to provide a more 'pure' measure of conscious recollection rather than other measures of explicit memory such as recall tasks.

There is neurological evidence from Positron Emission Tomography (PET) scans and from lesion studies which suggests that retrieval of information from semantic and episodic memory relies upon distinct (but interrelated) memory systems (Wheeler *et al.*, 1997). PET technology has provided evidence for the neuroanatomical correlates of remembering to be the frontal lobes (Buckner and Tulving, 1995). Wheeler *et al.*, (1997) similarly demonstrated that the frontal lobes appear to underlie autonoetic consciousness and proposed that episodic memory is subserved by a distinct neurocognitive system which has evolved specifically for that purpose. Other researchers (Stuss and Benson, 1986; Knowlton, 1998) provided further neurological evidence that remembering, an awareness of the self, personal thoughts and the awareness of the relationship between one's self and the social environment, appear to be largely dependent on the frontal lobes.

The remember/know research paradigm has been used in non-experimental, applied settings. For example, the remember/know distinction was used by van den Hout and Kindt (2003) to investigate an Obsessive-Compulsive Disorder (OCD) memory model. Herbert and Burt (1998) and others (Conway *et al.,* 1997) have applied the remember/know construct to learning situations. However, whilst the distinction between episodic and semantic memory has been referred to in the context of memory for both chronic and acute pain (Erskine *et al.*, 1993; Morley, 1993; Niven and Brodie, 1995; Brodie and Niven, 2000), these theoretical constructs have not been assessed using the remember/know research paradigm, and there has only been speculation on the role of episodic and semantic memory. Inaccurate recollections of the qualitative dimensions of pain have been taken to reflect a lack of episodic awareness (Niven and Brodie, 1995). But evidence from false memory research indicates that inaccurate recollections of prior events may nonetheless be accompanied by a feeling of remembering. False memory research and its relevance to pain memory research is discussed in the following section.

4.4 False memories

The issue of false memories – either memories which are recalled as different to the actual event, or memories of incidences which never occurred at all – has received increasing attention in recent years. Bartlett (1932) is widely cited as carrying out the first experimental investigations of false memory. In his study, English college students read an Indian story 'The

War of the Ghosts', which contained culturally-bound elements of the supernatural that were unfamiliar to the English participants. The participants were then asked to recall it several times starting from 15 minutes after the original reading to a number of weeks or months later. On later tests Bartlett found conspicuous distortions in the students' later recollections of the story, including omissions, alterations and additions to the original piece of text which brought the story more in line with their cultural expectations. Bartlett concluded that remembering involves the reconstruction of the past, in the light of our current understanding of the world (see also Ross, 1989)

Bartlett's studies highlighted the reconstructive nature of memory, rather than recollection involving the simple retrieval of a particular stored fact. Thus, aspects of the previously presented material are drawn together, relying upon pre-existing knowledge, in order to produce a plausible 'whole' recollection. In order to increase the coherence of the reconstruction, certain details of the original material may be distorted, added or removed. The more contemporary 'constraint satisfaction process' theory is consistent with Bartlett's earlier theory. McClelland (1995, p. 69) describes this process as one in which 'remembering is simultaneously constrained by knowledge of related material, and by constraints and influences imposed by the situation surrounding the act of recollection'.

Further evidence of the occurrence of false memory comes from the classic study by Loftus and Palmer (1974). After watching a series of short films, participants were asked to report an account of an accident they had just seen in the series and then to answer a number of specific questions about the accident. In one question, participants were asked about the speed of the cars prior to collision. Participants were asked 'about how fast were the cars going when they hit each other'. The word 'hit' was subsequently changed to 'smashed', 'collided' and 'bumped'. The mean speed estimate ranged from 31.8 miles per hour for the word 'contacted', to 40.8 miles per hour for the word 'smashed'. In the second part of the study, participants were either asked 'about how fast were the cars going when they smashed into each other', or 'how fast were the cars going when they hit each other' or were not asked any question about the speed of the cars. Again, participants who were asked 'how fast were the cars going when they *smashed* into each other' rated speed of the cars as significantly greater ($p<.05$). Participants were then asked if they had seen any broken glass in the accident. There was no broken glass in the films but since broken glass is commensurate with 'accidents occurring at high speed', the authors found that the participants who had been asked the question which contained the word 'smashed' would be more likely to say that they had seen broken glass, compared with those who had been asked the 'hit' question and with those who had not been asked about the speed of the car.

In a study which set out to investigate false memory, Roediger and McDermott (1995) found that participants falsely recalled, from lists, words which had not been previously presented. For example, in one study, participants studied six lists of 12 words which were associated with a word that had not previously been presented (e.g. bed, rest, awake, ... presented with the word 'sleep'). The authors found that the non-presented associates were recalled 40% of the time and participants reported high levels of confidence when recognising these words with which they had been previously presented. In a second study, they found a false recall rate of 55% when participants studied 16 lists of 15 words, occurring minutes after all of the lists had been verbally presented. The authors suggest that this pattern of results demonstrates that participants readily 'recognise' events that never happened, if these events fit some schema derived from the study experience. Roediger III and McDermott relate their findings to the 'implicit associative response model' of memory proposed by Underwood (1965). Many researchers have assumed that the associative response occurs to the subject during the study phase, (i.e. during the test phase, participants heard the word 'hot', and might think of an associate word such as 'cold'). Then, if cold were presented as a lure in the test phase, participants may claim to recognise the word because of the earlier implicit associative response. Roediger and McDermott (1995) suggest that the participant may not even become aware of the associative response during the study phase. They propose that on hearing a word (e.g. hot), activation may spread through an associative network (Anderson and Bower, 1973; Collins and Loftus, 1975) with subsequent false recognition occurring through residual activation. Thus, for false recall or false recognition to occur, a participant may not consciously think of the associate (i.e. cold) at all while studying the list to be recalled later. However, Roediger and McDermott suggest that one explanation for the occurrence of the high proportion of 'remember' responses is that these critical words *do* occur to participants in the study phase. Thus, participants claim to remember these words through a failure of reality monitoring (see also Johnson and Raye, 1981).

Holmes *et al.*, (1998) also investigated the occurrence of false memories using a 'semantic integration' paradigm, and by requiring participants to rate whether their responses reflected remembering or knowing. Semantic integration infers that when two sets of similar descriptors (or sentences) are encountered, they are semantically combined in memory to form a 'gist integration' of the sentences (Bransford and Franks, 1971). Holmes *et al.*, (1998), found a large number of 'remember' judgements were in fact false alarms, where participants indicated that they consciously recalled (that is, remembered) previously encountering a sentence which had not, in fact, been presented earlier. Over a number of different studies and sentence lengths, remember judgements and false alarms, Homes *et al.* suggest that the episodic nature of false memories is due to the constructive nature of memory, where retrieved memories are 'reconstructed entities rather than simple reproductions of past experiences' (Holmes *et al.*, 1998).

4.4.1 <u>The issue of 'false memory' in recollections of the qualitative dimensions of expected acute pain</u>

False memory research is consistent in demonstrating the reconstructive and constructive nature of memory. It is often possible to 'remember' things which did not occur, or items not previously presented. Relating false memory research to the study of pain, then, it might be expected to observe the lack of agreement in MPQ descriptor selection that has been reported in previous studies. Rather than provide an identical report of a prior pain experience, it might be expected that the descriptors used may vary, even if the patient or participant is consciously recalling their experiences of pain. The MPQ is made up of descriptors which may be semantically similar. If this is the case, it may be expected that participants may use descriptors interchangeably to describe their experiences of pain, or 'remember' selecting words which in fact they did not, but which are semantically similar to the ones they actually did select.

4.5 **Memory and language**

Evidence from both pain research (e.g. Niven and Brodie, 1995) and non-pain memory research highlights the difficulties in trying to describe perceptual memories. In a study investigating memory for taste, Melcher and Schooler (1996) highlight the fact that descriptions such as 'the wine was dry, but fruity' are 'merely impressionistic dabs that capture only the coarsest details of our perceptual memories' (Melcher and Schooler, 1996, p. 231). Verbal reports of subjective experiences such as pain, taste or smell can only ever be approximations of what the individual is actually experiencing. The verbal report may be interpreted or perceived by another in a way not intended by the individual experiencing the pain, or the sufferer may not be able to express their experience using appropriate descriptions.

The term 'verbal overshadowing' has been used to refer to the over-reliance upon a verbal representation at the expense of perceptual memory itself (Schooler and Engsler-Schooler, 1990; Melcher and Schooler, 1996). The authors suggest that this reliance may be inconsequential when either the perceptual memory is relatively limited, or if the verbal representation is extensive. However, they suggest that memory impairments may occur when perceptual memory exceeds the individual's ability to communicate the previously experienced perceptual event. Thus, when using verbal descriptors to express something which is difficult to describe, individuals may rely upon verbalisable memory attributes at the expense of the non-verbalisable attributes. Melcher and Schooler (1996) suggest that this emphasis on verbal aspects of memory may be detrimental if the linguistic skills for communicating complex perceptual experiences are limited. In this context, the use of the MPQ might be beneficial in that it should allow for a comprehensive description of a pain experience to be communicated if the participant experiences difficulties in generating for him or herself appropriate descriptors to express their subjective experience of pain.

4.6 Memory for pain studies and memory theories

The research reviewed above can be applied to assist in the investigation of memory for pain and suggests that the way the subjective sensory experience of pain is verbalised (by the sufferer themselves or perhaps by a carer or health professional) may influence memory for pain. We can use the example of implicit associative responses given by Roediger III and McDermott (1995). If a patient selects the word 'hot', he or she might think of an associate (e.g., 'burning' or some other thermal descriptor available on the MPQ). Retrospectively – and especially if the patient had been in any sort of confused state perhaps due to analgesic use or anxiety – the patient may recognise the word 'burning' and subsequently select this word to describe their recollections of their sensory experiences.

The work of Loftus and Palmer (1974) is also relevant to memory for pain research. Memory of a pain experience may be influenced by external information supplied after the event. Over time, information from these two sources may be integrated in a way which renders them indistinguishable from one another. Conway *et al.,* (1997) proposed that over time, newly learned information becomes conceptual knowledge, which is virtually free of specific episodic details. The resultant 'schemas' are not records of individual experiences of a particular concept, but a generalised representation of multiple experiences. The schema can represent underlying objects, situations, events or actions which relate to a particular concept. Newly acquired information (e.g. a pain event) may then be processed in relation to these previously held schemas.

4.6.1 The applicability of the remember/know distinction in memory for pain

A number of studies have assessed memory for pain using verbal pain ratings such as the McGill Pain Questionnaire. These studies have assumed that correct endorsement of previously selected pain descriptors (or numerical ratings) represents good pain recall. But experimental memory research suggests that people are often able to make good judgements about previous experiences for which they have no conscious recollection (Tulving, 1985). In terms of memory for pain, it is possible that participants have no conscious recollection of the sensory nature of the pain experience, but simply select verbal descriptors or make ratings using linear rating scales to provide an estimate of a pain that they simply 'know' occurred. If the participants simply happen to select the same pain descriptors (i.e., aching, cramping and tiring to describe menstrual pain) this, using the paradigms employed so far to assess memory, would be taken to reflect accurate memory. In fact, it is possible that the participants could simply select the same descriptors without any conscious recollection of (that is remembering) the pain at all.

Brodie and Niven (2000) and Niven and Brodie (1995) interpret their findings within the theoretical framework of semantic and episodic memory. Their data suggest that it may be possible to provide ratings of past pain reports without mnemonic reference to that particular experience. Therefore, the authors suggest that episodic memory in pain recall may be limited. But the current approach to assessing memory for pain may be equated to Tulving's (1989) term used to describe earlier methods of assessing conscious recollection – 'the doctrine of concordance of behaviour, cognition and experience'. That is, based on the subject's performance of a task, the nature of the participant's mental experiences is inferred. Thus, the study of *cognitive processes* has been assumed to be the study of *conscious experience* (Rajaram, 1993).

The use of the remember/know paradigm, therefore, should be instrumental in assessing memory for acute pain in a number of ways. First, it could be instrumental in ascertaining the influence of episodic recollections in memory for pain. Rajaram (1993) and Hamilton and Rajaram (2003) provide evidence that 'remember judgements' provide a 'pure' measure of episodic recall. Tulving (1985) postulated that the know judgements reflect semantic memory systems and later research has implicated both episodic and procedural memory in knowing (Gardiner, 1988; Postma, 1999). Second, as previous research has been concerned with whether retrospective reports are a reflection of memory for the pain experience, or memory of the words selected whilst in pain, participants could be asked to distinguish between whether their recollections involve 'remembering' the sensations implied by the descriptor used to express their recalled pain, whether it is the previously used pain descriptor that is being recalled, or whether they simply 'know' that the descriptors selected are appropriate to describe their recollections. Third, the pattern of remember and know judgements may be used to investigate the influence of expectations on memory, by comparing retrospective reports judged as remember/know with a pattern of words selected prior to the expected acute pain event.

4.7 Memory for other sensory experiences

Jones (1957) suggested that the difficulty in remembering the sensory qualities of pain in any vivid or realistic way resulted from 'a simple act of intense repression'. But the accuracy of pain memory comparative to memory for other sensory experiences has not been investigated empirically. An assessment of the recall accuracy of sensory experiences, unrelated to a pain event but occurring concurrently may help to further our understanding of whether memory for pain is indeed a 'special case' of remembering or whether it shares similarities with memory for other sensory experiences.

Taste and smell are subjective sensory experiences and like pain, can be highly emotive experiences. In addition, when people discuss painful or upsetting events, taste and smell are often recalled as part of the experience (for example, the taste of some unpleasant medicine, and many people report an aversion to the smell of hospitals). It appears that there have been no studies which have investigated memory for pain and compared it with memory for taste and smell. Indeed, research into memory for such sensory experiences *without* such comparisons, is limited.

In a relatively large study, Barker and Weaver III (1983) investigated recall accuracy for the intensity of taste and smell over four time periods (one, five or fifteen minutes or 72 hours). Participants (n=336) tasted 10 ml of 15% sucrose solution and were asked to remember the intensity of the sweetness. Participants were then divided into one of the four time delay condition groups, varying from one minute to 72 hours, and asked to compare a second solution (ranging from 5% to 20% sucrose) to the first and report whether the second was 'less sweet', 'more sweet' or 'the same'. The authors found that participants reliably reported 5% solutions as less sweet than the original, and 20% solutions as more sweet. When presented with the 15% solution, 60% of the subjects reported the solution as being sweeter, regardless of the delay between the first and second presentation. The authors found that, when the second solution tasted was 15% sucrose, across the four time conditions, fewer than 30% of the participants reported it as equal in intensity to the original 15% stimulus. The authors suggest that this indicated that participants were fairly consistently remembering the original solution as being less sweet than it actually was.

In an additional component of their study, Barker and Weaver III (1983) measured the duration of memory of an olfactory stimulus. In this study, 20 participants smelt a plastic bottle containing two concentrations of pyridine in oil. Participants were divided into two groups, one of which was retested at one minute, the other at seven minutes, when they were asked to smell five bottles containing concentrations of pyridine and select an appropriate one to match the test concentration. The authors found the same pattern of results as in the taste study; participants consistently picked a concentration weaker than the test concentration. The authors conclude that olfactory and taste stimuli are remembered as being weaker within minutes of the presentation of the original stimuli. They suggest that this recollection then remains unchanged for at least a number of days. The authors discuss their findings in relation to other sensory memory stores such as pain stating that mothers typically report forgetting the intensity of the pain of childbirth. Unfortunately, the authors do not cite references to support this claim.

Algom and colleagues have conducted some sophisticated research which has investigated memory for taste, smell and pain using psychophysical research paradigms (Algom and Marks, 1989; Algom *et al.,* 1993; Algom and Lubel, 1994), but have not compared memory for these sensory modalities in the same study. Algom and Lubel (1994) investigated the relationship between memory for labour pain and the biometrically measured magnitude of the participants' uterine contractions. The authors obtained tocographic traces to provide information on the intensity duration and phasic characteristics of contractions over the course of labour. Women were assigned to one of four study conditions. In a perceptual condition, the participants were instructed to judge the intensity of the pain felt at five contractions. In the three memory conditions, where memory for the *relative* pain of five contractions was assessed, participants were instructed to associate colours to each of the five contraction times. The participants were not required to make ratings of pain whilst experiencing the contractions. At each contraction, the women were shown a large glossy coloured card and asked to 'learn the colour label' for the contraction being experienced. At recall (eight, 24 or 48 hours) after the median contraction had been measured, participants were shown the coloured cards and asked to rate how painful that contraction was in relation to others. The match between the relative pain intensity of the recalled contraction and the tocograph measurements were good, which suggested that participants were remembering the intensity of the labelled contractions.

In a study methodologically similar to Algom and Lubel's (1994) memory for labour pain study, Algom *et al.,* (1993) required participants to judge the intensity of a number of concentrations of sucrose and orange flavourings. Twenty-four participants were presented with nine combinations of an odorant (orange) and/or sucrose. In the first part of the study, all participants learned to associate colours with each of the unmixed odour and taste stimuli (two concentrations of orange odorant and two concentrations of sucrose). After 24 hours, the participants returned for a test session. Participants were randomly assigned to either a 'perceptual' condition or a 'memory' condition. In the perceptual condition, participants judged the overall intensity of the nine taste/smell combinations (combinations of 0, 0.025 and 0.1% of odorant and 0, 5% and 15% sucrose). In the memory condition, no solutions were presented. Instead, intensities were represented by their previously learned colours. When presented with a pair of colours, the subjects imagined an appropriate mixture represented by the coloured cards. These participants were required to assign the stimulus first presented a number which seemed most appropriate to represent its intensity and then to assign proportional numbers to succeeding stimuli, using whole numbers, decimals and fractions if necessary. The authors found that memory for the solutions were very similar for both the 'perceptual estimation' and the memory estimation group, and suggested that memories for the taste and smell were implicit, rather than explicit.

As noted above, there has apparently been little prior research which has investigated memory for the specific qualitative aspects of a taste, and none which has compared memory for the qualitative dimensions of pain with those of taste. Making such a comparison could significantly add to our understanding of memory for sensory experiences.

4.8 Chapter summary

This chapter has discussed some contemporary memory theories and in particular, has reviewed the use of the remember/know research paradigm and its applicability to investigating memory for pain. Current methods of assessing memory for pain suffer two major limitations. First, the data obtained are unable to indicate whether patient or participant reports reflect the pain *per se* or whether it is simply the prior pain *rating* which is being recalled. Second, it is impossible to infer whether recollections of pain are based on actual memory for that experience, or upon other non-episodic memory. We can investigate pain memory further by requiring participants to make judgements about their memory, in terms of whether they are able to consciously remember the pain experience or simply know that a prior event was painful. Previous research which has assessed memory for the quality of a previously experienced pain observed both omissions and intrusions in retrospective reports (Roche and Gijsbers 1986; Terry and Gijsbers, 2000). Niven and Brodie (1995) suggest that these might reflect participants' attempts to reconstruct and augment an imperfectly remembered pain experience by resorting to semantic knowledge of what a particular pain should be like. The study reported in the following chapter aims to address some of the issues raised in the preliminary studies and posed by numerous other pain memory studies, by employing the remember/know research paradigm to assess memory for pain in an experimental setting.

CHAPTER FIVE: STUDY THREE – STATES OF AWARENESS IN RECOLLECTIONS OF THE QUALITY AND INTENSITY OF EXPECTED ACUTE PAIN INDUCED IN AN EXPERIMENTAL SETTING

5.1 Introduction

The central aims of this study were to address the issues highlighted by the two preliminary studies (Chapters Two and Three) and to employ a contemporary memory research paradigm to investigate how expected acute pain events are recalled. The first issue is that there remains some debate as to whether the qualitative dimensions of pain are recalled differently to recollections of pain intensity. Secondly, as previous studies have been unable to provide much information about the phenomenological experience of recalling a past pain event, it is not known whether the pain is *remembered*, or if patients or participants provide retrospective reports based on other, non-episodic recollections. A related issue, of whether it is a recollection of the pain *per se* or the previously made pain *rating* which is being recalled, remains contentious.

The anticipation of the likely nature of an expected acute pain event is an intrinsic aspect of the pain experience. In turn, the anxiety associated with these expectations also needs consideration, and how expectations and anxiety subsequently influence recollections of the pain requires further clarification. Finally, the extent to which pain memories share phenomenological characteristics with memories for other sensory experiences requires further investigation.

A number of methodological points highlighted by the literature reviews and in the preliminary studies, such as the choice of pain assessment used, sample sizes and limitations of different methods of data analysis, also need to be considered. In order to investigate the issues outlined above, the present study used an experimental research design and applied the remember/know method to assess the recollections of the induced pain. A justification and rationale for the research design employed to execute this study is presented below.

5.1.1 Assessing the extent to which the intensity and qualitative aspects of expected acute pain can be recalled

The first issue is to clarify the extent to which pain intensity is recalled in comparison to recollections of the qualitative dimensions of pain.

5.1.1.1 Using Kappa to investigate memory for the qualitative nature of acute pain

Prior studies investigating memory for acute pain have made the assumption that the qualitative nature of pain may be recalled less well than its intensity (e.g. Beese and Morley, 1993). However, as discussed previously, it is possible that the qualitative dimensions of pain are recalled at a broader level than has been previously assumed. Kappa analysis of the MPQ *categories* selected may provide more pertinent information about memory for pain than the analysis of MPQ descriptors. If pain experiences are recalled at this broader level, it may be inappropriate to infer memory by the comparison of the MPQ descriptors. It is possible that Kappa analysis of the agreement between the MPQ pain descriptors does not so much reflect pain memory, but the participants' tendency to use the same descriptors to describe a past pain event. Melzack and Katz (1994) point out that some of the descriptors contained within the MPQ are synonymous and in everyday language we may, for example, describe an aching tooth as 'sore, throbbing and exhausting' at one moment and as 'aching, tiring and pulsing' at the next. At the MPQ descriptor level, there is clearly no agreement between ratings, although both give a PRI rank order rating of eight. However, in 'everyday' language, the two sets of words could be used interchangeably to describe a similar experience and each description uses the same MPQ categories. Using Kappa to assess agreement between the MPQ descriptors chosen would indicate that there was no consistency between the two pain ratings. At a 'type of pain' level, however, recall would be considered to be perfect. Only one prior study (Niven and Brodie, 1995) has used Kappa to investigate how consistently participants selected descriptors from the 20 MPQ categories (that is, how consistently the pain was described at a 'type of pain' level). Unsurprisingly, as this study investigated memory for labour pain occurring some years previously, the Kappa values reflecting agreement between rating times, were poor. The present study seeks to add to the limited literature assessing recall of the broader type of pain experienced, by using Kappa to assess the agreement between the MPQ categories chosen to rate experimental pain.

5.1.2 The use of the remember/know paradigm to assess memory for pain

Whilst Kappa might provide some measure of the extent to which retrospective descriptions of pain agree with those used whilst in pain, such analysis tells us little of the subjective experiences of these recollections. In addition, understanding more about the awareness that accompanies the recollection of pain will help to clarify whether descriptions of pain are remembered or whether the pain itself is remembered, and to understand more about the role of episodic and semantic memory in recalling previously experienced pain.

To recap, remembering refers to a conscious awareness of oneself in the past and is equated with autonoetic consciousness and episodic memory (Hamilton and Rajaram, 2003, and see Literature Review in Chapter Four). In the context of pain recollection, remembering (or, declaring a 'remember' judgement) would refer to the distinct conscious awareness of oneself experiencing the pain, but should not be interpreted to equate with 'sensory re-experiencing' or what Katz and Melzack (1990) have termed 'somatosensory memory', which occurs only very rarely.

Declaration of a 'know' judgement, on the other hand, refers to a recollective experience which does not invoke any specific details. Know judgements indicate that there is no conscious recollection or 'mental time travel' (Tulving, 1985). Knowing may consist of previously experienced episodes which are not consciously remembered, but are accompanied by a 'feeling of knowing' or may consist of non-experiential, semantic information; meaningful rules, facts or information about a particular pain. The use of the remember/know paradigm then, should be able to provide insights into how we represent pain – as a piece of knowledge from the past (knowing) or as an experience that is recalled vividly (remembering).

5.1.2.1 Episodic and semantic memory systems in recall of the qualitative dimensions of pain

Prior pain memory research has speculated on the extent of semantic and episodic memory involvement in the provision of retrospective ratings of pain, (Niven and Brodie, 1995; Brodie and Niven, 2000) but have not tested this directly using the remember/know research paradigm introduced by Tulving (1985). But without obtaining a more direct measure of the participants' subjective experience, (that is, requiring individuals to indicate whether their recollections reflect 'remembering' or 'knowing'), the role of episodic and semantic memory can only be inferred from the participants' selection of pain descriptors.

5.1.2.2 Recalling previous pain ratings or pain experiences

A frequently raised concern pertaining to the findings of previous research is whether retrospective ratings of acute pain reflect a recollection of the previously experienced pain, or a recollection of a previously expressed pain *rating* (Clark and Bennett-Clark, 1993). Requiring participants to make a decision about whether retrospective pain ratings reflect something which is remembered or simply known should also help to decipher the extent to which pain memories reflect recalled pain or recalled pain descriptors. More specifically, if participants report consciously recalling (remembering) some aspect of the pain, for example, having selected the descriptor 'nagging', participants can be asked to judge whether their recollection was one of a nagging pain *per se*, or of having previously chosen the descriptor 'nagging' to express the pain. In this way, the extent to which memories of pain, and memory for pain *descriptors* are being recalled, may be gauged.

5.1.3 Recalling the different dimensions of pain

The MPQ is also purportedly able to provide information about the sensory, affective and evaluative aspects of a pain experience. Although support for the three-factor structure of the MPQ has not been unequivocal, there is evidence to support the distinction between the sensory and affective/evaluative components (Reading, 1989; Melzack and Katz, 1994). Prior research using correlation analyses has found some evidence that the sensory and affective aspects of a prior pain may be recalled with different degrees of accuracy (Hunter *et al.*, 1979; Roche and Gijsbers, 1986). On the other hand, using Kappa analyses, Beese and Morley (1993) found no evidence of differences in the consistency of MPQ sensory descriptor selection and total MPQ descriptor selection. However, because of the small sample sizes in their participant groups, the lack of significant differences may have been due to a lack of statistical power. The relative extent to which recollections of the sensory and affective/evaluative components of pain are encoded and/or recalled separately, requires clarification.

5.1.4 Factors to be considered when assessing memory for pain

5.1.4.1 Expectations of pain

As expected pain experiences can be planned for and anticipated; how this 'episodic future thinking' (Attance and O'Neill, 2001) influences subsequent memories of the pain requires further investigation. Previous memory research, including that considering false memory phenomena (Ross, 1989; Roediger and McDermott, 1995; Conway *et al.*, 1997; Holmes *et al.*, 1998) has demonstrated that memory is largely a constructive process. But the extent to which pain recollections are augmented or influenced by prior expectations requires clarification.

The study reported in Chapter Two and the research reported by Terry and Gijsbers (2000) attempted to assess the extent to which expectations of pain influenced retrospective ratings. The small sample sizes used in these studies were prohibitive in terms of drawing anything but tentative conclusions. In order to investigate the influence of expectations more fully, a sample size is required which is sufficiently large enough to allow for the use of multiple regression analysis to assess the extent to which prior semantic knowledge is able to predict recollections of pain. Brodie and Niven (2000), Niven and Brodie (1995) and the second preliminary study reported in this thesis (Chapter Three) have shown that it is possible to provide appropriate estimates of the qualitative dimensions of a particular pain without any first-hand experience of the pain in question. It is possible then, if the nature of the prior pain event is not being remembered, that retrospective ratings rely on previously held semantic knowledge to provide a 'likely' description of the previously experienced pain.

5.1.4.2 *Anxiety*

Anxiety is intrinsically related to the anticipation of expected acute pain events. Research has suggested that anxiety may also affect memory for acute pain (Eli *et al.*, 2000; Gedney and Logan, 2004). The relationship between anxiety and measures of pain recall accuracy was investigated in the preliminary study reported in Chapter Two but a larger sample size is required in order to sufficiently investigate the inter-relationship between anxiety, expectations and retrospective ratings of pain. It might be argued that it is of limited value to investigate situational anxiety in controlled experimental settings. However, the STAI allows for an investigation of both situational (state) and trait anxiety. Weisenberg (1994) suggests that it may be trait anxiety which is relevant to the outcome of expected acute pain events and in preparation for surgery. Taenzer *et al.*, (1986) found that trait anxiety along with neuroticism were the most important predictors of postoperative pain reports, rather than state anxiety. The relationship between anxiety and memory for pain is unclear and has rarely been considered in previous research. Thus a situation which is non anxiety provoking might be a particularly appropriate place to investigate the relationship between trait anxiety, pain and memory for pain.

5.1.5 Comparing recollections of pain with recollections of other sensory experiences

There is paucity of research which has attempted to compare memory for pain with memory for other types of sensory experience. Prior research has acknowledged this issue by investigating memory for external events incidental to the pain event such as the weather (Hunter *et al.*, 1979) and memory for mood (Beese and Morley, 1993). Hunter *et al.*, reported that patients' recollections of pain were 'no worse' than recollections of events occurring incidentally to the pain event but concluded that 'the extent to which memory for pain resembles the memory for other kinds of experience remains to be determined' (Hunter *et al.*, 1979, p. 45). Beese and Morley (1993) required participants to recall their mood at the time of rating their pain, which was assessed using the UWIST Mood Adjective Checklist (UMACL; Matthews *et al.*, 1990) as well as their pain experience, in order to assess participants' recollections of a subjective experience analogous to pain. They found that recollections of mood and pain were broadly similar. A literature search for the present investigation found no published research which has compared the accuracy of recollections of pain quality with memories of the qualitative dimensions of other sensory experiences, such as those involving taste or smell. A comparison of memory for pain with memory for other sensory experiences would provide a more 'like with like' comparison than has been reported in prior research.

5.1.6 Statistical and methodological issues to be considered when assessing memory for pain

The statistical and methodological issues to be borne in mind when designing a study to investigate memory for the quality and intensity of expected acute pain events are reiterated and summarised below in the context of the design of the current study.

5.1.6.1 Methods of pain assessment

Visual analogue scales are able to provide numerical ratings of the intensity of pain experienced and recollected. MPQ descriptors chosen whilst in pain and retrospectively can be recorded and the constellations of selected descriptors may be examined and compared. As discussed above, our understanding of pain memory can be further enhanced by using the remember/know paradigm. Each of these methods of assessing pain has unique benefits, and a combining these different techniques should provide rich data about pain memory.

5.1.6.2 Type of statistical analyses

The most appropriate statistical methods to adequately assess pain recall has been a matter of some debate and depends on the requirements of the research. Numerical ratings obtained from linear scales and the MPQ can be analysed using difference scores, correlations, *t* tests and repeated measures designs to investigate similarities or differences across repeated assessment times. Earlier studies investigating recall of the qualitative dimensions of pain have reported the percentages of retrospectively selected MPQ descriptors or categories which agree with those selected whilst in pain (e.g. Hunter *et al.*, 1979; Roche and Gijsbers, 1985). Beese and Morley (1993) were the first to employ Cohen's Kappa as a more stringent measure of the extent to which pain descriptors chosen retrospectively agree with those chosen whilst in pain. Kappa can also be used to investigate how consistently each of the individual MPQ descriptors and categories are being used, and in this way provide an indication of whether some are being used more or less consistently than others. Previous research has not used Kappa in this way but assessing the consistency of MPQ descriptor selection with Kappa analysis can also add to the data obtained from Pain Profiles. Pain Profiles can provide information about the overall frequency with which MPQ descriptors or categories are selected at each assessment time but cannot provide information about the extent to which the same participants are using the descriptors and categories at each assessment time.

Whilst the use of percent agreement might be too lenient as an assessment of recall accuracy, inferring the accuracy of memory by comparing the individual descriptors using Kappa might be too stringent in its correction for 'chance'. In addition, as discussed earlier, an investigation of memory for pain also needs to consider participants' ability to recall pain at a 'type of pain' level (reflected by the MPQ categories) in addition to an assessment of the reselection of the same MPQ descriptors selected whilst in pain. Analysis of the MPQ category use might be more appropriate to investigate memory for pain. The use of the MPQ categories may be more likely to reflect recollections of pain rather than pain ratings; if participants select words from the same category, but not the same word, this may indicate an attempt to recall the pain experience *per se*, rather than simply select the same descriptor previously used.

A central feature of this study was to apply the remember/know paradigm to assess recollections of expected acute pain induced in an experimental setting, whereby participants were required to make a judgement about the MPQ descriptors they have retrospectively selected. This method may make the correction for 'chance' redundant, by the fact that it directly asks the participant why the MPQ descriptor was chosen.

5.1.6.3 Sufficient statistical power

Ideally, study sample sizes should be large enough to allow for the detection of small but real differences in the sample whilst still being able to reject non-real differences that might be apparent (i.e. Type I vs. Type II errors) (Brace *et al.*, 2003). There are other reasons for obtaining larger sample sizes. For example, Brace *et al.*, suggest that ideally, correlation analysis should be carried out on samples sizes of 100 participants or more in order to prevent the possibility of a small number of participants with extreme scores skewing the data.

Obtaining sufficient sample sizes in clinical situations is often difficult and poses problems which can be circumvented by using non-patient participants in an experimental setting.

5.1.6.4 Investigating memory for pain in clinical and experimental settings

Experimentally induced pain, in spite of its widespread use and acceptance as a method of furthering an understanding of pain phenomena, is crucially different to clinical pain in that the fear of physical damage or inability to control the pain is reduced or eliminated (Dworkin and Chen, 1982). But although experimental pain lacks many of the anxiety-provoking components of clinical pain, the numerous methodological issues faced when assessing memory for clinical pain – which may be circumvented in experimental pain studies – can justify its use. Experimentally induced acute pain can provide a model of expected acute pain, in as much as it can be planned for, anticipated and thought about in advance. Although it is essential to investigate factors affecting memory of acute pain occurring in clinical settings, it is also necessary to investigate selected factors whilst controlling for extraneous variables, in order to further understand memory for pain. The use of an experimental research design can circumvent the ethical and methodological difficulties which arise if patients are required to provide detailed and repeated pain ratings in the form of qualitative data in a clinical setting. For example, labour pain has often been rated retrospectively (Robinson *et al.*, 1980; Niven and Brodie, 1995), or participants have been required to provide pain ratings on linear scales only (Redelmeier and Kahneman, 1996). In addition, the 'remember/know' research paradigm has not previously been used to investigate memory for the qualitative dimensions of acute pain. It seems appropriate to try such a method in the most controlled environment possible, before attempting to apply the method in clinical situations.

5.1.6.4.1 The use of the Cold Pressor test to investigate memory for pain

The importance of being able to investigate pain in a controlled experimental setting is now widely recognised (Mitchell *et al.*, 2004). Experimentally induced pain allows for a variety of pain phenomena to be assessed, measured and controlled in a comparatively fast and efficient manner. Two widely used methods of inducing pain in an experimental setting are the use of ischaemic or tourniquet techniques (e.g. Smith *et al.*, 1966) and the use of very cold water; the Cold Pressor (CP) test (e.g. Hilgard, 1969). The CP test, which involves placing a hand in a bath of water set at a low temperature, has been found to have excellent reliability and validity (Edens and Gill, 1995). Water temperatures in previous pain research studies using the CP test have generally been set between 0 °C and 7 °C (Mitchell *et al.*, 2004). Water circulation is essential in order to maintain the water at a consistent temperature and to avoid heat build up around the hand. Commercially available circulating water baths are readily obtainable and are capable of maintaining a precise and constant temperature.

5.1.7 Aims and objectives

The objective of the present study was to investigate memory for expected acute pain, in an experimental setting. The aims of the study are set out below.

1) The first aim was to investigate the consistency of Expectations of pain, Actual and Retrospective ratings of pain (made two weeks after using the CP test), using a VAS and the MPQ to assess pain intensity and the qualitative nature of the pain.

2) The second aim was to use the remember/know paradigm to:

a) assess the involvement of episodic and semantic memory (or noetic and autonoetic consciousness) in recollections of CP pain, and;

b) investigate the extent to which participants remember pain *sensations* or previously selected pain *descriptors*. To achieve this aim, a requirement of the study was for participants to indicate whether their retrospectively selected pain descriptors reflected i) remembered sensations, and/or; ii) remembered pain descriptors, or, iii) a general feeling of 'knowing' that the pain occurred.

3) The third aim of this study was to carry out some exploratory analyses of the usage of the sensory, affective/evaluative and miscellaneous dimensions of the MPQ when making reports of expected acute pain and subsequent recollections.

4) The fourth aim of the study was to investigate the relationship between anxiety and i) ratings of CP pain, ii) Kappa values reflecting agreement between Actual and Retrospective ratings of the qualitative nature of CP pain and iii) the pattern of remember and know judgements.

5) The fifth aim was to investigate memory for the taste of an unusual vegetable drink, in order to assess memory for pain relative to another similar subjective sensory experience.

5.1.8 Hypotheses

A number of predictions were made, based upon the findings from the preliminary studies and on previous literature.

Hypotheses relating to Aim One:

1) Consistent with previous research (Erskine *et al.*, 1990, Salovely *et al.*, 1993 and see Chapter Two), it was hypothesised that Retrospective PRI, PPI, and VAS ratings, and Numbers of MPQ descriptors chosen (NWC) would be consistent with the corresponding Actual pain ratings provided when using the CP test.

2) Using multiple regression analyses, where Actual pain ratings and Expectations of pain were entered as predictor variables, it was hypothesised that both Expectations of pain and Actual pain ratings would significantly predict Retrospective pain ratings (PRI and VAS), but that Actual pain ratings would be the stronger predictor. Previous research (e.g., Kent, 1984; Gedney *et al.*, 2003; Niven and Brodie 1995, and the study reported in Chapter Two) has indicated that Expectations of pain may influence Retrospective ratings of pain, but this issue requires further clarification.

3) Based on the findings of previous studies utilising Kappa to assess agreement between the qualitative reports of pain, it was hypothesised that:

   a) Kappa values would emerge as no better than 'fair' ($\kappa \leq 0.60$) when assessing the agreement between MPQ descriptors used to express Actual pain experiences and Retrospective ratings, in line with previous studies (Beese and Morley, 1993;

Niven and Brodie, 1995; Brodie and Niven, 2000; Terry and Gijsbers, 2000), but that;

b) Kappa values reflecting the consistency of MPQ *category* selection between Actual and Retrospective ratings would be higher than previously obtained in prior pain memory research utilising Kappa.

Hypothesis relating to Aim Two:

4) It was hypothesised that participants would be able to make a distinction between the phenomenological experience of 'remembering' and 'knowing' about previously experienced pain, and between remembering the pain *sensation* and remembering selecting a particular MPQ *descriptor* to report pain experiences.

Hypothesis relating to Aim Three:

As Aim 3 was of an exploratory nature, no specific hypotheses were made regarding to this aim.

Hypothesis relating to Aim Four:

5) It was hypothesised that participants with higher levels of anxiety would provide Recollections of pain which were less similar to their Actual pain ratings than Recollections of pain provided by participants with lower levels of anxiety, and that this lack of consistency would be reflected by lower Kappa values being obtained for participants with higher anxiety.

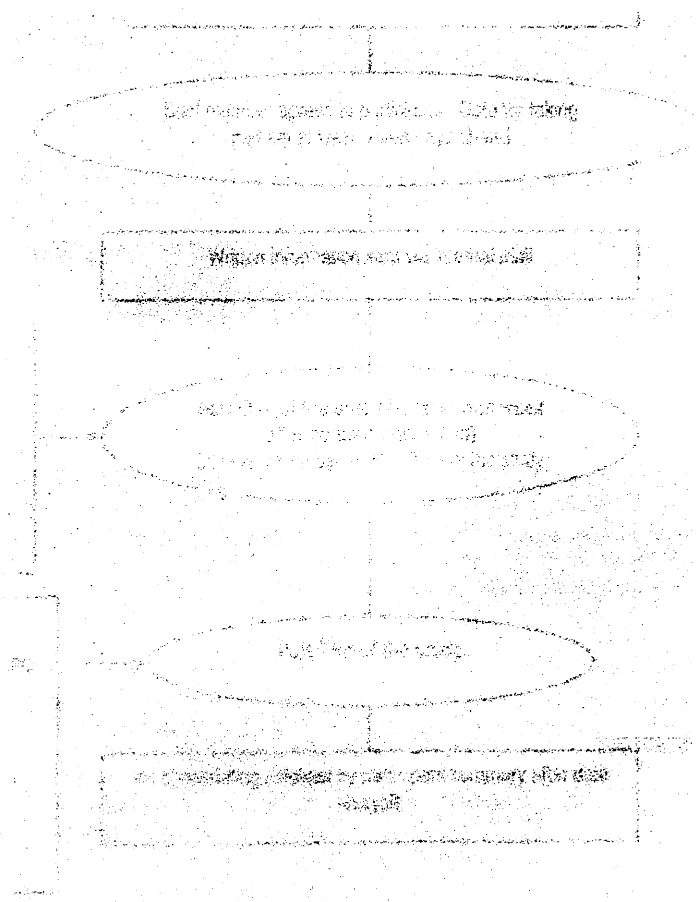
Hypothesis relating to Aim Five:

6) No differences were hypothesised in the numbers of descriptors chosen, the Kappa values (reflecting the consistency of taste descriptors chosen and the consistency of pain

descriptors), and the pattern of remember/know judgements for each sensory modality, as previous studies have not observed systematic differences in pain recall compared to recollections of other events (Hunter *et al.*, 1979; Beese and Morley, 1993).

5.2 Method

The flow diagram below in Figure 5.1 details the methods and procedure of the present study.



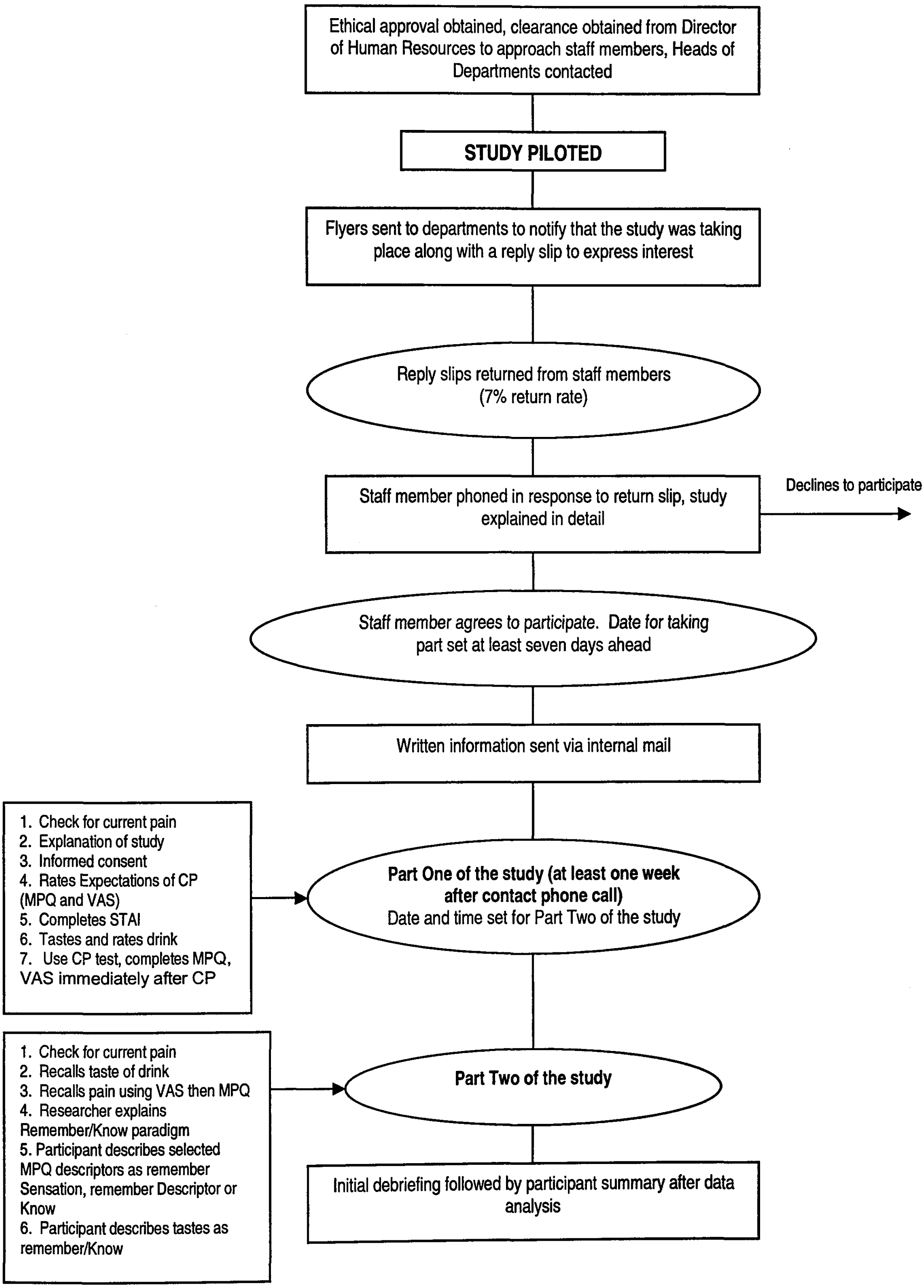


Figure 5.1: *Flow diagram of Study Three procedure*

5.2.1 Design

The study reported here was a within subject design, obtaining ratings of CP pain, ratings of the taste of an unusual drink and ratings of anxiety. In Part One of the study, participants rated their Expectations of the quality and intensity of CP pain, prior to using the CP test, and then provided Actual ratings of pain whilst using the CP test. In Part Two of the study, two weeks after using the CP test, participants provided Retrospective ratings of the CP pain.

Measures of anxiety were obtained using the STAI. During Part One of the study, state anxiety was assessed prior to using the CP test. In Part Two, trait anxiety was assessed after providing Retrospective ratings of pain.

Participants also reported their Actual ratings of the taste of the drink in Part One, whilst tasting the drink, and in Part Two, provided Retrospective ratings. Two weeks after using the CP test was considered to be an appropriate time to obtain Retrospective ratings of pain (and taste) as in clinical settings two week follow-up appointments are often routine.

5.2.2 Participants

Participants were 101 members of staff and students from the University of Stirling. In total, data from 42 men and 57 women were included in the final analyses (see screening details below in Section 5.3.1). Exclusion criteria included having diabetes, heart disease or any peripheral nerve damage or disorder involving the hand which the participants would place in the cold water.

5.2.3 Materials and apparatus

5.2.3.1 The Cold Pressor (CP) test

The present study utilised a Grant Refrigerating Circulator, (model number LTD6G) which consisted of a 150x285x155 mm water bath into which participants submerged their non-dominant hand. The CP test induces intense acute pain when participants submerse their hand and forearm into the cold water. Conventionally, the temperature of the water is set between 0 – 7 °C (see Mitchell *et al.*, 2004). In this study, the temperature was set at 5 °C ($\pm$ 0.1 °C) so that participants would not withdraw their hand from the cold water too quickly and to enable participants to re-submerse their hand in the water again in order to maintain the sensations in their hand whilst the researcher read the MPQ.

5.2.3.2 Pain assessment measures

5.2.3.2.1 The VAS

A 100 mm horizontal visual analogue scale (VAS) was provided for participants to report their Expectations of pain, Actual pain experiences and Retrospective ratings of CP pain intensity. The VAS was anchored at each end, with the words 'No Pain' on the left and 'Worst Pain' on the right. As in the preliminary studies, a VAS was the preferred method of assessing pain intensity as opposed to a NRS, in order to reduce the possibility that participants simply recall prior numerical ratings when providing Retrospective reports of pain intensity.

5.2.3.2.2 The MPQ

The full McGill Pain Questionnaire (MPQ) was used to obtain ratings of Expectations of pain, Actual pain and Retrospective reports of CP pain. The 20 MPQ descriptor categories were read to the participants in a different order at each time of testing.

The Total MPQ PRI score was calculated as were the PRI values for the sensory MPQ dimension categories (1-10), the affective/evaluative categories, (11-16), and the miscellaneous categories (17-20) (see Figure 1.2 in Chapter One). The PRI score was calculated using both the non-weighted rank scoring method proposed by Melzack (1975) and using the weighted rank (Melzack *et al.*, 1985) which theoretically takes into account the relative intensity implied by the MPQ descriptors. The Present Pain Intensity (PPI) rating scale was also used to obtain ratings of Expectations of pain, Actual pain and Retrospective reports of CP pain. The Number of Words Chosen (NWC) from the MPQ was calculated as an additional pain measure.

Melzack (1975) suggested that the MPQ should be read to participants. Many recent studies do not specify whether the MPQ was read to participants or if participants read the questionnaire themselves (e.g. Gagliese and Melzack, 2003; Mongini *et al.*, 2003; Trip *et al.*, 2004, and for an earlier review see Wilkie *et al.*, 1990). In the present study, an attempt was made to reduce the risk of any possible cueing or order effects caused by presenting the MPQ in a standard format by reading the MPQ to the participants and by ensuring that pain categories were presented in a different order at each rating time.

5.2.3.3 The taste test

The rationale for requiring participants to taste, describe and recall the flavours of an unusual drink is described above. An organic vegetable drink (from the 'Biotta' range of drinks, widely available in health food stores in Scotland) containing beetroot, celery, radish, carrot and potato was used for the taste test part of the study. The drink was dark red in colour with a strong vegetable aroma although the odour of the five juices combined did not smell like any one particular vegetable. The drink was presented to all participants in a clear plastic cup which was kept covered until immediately prior to tasting. The drink was stored in the departmental refrigerator for no more than one week (recommended to consume within eight days), after which time any drink remaining was discarded and a new bottle started. The drink was always served chilled, from the same refrigerator.

5.2.3.3.1 Taste questionnaire

The taste questionnaire (shown in Appendix 3.4) was developed by Piggott *et al.*, (1998) based on the work of Harper *et al.*, (1968). The questionnaire consists of a simple list of 57 descriptors which can be used to report a wide range of taste and smell. The numbers of words chosen, the specific descriptors selected and the consistency with which they were chosen was compared to pain descriptors selected.

5.2.3.4 Assessing anxiety

The Spielberger State-Trait Anxiety Inventory (STAI, Spielberger, 1983) was used to measure state and trait anxiety. State anxiety was measured prior to using the CP test and tasting the unusual drink. Trait anxiety was assessed two weeks after using the CP test, and after the Retrospective ratings were made.

5.2.4 Procedure

5.2.4.1 Piloting the study

Departmental Ethics approval was sought and granted, following the usual Nursing and Midwifery Departmental Ethical Application processes. After obtaining ethical approval, the study was 'piloted' by the author and her supervisors, which allowed the procedure to be fine tuned. A further three people piloted the study to ensure its smooth running, and to gauge the likely length of time required to complete each stage of the study. No further changes were made at this stage and no pilot data were used in any analyses.

5.2.4.2 Participant recruitment

Members of university staff were sent flyers (shown in Appendix 3.1) via the internal mail system notifying them that the study was taking place. It was agreed with the Stirling University Human Resources Department that any members of university staff could be contacted in this way, once the study had been ethically approved. The HR Department provided a list of all staff and their departments, which was then mail-merged onto address labels.

Once ethical approval had been granted, Heads of Department were contacted by email, prior to sending any flyers to staff memebers. The nature of the study and the proposed procedure for contacting staff were explained to the HODs. Most replied to indicate that they were happy for the flyers to be sent to their staff members. Two HODs made the proviso that staff within that department should take part in their own time.

Around 1,400 flyers were sent to most university departments to invite members of staff to take part in the study. If departments were large, every second or third member of staff from an alphabetical list was selected. If departments were small (<30 employees) all staff were sent a flyer. Reply slips were attached to the flyer which could be returned to the researcher via the internal mail, to indicate an interest in participating. Those returning the reply slip were then contacted by telephone and the study explained in more detail, and a date set to take part in the study. A checklist was used to ensure inclusion criteria were met.

In response to the flyers sent, 101 members of staff returned the reply slip to express an interest in the study. Sixteen were unable to participate due to health reasons, workload pressures or other time constraints, thus 85 of those returning reply slips subsequently took part. A further nine participants were then recruited by participants mentioning to other staff or students that they had taken part in a study, whilst an additional seven male members of staff known to the researcher were asked directly if they would participate in the study. A broad description of the participants defined by occupation is detailed in Appendix 3.5.

Overall, the mean response rate to the flyers was about 7%, but varied considerably between departments. After approximately 700 flyers had been sent it was clear that more female than male staff were responding to the flyer. A batch of around 350 flyers was sent to male staff members only, before sending a further batch of 350 flyers to both male and female staff. Data from 97 participants (40 men and 57 women) were subsequently used in the analysis (screening details below and in Appendix 3.6).

5.2.4.3 *Participant information*

The researcher took care to ensure that the instructions were given to participants in a standardised way. All participants received an information sheet (shown in Appendix 3.2) prior to taking part in the study. The time between sending the participant information sheet and participants taking part in the study was at least one week. Written consent was obtained prior to completing any questionnaires or participating in any part of the experiment.

5.2.4.4 *Procedure for Part One of the study*

Part One of the study always took place in the same room in the Nursing and Midwifery Department. On arrival, the researcher checked with the participant that written information had been received. Further explanations and details were given as required. After ensuring that participants were satisfied with the information and with the requirements of the study, participants were asked to sign a consent form (Appendix 3.3).

5.2.4.4.1 Providing Expectations of CP pain

The first requirement of Part One of the study was for participants to rate their Expectations of the CP pain using the VAS and MPQ. The MPQ was described to participants as a widely used questionnaire which can be used to describe all sorts of painful experiences. In order to provide participants with information regarding the likely nature of the CP test, participants were told the temperature of the water and told that it might feel colder than one would expect water of 5 ^{o}C to be, as the water was continuously circulating, thus preventing any heat build-up. Participants were told that the sensations of the CP might feel like handling ice, cleaning out an outdoor pond on a winter's day, and having 'painfully cold hands'. Asking participants to bear this information in mind when using the MPQ to rate their Expectations of cold pressor pain, the

MPQ was read to the participants, who selected descriptors to communicate their Expectations of the CP sensations.

5.2.4.4.2 Anxiety ratings

Participants were then asked to complete the state section of the STAI which was described as 'a questionnaire which asks how you are feeling at the moment'. At this point in the procedure, participants were left alone for three or four minutes to complete the STAI whilst the researcher prepared the taste test phase of the study.

5.2.4.4.3 The taste test

At the taste test phase of the study, the researcher checked with participants that they had no allergies to food. It was made clear that the drink was vegetarian, organic, contained no nuts or oils and was always stored in a refrigerator. Although participants were told that the drink contained no meat products and no artificial additives, no additional information about its contents was provided until after all data for that participant had been completed. Participants were told that they did not need to consume or swallow all of the drink and if the taste was too unsavoury for them, that it would be perfectly acceptable to spit the drink out into a cup provided. Only one person chose to do this. The participants were also offered a glass of cold water, either to freshen their palate before tasting the drink, or after the taste test had been completed.

The list of taste descriptors (shown in Appendix 3.4) was read to participants as they took sips of the drink. Participants were asked to select any of the descriptors if they felt it could appropriately communicate either the smell or the taste of the drink. No requirements were made of the participant to distinguish between taste and smell, as prior research has found that drinks which have no flavour but contain odorants are in fact perceived as having the taste of the odorant (Algom *et al.,* 1993).

5.2.4.4.4 The CP test

After rating their Expectations of the CP pain using the VAS and MPQ, completing the state section of the STAI and rating the taste of the drink, participants were then asked to use the CP. It was explained again to the participants that the aim of the study was to investigate memory for subjective experiences; for the cold and for the taste. For this reason, participants were told that they should not use distraction techniques in order to keep their hand in the cold water. Participants were told that it was not essential that they should retain their hand in the water whilst the whole MPQ was read. Rather, they were told that they should take their hand out of the water once the cold became intolerable, but to replace their hand in the water if they felt able, and if the researcher was still reading the MPQ. Nearly all participants removed and then replaced their hand from the water at least once whilst the MPQ was being read out to them.

Once the participants had initially submerged their hand in the water, the researcher waited a few seconds before starting to read the MPQ. This was to ensure that the participants had the opportunity to experience the sensations of the cold before the MPQ descriptors were presented to them. If participants did not hear a MPQ descriptor, or requested a descriptor to be repeated, the whole MPQ category was re-read. When the whole of the MPQ had been read to the participants, they were told that they could remove their hand from the water and dry it. As soon as the participant had dried their hand, they were asked to mark on the VAS the level of any pain experienced.

A suitable time to complete Part Two of the study was then arranged with each participant. Most participants were happy to meet at the same time, two weeks later. In all cases, the second part of the study took place in a room other than the room used for the CP test, in order to reduce contextual cues. Participants who were unable to use their own office or workspace came back to the Nursing and Midwifery Department, and were seen by the researcher in a room other than the one where the CP test took place, in order to eliminate any visual or situational cues.

5.2.4.4.5 Remuneration

Participants were not told of any incentive or payment prior to participating in Part One of the study. However, after completing Part One of the study and after arranging a time for the second meeting, a £5 shopping voucher was given to participants in a card as an acknowledgment of the researcher's appreciation of the participants' interest in the research. One participant refused the voucher, stating that he was happy to participate in the study without payment.

5.2.4.5 Procedure for Part Two of the Study

5.2.4.5.1 Recalling the taste of the drink

In Part Two of the study, participants were first asked to recall the taste of the vegetable drink as the taste questionnaire (the same as that shown in Appendix 3.4) was read to them. Participants were reminded that the drink was a 'red vegetable drink' and that it had been presented to them in a clear plastic cup. They were not reminded that it had been stored in a fridge (and was therefore cold). The list of taste descriptors was read to the participants in a different order to the first presentation.

5.2.4.5.2 Retrospective ratings of pain and remember/know instructions

After participants had used the list of taste descriptors to provide a recollection of the flavours of the vegetable drink, they were asked to think back to the CP test and try to recall the sensations experienced, as the MPQ was read to them. They were then told that they would be asked to make a memory judgement about the words they had just selected to describe their recollections of the CP pain and the taste. The participants were unaware before this point that they would be required to make further judgements regarding the nature of their recollections, and the remember/know paradigm was not explained to the participants until they had provided Retrospective ratings of both the taste and the CP pain.

It was crucial that the remember/know instructions were presented in a standardised way that all participants would understand. For this reason, a protocol was produced and adhered to, based on previous research (Rajaram, 1993; Herbert and Bert, 1998) and the same description of remembering and knowing was given to all participants as detailed below.

> 'If I asked you what colour a post box is, you would know that generally, in Scotland, post boxes are red. You would not need to think back to when you last saw one, you just 'know' that post boxes tend to be red'.
>
> 'On the other hand, if I asked you when you last *saw* a post box, you would need to think of a very specific moment in your 'personal past'; you might also *remember* what the weather was like or if you had a letter to post. Within that experience, there are things that you will consciously *remember* (e.g. it was raining) and things that you simply know occurred, for example

you know that you had several letters to post, but can't remember who they were all to'.

'In the same way, thinking about the cold pressor test, you might *remember* specific aspects of the cold pressor test, perhaps for example, you might remember feeling a specific sensation just before you removed your hand, or a few seconds after you had placed your hand in the water.

So, sometimes, you might have clearly, consciously remembered specific sensations and feelings. At other times, you might have remembered yourself selecting a particular word whilst you were using the Cold Pressor, and that is why you selected it this time. So, as I read back to you the *(X number)* of words that you have just selected can you tell me:

- whether you *remember feeling the sensation* that is described by the word
- whether *you remember selecting the word* whilst using the Cold Pressor'

Alternatively, you may have selected some words from the MPQ just now because you just 'know' that they seem like appropriate words to use to describe your recollections of the CP test'.

'Please only judge a pain/taste descriptor as 'remember' if you can consciously recall the specific sensation that the word describes or can remember yourself selecting the word whilst using the CP.

Anything else is a 'know' judgement. That is, you 'know' that the word you have just picked is right to describe your recollection of the cold.'

Participants were given the opportunity to describe their understanding of remembering and knowing. Additional examples of the distinction between the two states of awareness were provided, such as instantly recognising and remembering an old friend, or the feeling of 'knowing' that arises from seeing a familiar face, but being unable to remember exactly how the person is known. Once participants had made remember sensation/remember word and know judgements about the CP pain, they were asked to do the same for the taste descriptors they had selected.

5.2.4.5.3 Ratings of trait anxiety

After the remember/know judgements had been made, participants were asked to complete the trait section of STAI.

5.2.5 Statistical analyses

5.2.5.1 Power calculations

The statistical package 'G power' (Faul and Erdfelder, 1992) was used to calculate that a participant sample size of 94 would be sufficient for a study using multiple regression analysis with six predictor variables (that is ratings of Expectations of pain, Actual ratings of pain, state and trait anxiety, age and gender) with 80% power and alpha set at 0.05 medium effect size, 0.15).

5.2.5.2 Data processing

All participants' raw data were entered into Excel spreadsheets. A spreadsheet template was used for each of the participants which contained all taste and pain data. These spreadsheets were set up to calculate the variables subsequently entered into SPSS. Spreadsheets were also set up for the sensory and non-sensory dimensions of the MPQ. Separate Excel spreadsheets were used to calculate the participants' use of the individual MPQ descriptors and categories, and the taste descriptors. This method of data handing considerably reduced the potential for errors in calculations and allowed the data to be manipulated more easily. Weighted rank and non-weighted rank data were also calculated using Excel spreadsheets. SPSS was used for all statistical analyses.

5.2.5.3 Data analyses

5.2.5.3.1 Correlation and regression analysis and ANOVA

In addition to summary and descriptive statistics, regression and multiple regression analyses, and ANOVAs, where appropriate, were used to investigate relationships between pain ratings, taste descriptions and anxiety ratings. In ANOVAs, Greenhouse-Geisser corrections are presented when the sphericity assumption is violated (Mauchly's Test of Sphericity, $p<0.05$). All post-hoc pairwise comparisons used a Bonferroni correction for multiple comparisons. It has been argued that the calculation of the non-weighted rank PRI values provides ordinal data and subsequent analyses should therefore only entail the use of non-parametric statistical tests (Duncan *et al.*, 1989). In this study the PRI scores were calculated using both the weighted rank method (providing parametric data) and the non-weighted rank ordering scale. In all analyses, the Weighted Rank -PRI values were used.

5.2.5.3.2 Pain Profiles

Pain Profiles have been used in prior research to illustrate the pattern of most frequently used descriptors to report different syndromes (e.g., Brodie and Niven, 1995). In this study, Pain

Profiles provide a clear visual comparison of the pattern of MPQ descriptors and categories used to describe the CP pain.

5.2.5.3.3 Cohen's Kappa

Cohen's Kappa was used to assess the agreement between each participant's ratings of their Expectations of CP pain, their Actual pain experiences when using the CP, and Retrospective ratings of CP pain. Kappa was used to assess agreement between MPQ descriptor use and MPQ category use. As in the preliminary study with the vascular surgery patient participants, Kappa was used to compare:

1) Actual pain ratings and Retrospective ratings. In previous studies Kappa values reflecting consistency between Actual pain ratings and Retrospective ratings have been taken as indication of memory accuracy.

2) Expectations of pain and Actual pain ratings, which provided a measure of how closely the participants' ratings of their Expectations of pain matched their Actual pain ratings.

3) The agreement between Expectations of pain and Retrospective ratings, to obtain a measure of the how Retrospective ratings reflect Expectations of pain.

Kappa was also calculated to provide a measure of how consistently each of the most frequently selected MPQ descriptors and categories were used across each assessment time. In the taste test, Kappa values were obtained as a measure of agreement between participants' Actual ratings of the taste of the drink and Retrospective ratings. Kappa was also used to investigate how consistently each of the most frequently selected taste descriptors were used across assessment times.

5.2.5.3.4 Remembering and knowing

As described above, two weeks after using the CP test, participants were asked to provide Retrospective ratings on the pain using the MPQ and a VAS. Having done this, the remember/know paradigm was explained. Participants could rate their selected MPQ descriptors as 'remember sensation' 'remember word' or 'know'. The proportions of these endorsements were then calculated to ascertain the proportion of 'remembering' and 'knowing' involved in the Retrospective pain ratings. If participants made a remember judgement they were asked to indicate whether their memories related to the sensation alone, the descriptor alone, or a conscious recollection of experiencing the pain and selecting the descriptor. Therefore the proportions of remember and know judgements for each participant did not equal one.

5.3 Results

5.3.1 Data Screening

The data were initially screened following the guidelines in Tabachnik and Fidell (2001). Outliers in the data were investigated by transforming the MPQ PRI scores, remember/know proportions and VAS and anxiety scores to *Z* scores. *Z* scores greater than 3.3 and disconnected from the distribution of scores were considered to be outliers and removed. One participant was identified as an outlier in their MPQ data and was excluded from further analysis, and one participant was identified as an outlier in their taste data and was removed from analyses. Skewness and kurtosis were investigated by dividing the skewness and kurtosis values by their respective standard errors. Levels of skew and kurtosis were considered to be significant when skewness/SE skewness and kurtosis/SE kurtosis ≥ 3.3, and none of our data exceeded this level. There are differences of opinion regarding when skewness should be considered problematic. For example, some have argued that skewness and/or kurtosis should be considered problematic if skewness or kurtosis is more than four times greater than its standard error. The slightly skewed nature of our data did not warrant transformation, given the nature of our data, the sample size, and the extent of skew. Appendix 3.6 contains SPSS output tables showing descriptive statistics for weighted rank MPQ scores, VAS scores, state and trait anxiety ratings, and details of removed outliers.

5.3.1.1 Missing data

One hundred and one participants agreed to take part in the study. Two participants who initially responded to the flyer had chronic pain and one of these also had heart disease. These participants wanted to participate in the taste test part of the study even though the exclusion criteria prevented them participating in the CP. One participant did not return for Part Two of the study and their data from Part One of the study was excluded from the analysis. When these data and that of the outlier were removed, the total sample size for the pain study was 97, and 98 for the taste test. Two participants did not have time to complete the trait anxiety questionnaire, and the Retrospective PPI score was missing for one participant. The missing data for these three cases was replaced with mean scores. Although Tabachnik and Fidell (2001) point out the possibility of biasing results through the reduction of variability within the variables, when replacing missing values with mean values, the effect on variability and the possibility of biasing results here was considered to be minimal. The remember/know data given by six participants were considered to be outliers and removed. The other pain, anxiety and taste data for these participants were retained.

5.3.2 Age and gender

Data were obtained for Part One and for Part Two of the study from 42 men and 57 women. The mean age for women was 39.9 (sd 9.7) and 46.4 for men (10.8). The mean age for all participants was 42.5 (sd 10.6). Independent *t* tests found significant age differences between gender ($t(96) = 3.1$, $p=0.002$). It was not a specific aim of the present study to investigate gender and age in relation to memory for pain, but as gender effects have often been observed in both taste and pain research (e.g., Larsson *et al.*, 1993; Keogh and Herdenfeldt, 2002) as well as age (e.g., Gagliese and Melzack, 2003), these variables were considered in the analyses and reported here. The level of statistical power was .78 for *t* tests between gender (medium effect size, $p=0.05$). No significant gender differences in any pain or anxiety scores were found ($p>0.05$), with the exception of Expectations of pain rated using the MPQ PPI rating scale, which were slightly higher for women (1.9, sd 0.84) than for men (1.6 sd 0.69; $t(96) = 2.031$, $p=0.046$).

No significant correlations were observed between age and MPQ scores, NWC or PPI scores ($p>0.05$). But a significant positive correlation between Actual VAS ratings and age was observed, ($r=0.26$, $p=0.01$) and between Retrospective VAS ratings of pan and age ($r=0.25$, $p=0.01$). That is, there was some tendency for older participants to report greater levels of pain using the VAS immediately after using the CP test (Actual pain VAS ratings) and to provide higher Retrospective ratings two weeks later. No other relationships between age and the other variables were observed.

5.3.3 Current pain

At Time One, prior to using the CP test, participants were asked if they were experiencing any (non-chronic) pain such as headaches or menstrual pain. Pain extraneous to the CP pain during the initial testing phase may have confounded data given regarding CP pain, and pain experienced whilst attempting to recall pain is widely accepted to affect memory for pain (Eich *et al.*, 1985; Smith and Safer, 1993). Seven participants reported experiencing some level of pain at Time One, whilst 14 were experiencing some kind of pain when completing Part Two of the study. A record was made of the reasons for the pain, which included, back pain, headache or other daily 'aches and pains'. Prior to using the CP test, the mean VAS ratings of pain for the seven participants was 29.0 (sd 16.0). When making the Retrospective ratings, the mean VAS rating for the 14 participants reporting extraneous pain was 22.2 (sd 1.6). Independent t tests were carried out to investigate the differences between ratings made by those in pain and those who were not. No significant differences in pain variables were found between participants experiencing pain and those who were pain free when the ratings were made (all $p>0.05$). As the types of pain were so diverse and non-specific, and the t tests revealed no difference in pain ratings between those who were and were not experiencing pain unrelated to the CP test, the data from these participants were not excluded from the analysis.

The section below reports the results in relation to the aims set in section 5.1.7 above.

5.3.4 Results pertaining to Aim One

5.3.4.1 Analysis of Global Pain Ratings (WR-PRI, Number of Words Chosen, PPI and VAS)

The Total PRI ratings were calculated using the non-weighted scoring method proposed by Melzack (1975) and weighted rank (WR) method proposed by Melzack *et al.*, (1985). Mean non-weighted PRI values for Expectations were 24.7 (sd 9.0), for Actual pain 28.9 (sd 11.8) and for Retrospective ratings 29.1 (sd 12.1). As described in Chapter One, there has been some debate as to the extent to which the non-weighted rank PRI values reflect the intensity implied by the descriptor. Therefore, the Weighted Rank (WR) values, detailed in Table 5.1, were used in all subsequent analyses. Full descriptive statistics for WR-PRI ratings are shown in Appendix 3.6. The non-weighted PRI values were calculated simply for comparative purposes and confirm that, in agreement with Melzack (1987), the differences in PRI values calculated using the weighted and non-weighted method are, in fact, very small.

	Pain Expectations	**Actual Pain**	**Retrospective Ratings**
Total-PRI	24.0 (10.0)	29.0 (13.1)	28.7 (13.0)
NWC (sd)	10.2 (3.3)	11.1 (3.7)	10.7 (3.5)
MPQ-PPI	1.8 (.77)	2.5 (1.2)	2.6 (1.1)
VAS (0-100 mm)	29.6 (18.6)	52.7 (23.2)	52.7 (21.9)

Table 5.1. Mean Weighted Rank PRI ratings, Number of Words Chosen (NWC), PPI and VAS Ratings

Two repeated measures ANOVAs were performed for WR-PRI ratings and PPI ratings and a significant effect observed for both (WR-PRI: $F(2,192) = 13.78$, $p<0.001$; PPI: $F(2,190) = 31.68$, $p<0.001$, Greenhouse-Geisser corrected). As the means suggest, (detailed in Table 5.1), post-hoc pairwise comparisons (Bonferroni adjusted) confirmed that Expectations of pain (WR-

PRI and PPI) were significantly lower than Actual and Retrospective ratings ($p<0.001$). No significant differences were found between Actual and Retrospective ratings, both $p>0.05$.

A repeated measures ANOVA to investigate differences in the Number of Words Chosen (NWC) between rating times was performed and a significant effect observed ($F(2,192) = 5.78$, $p=0.007$, Greenhouse-Geisser corrected). Pairwise comparisons (Bonferroni adjusted) showed that Expectations of pain were significantly lower than Actual ratings ($p=0.009$). No significant differences were found between Actual and Retrospective and between Expectations of pain and Retrospective ratings (means and sd detailed in Table 5.1).

A repeated measures ANOVA was performed to investigate differences in VAS ratings and a significant effect observed ($F(2,192) = 88.55$, $p<0.001$, Greenhouse-Geisser corrected). Post-hoc pairwise comparisons (Bonferroni adjusted) confirmed the significant difference between Expectations of pain and both Actual and Retrospective pain ratings ($p<0.001$). There was no difference in the ratings of Actual pain and Retrospective pain ratings (means and sd detailed in Table 5.1).

5.3.4.1.1 Correlations between WR-PRI ratings

Correlations between the PRI ratings were all statistically significant, although the correlation between Actual pain and Retrospective ratings were clearly stronger than other ratings (Actual pain and Retrospective ratings, $r = 0.80$; Expectations of pain and Actual pain, $r = 0.53$; Expectations of pain and Retrospective ratings $r = 0.53$ $p<0.001$). The differences in the strengths of the correlation coefficients were investigated by transforming the r values into z scores and, using the formula detailed in the results section of Chapter Two, testing for significant differences. The X^2 significance level was found on a standard chi-square table detailed in Tabachnik and Fidell (2001) and the differences between the strengths of the correlation coefficients were found to be significant (r = 0.80 and .53; X^2= 13.32, $p<0.01$).

5.3.4.1.2 Correlations between VAS ratings

Correlations between VAS ratings to describe Expectations of pain, Actual ratings and Retrospective ratings were as follows: Expectations of pain and Actual pain ratings, $r = 0.50$ $p<0.001$; Actual pain ratings and Retrospective ratings, $r = 0.83$, $p=0.001$; Expectations of pain and Retrospective ratings, $r = 0.34$, $p=0.001$). The correlation coefficients for Actual pain and Retrospective pain ratings and for Expectations of pain and Actual pain ratings were significantly stronger than the correlations between Expectations of pain and Retrospective ratings ($X^2 = 18.45$, $p<0.001$).

5.3.4.1.3 Correlations between PPI ratings

Expectations of the overall intensity of CP pain, measured using the PPI section of the MPQ were 1.8, and were significantly lower than Actual and Retrospective PPI ratings (2.5 and 2.6, respectively). Actual pain PPI ratings were significantly correlated with Retrospective ratings (r = 0.74, $p<0.001$), and Expectations of pain were significantly correlated with Actual pain ratings, (r = 0.27, p=0.007). There was, however, no significant correlation between Expectations of pain rated using the PPI and Retrospective PPI ratings, ($r = 0.19$, $p>0.05$).

It was hypothesised that both Expectations of pain and Actual pain ratings would predict retrospective pain ratings (WR-MPQ and VAS), but that Actual pain would be the stronger predictor. As this is included in a regression analysis which incorporates anxiety, this is reported in detail in 5.3.7.3 below.

5.3.4.2 Comparisons between VAS and WR-PRI ratings

Correlations between pain ratings using the VAS and the WR-PRI were significant: VAS and WR-PRI Expectations of pain r = 0.58, Actual Pain 0.53, Retrospective ratings, 0.53, all $p<0.001$.

5.3.4.3 Kappa analysis to investigate agreement in MPQ descriptor and category use across assessment times

Participants could select from 78 MPQ descriptors, presented in 20 categories, to describe the Expectations of pain, to report their Actual pain experiences, and to provide Retrospective reports of the CP pain two weeks later. Prior studies have calculated Kappa to reflect the agreement between each participant's MPQ ratings made whilst in pain and then when pain free, and the mean Kappa values have been used as a measure of the extent to which participants are able to recall their pain experience. In the present study, Kappa values were calculated for each participant comparing agreement between 1) Expectations of pain and Actual pain ratings, 2) Expectations of pain and Retrospective ratings and 3) Actual pain ratings and Retrospective ratings. These comparisons were calculated for both the MPQ descriptors and MPQ categories. The mean Kappa values for each comparison are detailed in Table 5.2. A repeated measures ANOVA comparing the three Kappa values reflecting agreement between MPQ descriptor choice revealed significant differences ($F(2,192) = 16.20$, $p<0.001$). Pairwise comparisons (Bonferroni adjusted) demonstrated that all Kappa comparisons between the different assessment times were significantly different from one another ($p<0.05$); the highest Kappa values were found when comparing Actual pain ratings with Retrospective ratings. The least agreement between pain rating times was found between the descriptions of Expectations of pain and Actual Pain ratings.

A repeated measures ANOVA also revealed significant differences between the three Kappa comparisons for the MPQ *categories* ($F(2,186) = 7.54$, $p=0.001$, Table 5.2). Pairwise comparisons demonstrated that Kappa values reflecting agreement between Actual pain ratings and Retrospective ratings was significantly greater than the other two comparisons ($p<0.01$). Kappa values reflecting agreement between Expectations of pain and Actual pain and those reflecting agreement between Expectations of pain and Retrospective ratings were not significantly different from one another ($p>0.05$).

Kappa Mean (sd)	Expectations of pain and Actual pain	**Actual pain and Retrospective ratings**	Expectations of pain and Retrospective ratings
Descriptor	.33 (.21)	**.45 (.18)**	.38 (.23)
Category	.54 (.21)	**.61 (.16)**	.53 (.18)

Table 5.2. Kappa values reflecting the consistency of MPQ descriptor use at each assessment time and MPQ category use at each assessment time

5.3.4.3.1 Correlations between Kappa values

Correlation analysis revealed that the Kappa values comparing Expectations of pain, Actual pain and Retrospective ratings of pain were significantly positively correlated. For both the MPQ descriptors and the MPQ categories, the Kappa values reflecting agreement between Actual pain ratings and Retrospective pain ratings were significantly correlated with the Kappa values reflecting agreement between Expectations of pain and Actual pain ratings (descriptors $r = 0.32$,

p= 0.001; categories: r = 0.29, p=0.005). Similarly, the Kappa values reflecting agreement between Actual pain and Retrospective pain ratings were also significantly correlated with the Kappa values reflecting agreement between Expectations of pain and Retrospective ratings of pain; (descriptors r = 0.30, p=0.002; categories r = 0.24, p=0.021). The highest correlation was observed between Kappa values reflecting agreement between Expectations of pain and Actual pain and the Kappa values reflecting agreement between Expectations of pain and Retrospective pain (descriptors r = 0.60, p<0.001, categories r = 0.51, p<0.001). Thus, if Expectations of pain were consistent with Actual pain ratings, in turn, Retrospective ratings were more likely to match Expectations of pain.

5.3.4.4 Patterns of MPQ descriptor and category use

The descriptors most frequently chosen from the MPQ (by >10% of participants at any of the three assessment times) to report Expectations of pain, Actual experiences and Retrospective pain ratings are shown in the Pain Profile in Figure 5.2 below, and a Pain Profile illustrating the frequency of MPQ category use is shown in Figure 5.3. These Profiles depict the relatively low usage of the affective descriptors and categories and show that whilst those used to describe Expectations of pain were somewhat dissimilar to those used in subsequent ratings, descriptors and categories used to report Actual pain and those chosen to provide Retrospective reports were more similar to one another.

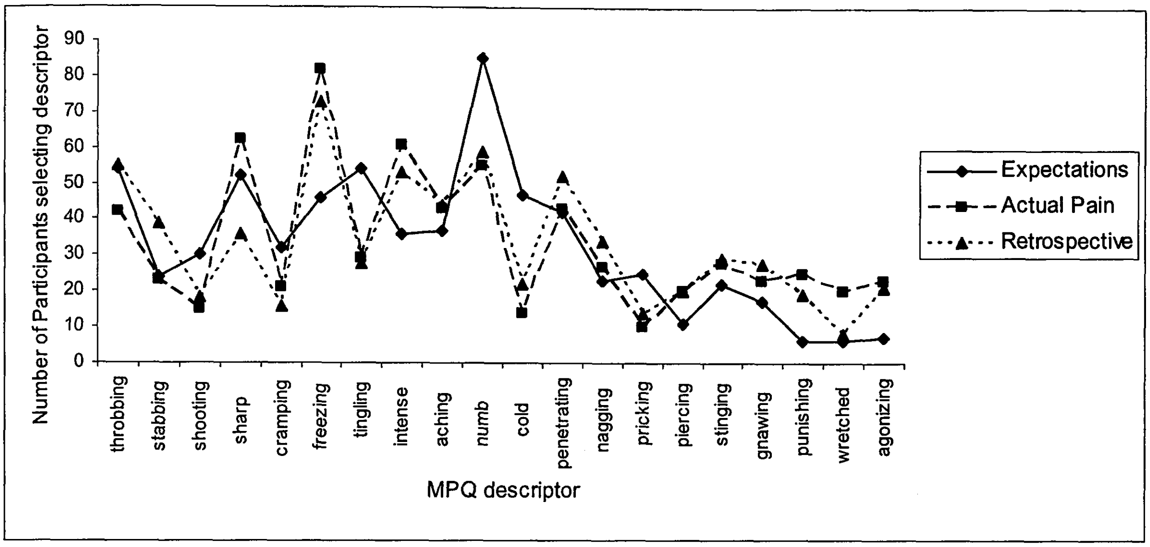


Figure 5.2: *Mean number of times MPQ descriptors selected to report Expectations of pain, Actual pain, and Retrospective ratings of CP pain*

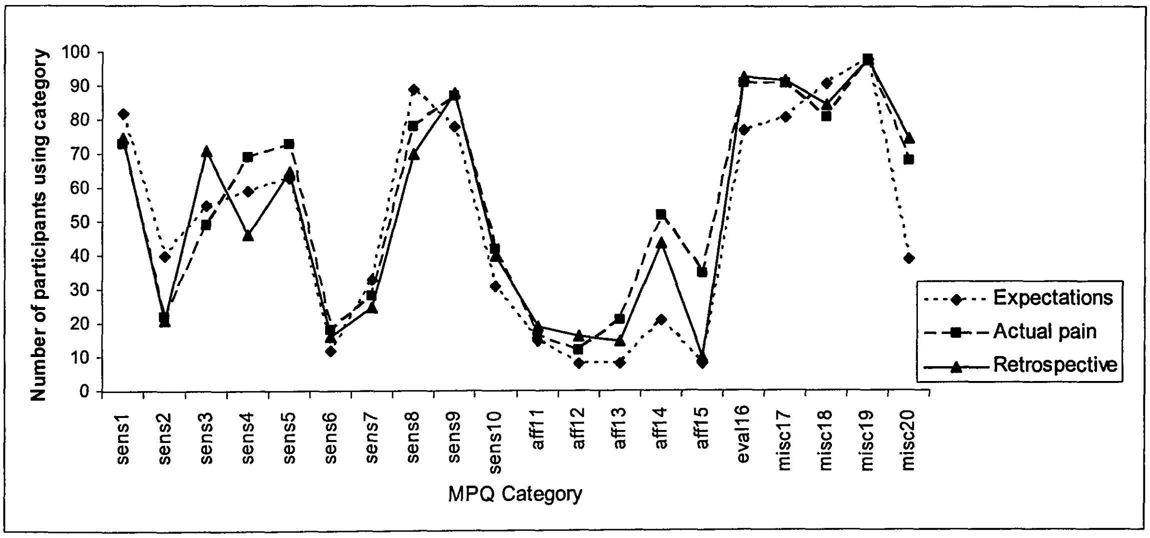


Figure 5.3: *Mean number of times MPQ categories selected to report Expectations of pain, Actual experiences, and Retrospective ratings of CP pain*

5.3.4.4.1 Analyses of MPQ descriptors and categories selected using Cohen's Kappa

The Pain Profiles (Figure 5.2 and Figure 5.3) illustrate the frequency of MPQ descriptor or category use when expressing Expectations of pain, Actual pain experiences and Retrospective ratings of pain. These Profiles, however, do not reflect the extent to which the participants consistently selected (or did not select) each of the MPQ descriptors and categories. In this study, Kappa values were calculated to provide a measure of agreement between the individual MPQ descriptors and categories used across each of the pain rating times. Kappa was calculated for each of the MPQ descriptors selected by more than 10% of participants at any of the assessment times, and for the MPQ categories. In this way, the agreement between MPQ descriptor choice to express Expectations of pain and Actual pain, Actual pain and Retrospective ratings, and Expectations of pain and the Retrospective ratings was assessed. Details of each MPQ descriptor category and rank, the number of times the descriptor was selected and the Kappa values comparing descriptors used on three questionnaires are shown in Appendix 3.7. For clarity, these are graphically illustrated in this Results section. Figure 5.4 details the agreement between individual MPQ descriptors and Figure 5.5 details agreement between MPQ category use.

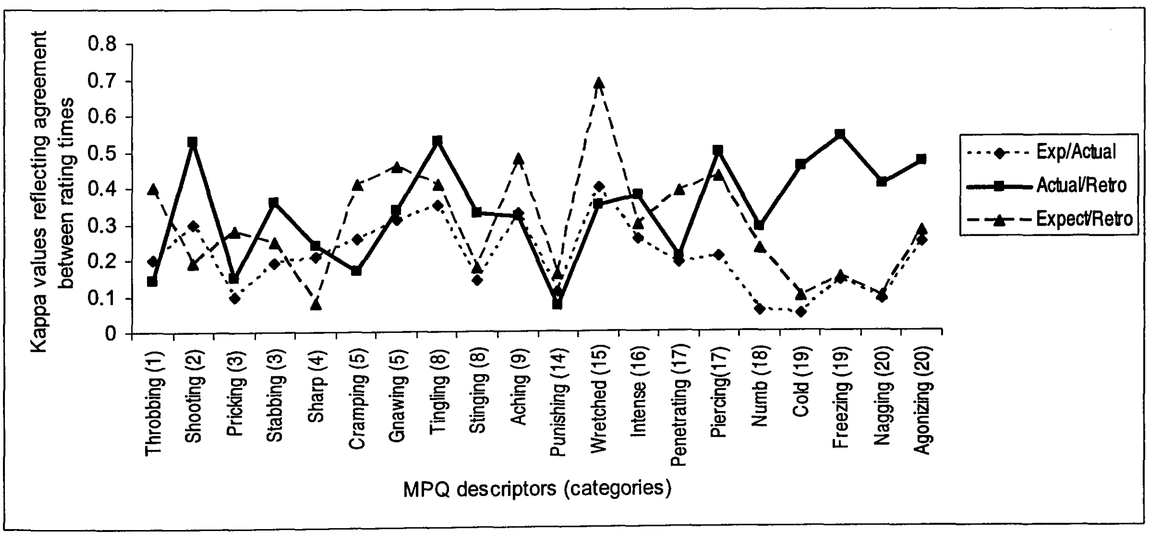
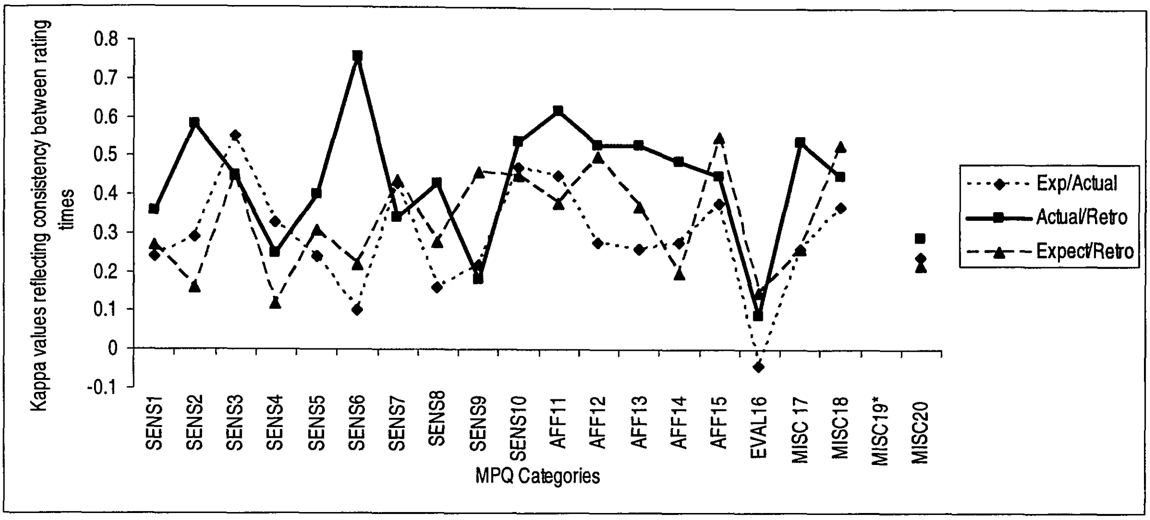


Figure 5.4: Kappa values for each of the most frequently selected MPQ descriptors

The mean Kappa score comparing each descriptor used to express Expectations of pain and Actual pain was 0.21 (sd 0.10). Kappa values comparing descriptors used to express Actual pain and Retrospective ratings was 0.34 (sd 0.14). Kappa values comparing descriptors used to report Expectations of pain and Retrospective ratings was 0.30 (sd 0.16). A one-way ANOVA with repeated measures was used to investigate differences in mean Kappa values across the three comparisons of individual MPQ descriptor selection and a significant effect was observed ($F(2,38) = 6.436$, $p=0.013$, Greenhouse-Geisser corrected). Pairwise comparisons (Bonferroni adjusted) demonstrated that the Kappa values reflecting the agreement between Actual pain descriptions and Retrospective ratings were significantly higher than Kappa values reflecting consistency between Expectations of pain and Actual pain ratings ($p=0.007$). The Kappa values reflecting consistency between Actual and Retrospective descriptor choice were not significantly higher than Kappa ratings reflecting agreement between Expectations of pain and Retrospective ratings, $p>0.05$).

The Kappa values calculated to reflect the agreement between each of the MPQ *categories* selected at each rating time are shown in Figure 5.5. The mean Kappa value comparing the use of each MPQ category to describe Expectations of pain and Actual pain was 0.28 (sd 0.15). The mean Kappa value reflecting agreement between each category used to describe Actual pain and Retrospective ratings was 0.41 (sd 0.18). The mean Kappa value reflecting agreement between the categories selected to describe Expectations of pain and Retrospective descriptor selection was 0.32 (sd 0.15). A repeated measures ANOVA was carried out to compare kappa values reflecting agreement between MPQ category use and a significant effect was found ($F(2,186) = 7.54$, $p=0.002$). Post-hoc pairwise comparisons (Bonferroni adjusted) confirmed that Kappa values reflecting agreement between category use to express Actual pain and Retrospective reports were significantly higher than the other Kappa comparisons ($p<0.05$).



* Kappa cannot be calculated for Category 19. All participants chose descriptors from this category. There is no variation, and therefore no shared variation; thus there is no 'evidence' on which to base whether or not there is agreement between assessment times

Figure 5.5: *Kappa values for each of the most frequently selected MPQ categories*

5.3.5 Results pertaining to Aim Two

The remember/know research paradigm was used to assess the phenomenological experience of recalling acute pain. When providing Retrospective ratings of pain, two weeks after using the CP test, participants were first asked to select descriptors from the MPQ as it was read to them to express their recollections of CP pain. Participants were then requested to make remember/know judgements about the MPQ descriptors they had just chosen. Participants were asked to indicate whether they consciously remembered the *sensations* implied by the MPQ descriptor that they had chosen (remember sensation), and/or whether they consciously remembered selecting the *MPQ descriptor* whilst using the CP test (remember word). Alternatively, if participants did not feel that they remembered either the sensation or selecting the descriptor they were asked to report that they simply 'knew' that the descriptor chosen was appropriate to describe their recollections of the CP pain (a know judgement). Remember sensation and remember word judgements were assumed to reflect that the participant also knew that the pain descriptor was appropriate, (that is, in line with Tulving's (1985) hypothesis, remember judgements are assumed to reflect a higher level of conscious recollection, or episodic recall, which presupposes the involvement of semantic memory, or knowing).

All participants felt that they remembered (consciously recalled) some of the pain sensations reflected by the MPQ descriptors they had chosen, but not all participants chose to endorse MPQ descriptors on the Retrospective questionnaire as either remember word or know. Fifty-eight per cent of participants endorsed at least one MPQ descriptor as remember word, whilst 74% of the participants endorsed at least one MPQ descriptor as know. Table 5.3 details the proportion of Retrospective descriptors judged as remember sensation, remember word and know. Because participants could report that they remembered selecting the descriptor *and* remembered the *sensation*, the total number and proportion of remember sensation, remember word and know judgements was greater than 1.0.

Endorsed as:	**Remember sensation**	**Remember word**	**Know**
Mean proportions	0.73 (0.18)	0.20 (0.21)	0.23 (0.17)
Range	0.3 – 1	0.0 – 0.75	0.0 – 0.63

Table 5.3. Mean proportions of MPQ descriptors selected as remember sensation, remember word or know

The proportions of MPQ descriptors selected Retrospectively and then endorsed as remember sensation, remember word and know were compared to those selected to report Actual pain experiences. Table 5.4 shows the proportion of Retrospective MPQ descriptors endorsed as remember and know that were selected whilst using the CP to report Actual pain. A one-way

ANOVA revealed no significant differences between the proportions of words correctly endorsed as remember sensation, remember word and know, ($F(2,219) = 2.35, p>0.05$).

Endorsed as:	Remember sensation	Remember word	Know
Mean	.57 (.20)	.58 (.35)	.48 (.36)
Range	*0.13 - 1*	*0.0 – 1.0*	*0.0 – 1.0*

Table 5.4. Mean proportions of MPQ descriptors endorsed as remember sensation, remember word or know that correspond to descriptors used to report Actual pain experiences

The proportions of Retrospective descriptors judged as remember sensation, remember word and know were also compared to the descriptors selected to express Expectations of pain. Table 5.5 shows the proportion of remember and know judgements for the MPQ descriptors which agreed with those chosen to express the participants' Expectations of pain. A one-way ANOVA revealed significant differences between the proportions of words correctly endorsed as remember sensation, remember word and know, ($F(2,219) = 11.08$, $p<0.001$). Post-hoc pairwise comparisons (Bonferroni adjusted) revealed that the differences were significant between remember sensation and know ($p=0.004$) and between remember word and know ($p<0.001$), but not between remember sensation and remember word ($p>0.05$). Thus, remember judgements significantly more often corresponded to descriptors used to communicate Expectations of pain than did the know judgements.

Endorsed as:	Remember sensations	Remember word	Know
Mean	.51 (.25)	.59 (.35)	.35 (.31)
Range	0.00 – 1.00	0.00 – 1.00	0.00 – 1.00

Table 5.5. Mean proportions of MPQ descriptors endorsed as remember sensation, remember word or know that correspond to descriptors used to express Expectations of pain

The proportions of remember and know judgements correctly corresponding to Actual pain ratings were compared to the proportions which corresponded to descriptors selected to describe Expectations of pain. The proportion of descriptors endorsed as remember sensation which correctly corresponded to those chosen to report Actual pain ratings, was 0.57. This proportion was significantly greater than the proportion of descriptors endorsed as remember sensation which corresponded to Expectations of pain (0.51), ($t(1,90)=2.53$, $p=0.01$). Similarly the proportion of words retrospectively judged as 'know' corresponded significantly more often to Actual pain ratings (0.48) than those used to express Expectations of pain (0.35); ($t(1,71)$, $= 2.54, p=0.01$).

5.3.5.1 Remembering and knowing MPQ categories

As participants could only select one descriptor from any MPQ category, the proportions of *categories* endorsed as remember sensation, remember word and know are the same as the proportion of descriptors, detailed in Table 5.3. However, the proportions of categories containing MPQ descriptors endorsed as remember and know which matched those used to report Actual pain ratings was calculated, and are shown in Table 5.6. Participants were generally highly consistent in their use of MPQ categories to describe CP pain.

Categories endorsed as:	Remember sensation	Remember word	Know
Mean	.87 (.14)	.85 (.28)	.73 (.31)
Range	.56 - 1	0 – 1	0 – 1

Table 5.6. Mean proportions of MPQ categories containing descriptors endorsed as remember sensation, remember word, or know that correspond to categories used to report Actual pain experiences

A one-way ANOVA revealed significant differences in the proportions of categories which agreed with those used to describe Actual pain ($F(2,218) = 7.1$, $p<0.001$). Pairwise comparisons (Bonferroni adjusted) showed that the differences stemmed from the proportion of categories containing descriptors endorsed as remember sensation and endorsed as know ($p=0.001$) and between categories containing words endorsed as remember word and know ($p=0.022$). There were no significant differences in the proportion of remember sensation and remember word responses which matched those selected whilst using the CP.

The proportion of categories endorsed as remember sensation, remember word and know which matched those used to express *Expectations* of pain are shown in Table 5.7. A one-way ANOVA revealed significant differences in the proportions of categories endorsed as remember sensation, remember word and know which corresponded to those selected to express Expectations of pain ($F(2,218) = 16.8$, $p<0.001$). Pairwise comparisons (Bonferroni adjusted) found significant differences between the proportion of know judgements and the proportion of remember judgements that correctly corresponded to the categories used to express Expectations of pain ($p<0.001$); remember judgements corresponded significantly more often to those chosen to report Expectations of pain than know judgements.

Categories endorsed as:	**Remember sensation**	**Remember word**	**Know**
Mean	.81 (17.0)	.86 (.24)	.60 (.37)
Range	.33 - 1	0 – 1	0 – 1

Table 5.7. Mean Proportion of MPQ categories containing descriptors endorsed as remember sensation, remember word, or know that correspond to categories used to express Expectations of pain

Paired t tests were used to assess the differences in the proportions of categories judged as remember sensation and/or remember word or know which correctly compared to Actual pain ratings and to Expectations of pain. As with the individual MPQ descriptors, the proportions of categories containing descriptors endorsed as remember sensation and know which corresponded to Actual pain ratings were higher than those corresponding to Expectations of pain (remember sensations: $t(90) = 3.16, p=0.002$; know $t(71) = 2.43, p=0.01$). There were no significant differences between the proportions of Retrospective MPQ descriptors judged as remember word that corresponded to Actual pain ratings and ratings of Expectations of pain.

Pearson's r was also used to investigate the relationship between the proportion of remember/know judgements which matched descriptors chosen to express Actual pain and the proportion of remember/know judgements which matched descriptors chosen to express Expectations of pain. The correlation coefficient for descriptors endorsed as remember sensation which correspond to those selected to report Actual pain, and those which correspond to descriptors to report Expectations of pain suggest that, if pain sensations are correctly remembered (i.e. they match Actual pain ratings), the descriptors also tend to have been selected to express Expectations of pain ($r = 0.37, p<0.001$). This finding was not observed for descriptors correctly endorsed as 'remember word' ($r = 0.14, p>0.05$) or descriptors correctly endorsed as 'know' ($r =0.19, p>0.05$).

5.3.6 Results pertaining to Aim Three

The third aim of this study was an exploratory one. The MPQ is designed to assess the different underlying dimensions of pain. In order to investigate whether there are systematic differences in the recollection of these dimensions, the sensory, affective/evaluative and miscellaneous categories of the MPQ were analysed separately, where appropriate, using correlation, ANOVA, Kappa and the remember/know paradigm. Three repeated measures ANOVAs for sensory, affective/evaluative and miscellaneous PRI values were carried out (Means and SD shown in Table 5.8).

<u>Sensory</u>: There were no significant differences between the sensory PRI ratings ($F(2,192) = .925, p>0.05$).

<u>Affective/evaluative</u>: Significant differences were observed between affective/evaluative ratings $F(2,192) = 22.34$, $p<0.001$, Greenhouse-Geisser corrected. Post-hoc pairwise comparisons (Bonferroni adjusted) confirmed the difference between Expectations of pain and both Actual and Retrospective affective/evaluative PRI ratings were significant (both comparisons $p<0.001$). There was no difference in the Actual pain ratings and Retrospective pain ratings ($p>0.05$).

<u>Miscellaneous</u>: Significant differences were observed between miscellaneous PRI ratings ($F(2,192) = 27.04$, $p<0.001$, Greenhouse-Geisser corrected). Post-hoc pairwise comparisons (Bonferroni adjusted) again confirmed the significant difference between Expectations of pain and both Actual and Retrospective miscellaneous ratings (both comparisons $p<0.001$). There was no difference in the miscellaneous PRI ratings of Actual pain and Retrospective ratings of pain ($p>0.05$).

Weighted Rank PRI	**PRI Expectations of pain**	**PRI Actual pain**	**PRI Retrospective ratings**
Sensory	12.7 (5.8)	13.2 (7.5)	13.1 (7.6)
Affective/evaluative	3.9 (3.3)	6.5 (3.3)	5.9 (4.1)
Miscellaneous	7.4 (2.6)	9.3 (3.1)	9.7 (3.1)

Table 5.8. Mean sensory, affective/evaluative and miscellaneous PRI Ratings

5.3.6.1 Comparisons of correlation coefficients for MPQ

The strengths of the correlation coefficients differed between the MPQ subcategories (see Table 5.9). The correlations between PRI Expectations of pain and Actual ratings, between Actual ratings and Retrospective ratings, and between Expectations of pain and Retrospective ratings of the sensory, affective/evaluative and miscellaneous dimensions were compared. The *r* value for the affective/evaluative dimension was significantly stronger than for the miscellaneous dimension (miscellaneous $r = 0.62$, affective/evaluative, $r = 0.79$, $X^2=4.6$, $p<0.05$; see Table 5.9).

	Expectations and Actual pain	**Actual pain and Retrospective ratings**	**Expectations and Retrospective**	***Sig. Differences between correlations?***
Sensory	.56*	**.74***	.52*	***r=.56 and .74 X^2= 3.96, p<0.05***
Affective/ Evaluative	.44*	**.79***	.48*	***r=.48 and .79 X^2=14.15, p<0.005***
Miscellaneous	.26†	**.62***	.33*	***r=.33 and .62 X^2=7, p<0.01***
Sig.Differences in correlation coefficients?	*r=.26 and .44, p>0.05*	*r = .62 and .74 p>0.05* ***r=.62 and .79, x^2=4.6, p<0.05***	*r=.33 and .48 p>0.05*	

* $p<0.001$ † $p<0.05$

Table 5.9. Correlations between rating times for PRI total, sensory, affective/evaluative and miscellaneous ratings

5.3.6.2 Kappa values reflecting agreement between sensory and total MPQ descriptor choice

It was not appropriate to calculate Kappa values for the affective/evaluative and miscellaneous MPQ categories because of the small numbers of MPQ descriptors selected and/or the small numbers of categories (cf. Beese and Morley, 1993). Kappa values reflecting agreement between sensory MPQ descriptor selection at each rating time and category use at each rating time are shown in Table 5.10. These sensory Kappa values were compared to Kappa values obtained for Total MPQ descriptors and categories using paired *t* tests. No significant differences were found between Kappa values for the Total MPQ and the sensory MPQ descriptors. However, MPQ category reselection was significantly more consistent for the Total MPQ than for the sensory categories alone. For clarity these are shown in the last row of Table 5.11.

Kappa comparisons	**Expectations and Actual pain**	**Actual pain and Retrospective**	**Expectations and Retrospective**
Sensory descriptors	.22 (.26)	**.40 (.26)**	.36 (.26)
Sensory categories	.42 (.28)	**.45 (.27)**	.39 (.27)

Table 5.10. Kappa values calculated for the sensory dimension of the MPQ only (descriptors and categories, 1-10)

Kappa comparisons for Categories	**Expectations and Actual pain**	**Actual pain and Retrospective**	**Expectations and Retrospective**
All MPQ categories	.54 (.21)	**.61 (.16)**	.53 (.18)
Sensory categories	.42 (.28)	**.45 (.27)**	.39 (.27)
***t* tests**	$t(92)=3.3, p< 0.01$	$\mathbf{t(91)=4.84, p< 0.01}$	$t(91)=3.73, p< 0.01$

Table 5.11. Comparisons of Kappa values calculated for the sensory categories and all MPQ categories using t tests

5.3.6.3 Differences in remembering and knowing between the dimensions of the MPQ for descriptor and category selection

The mean proportions of sensory, affective/evaluative and miscellaneous MPQ descriptors judged as remember, remember word and know that match MPQ descriptors used to express Actual pain are shown in Table 5.12. The mean proportions of sensory, affective/evaluative and miscellaneous MPQ *categories* containing descriptors judged as remember, remember word and know that match MPQ categories used to express Actual pain are shown in Table 5.13.

Proportion of descriptors	**Remember Sensation**	**Remember word**	**Know**
Sensory (sd)	.52 (.31)	.54 (.41)	.41 (.37)
Affective/eval(sd)	.59 (.43)	.56 (.48)	.42 (.48)
Miscellaneous (sd)	.63 (.29)	.70 (.42)	.62 (.46)

Table 5.12. Mean proportions (sd) of sensory, affective/evaluative and miscellaneous descriptors endorsed as remember sensation, remember word and know which match those selected to express Actual pain ratings

Two 3 (Dimensions: the sensory, affective/evaluative and miscellaneous categories of the MPQ) x 3 (Recollective state: whether the descriptors were judged as remember sensation, remember word or know) ANOVAs were used to investigate any differences in the proportions of descriptors endorsed as remember sensation, remember word and know, between the MPQ subcategories (sensory, affective/evaluative and miscellaneous). In these analyses, Dimensions was a within-subjects variable and Recollective state was a between subjects variable.

The first 3 x 3 ANOVA was used to compare mean proportions of sensory, affective/evaluative and miscellaneous MPQ *descriptors* judged as remember, remember word and know, which match descriptors to describe Actual pain. There was no significant main effect for Recollective state (remember sensation, remember word or know) ($F(2,110) = 3.18$, $p>0.05$). There was a significant main effect for Dimension revealing differences between the proportions of descriptor chosen from the sensory, affective/evaluative and miscellaneous dimensions of the MPQ, ($F(2,55) = 3.66$, $p=0.032$). Post-hoc pairwise comparisons showed the significant differences were between affective and miscellaneous dimensions ($p=0.007$) where the proportion of miscellaneous descriptors more frequently corresponded to those chosen to describe Actual pain. There was no significant interaction (Dimension x Recollective state) ($F(4,110) = 2.14$, $p>0.05$).

The second 3 x 3 ANOVA was used to compare mean proportions of sensory, affective/evaluative and miscellaneous MPQ *categories* judged as remember, remember word and know, which matched categories used to describe Actual Pain. There was no significant main effect for Recollective state (remember sensation, remember word or know) ($F(2,108) = 1.36$, $p>0.05$). There was no significant main effect for Dimension revealing that there were no differences between the proportions of categories chosen from the sensory, affective/evaluative and miscellaneous dimensions of the MPQ, ($F(2,54) = 1.95$, $p>0.05$) and no significant interaction (Dimension x Recollective state) ($F(4,108) = 1.66$, $p>05$).

Proportion of categories	Remember sensation	Remember word	Know
Sensory	.84 (.22)	.80 (.32)	.67 (.39)
Affective/evaluative	.90 (.23)	.91 (.25)	.69 (.46)
Miscellaneous	.91 (.17)	.94 (.22)	.92 (.25)

Table 5.13. Mean proportions(sd) of sensory, affective/evaluative and miscellaneous MPQ categories judged as remember sensation, remember word and know that match categories used to express Actual pain

5.3.7 Results pertaining to Aim Four

The fourth aim of the study was to investigate the influence of state anxiety (assessed prior to using the CP test at Time One) and trait anxiety (assessed at Time Two), on Retrospective ratings of pain. Mean state anxiety was 28.9 (sd 6.6) and mean trait anxiety was 38.0 (8.7). No linear correlations between anxiety ratings and VAS ratings on any of the three questionnaires were observed (r values all > 0.09; $p>0.05$). On the other hand, there were some significant correlations between WR-PRI ratings and anxiety. State anxiety was significantly associated with Actual WR-PRI pain ratings (r = 0.20, p=0.05), and trait anxiety was significantly associated with Expectations of pain (r = 0.21, p=0.04).

5.3.7.1 Anxiety ratings and Kappa values

It was hypothesised that participants with higher levels of anxiety would provide Retrospective ratings of pain which were less similar to their Actual pain ratings than Retrospective ratings of pain provided by participants with lower levels of anxiety, and that this lack of consistency would be reflected by lower Kappa values. The only significant correlation found between the anxiety measures and Kappa values was a positive correlation between trait anxiety and the

Kappa values reflecting agreement between the MPQ categories used to report Expectations of pain and Retrospective ratings: (r = 0.22, p=0.029). In other words, there was a tendency to observe greater consistency between the MPQ categories used to express Expectations of pain and Retrospective ratings of pain in participants exhibiting higher trait anxiety. Anxiety was not related to any of the other Kappa values (p>0.05)

5.3.7.2 Anxiety and remember/know judgements

There were no significant correlations between any of the anxiety ratings and the proportions of MPQ descriptors endorsed retrospectively as 'remember sensation' 'remember word' or 'know'. Likewise, there were no significant correlations between any of the anxiety ratings and the proportion of MPQ descriptors or categories endorsed as remember sensation, remember word or know which matched those used to report Actual pain (p>0.05).

5.3.7.3 Expectations of pain, anxiety, and memory for pain

Sequential multiple regression analyses were used to investigate the relative extent to which Expectations of pain, Actual pain ratings, and state and trait anxiety could explain the variance in Retrospective VAS and WR-PRI ratings. Prior to carrying out the regression analysis, data were screened for multivariate outliers by computing a Mahalanobis distance for each of the variables. A chi-square table of critical values was used (p=0.001) to ensure that the Mahalanobis score did not exceed this value (22.46). None exceeded this value. Colinearity statistics were requested and examined for variables with low tolerance levels; no problems with co-linearity emerged.

First, regression analysis was used to investigate the extent to which Expectations of pain and Actual pain ratings and anxiety could predict Retrospective VAS ratings. The correlation matrix for the variables for this model is shown in Table 5.14. In this regression analysis, VAS Actual Pain was entered first and explained 69% of the variance ($F(1,95) = 211.4$, $p<0.001$). Expectations of pain, state and trait anxiety were sequentially entered but did not explain a significant increment in the proportion of variance explained. Thus in this model, only Retrospective ratings of pain were significantly associated with Actual ratings of pain. A summary table of the model is detailed in Table 5.15.

	VAS Retrospective	VAS Actual	VAS Expect.	State anxiety
VAS Actual	.83(**)			
VAS Expect.	.34(**)	.50(**)		
State anxiety	-.04	.04	.09	
Trait anxiety	-.01	-.02	.04	42(**)

** Correlation is significant at the 0.01 level (2-tailed).

Table 5.14. *Correlations between variables (VAS Expectations of pain, Actual pain ratings and state and trait anxiety)*

Step	**Predictor variable**	**β***	**t**	**R**	**Adj R^2**	***F* change**	**Sig *F* change**
1	VAS Actual	.84	13.54	.83	.69	211.39	.00
2	VAS Expect	-.12	-1.54	.84	.69	2.57	.11
3	State anxiety	.02	.77	.84	.69	.04	.84
4	Trait anxiety	-.02	-1.38	.84	.69	1.90	.17

* Standardised coefficients

Table 5.15. *Summary table of hierarchical regression analysis predicting Retrospective ratings of pain using the VAS*

Regression analysis was then used to investigate the extent to which Expectations of pain, Actual pain ratings and anxiety could predict Retrospective PRI ratings. The correlation matrix for the variables is shown in Table 5.16. In this regression analysis, PRI Actual pain was entered first and explained about 65% of the variance in Retrospective PRI ratings ($F(1,95) = 173.6$, $p<0.001$). Expectations of pain was entered next and further explained just over 1% of the variance in Retrospective ratings of pain. State and trait anxiety did not explain a significant increment in the proportion of variance. Thus in this model, Retrospective ratings of pain were significantly associated with Actual ratings of pain and, to a small but significant extent, Expectations of pain. A summary of the model is detailed in Table 5.17.

	PRI Retrospective	PRI Actual pain	PRI Expectations of pain	State anxiety
PRI Actual	.80**			
PRI Expect.	.53**	.53**		
State anxiety	.19	.20*	.18	
Trait anxiety	.17	.17	.21*	.42**

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 5.16. Correlations between variables (PRI Expectations of pain, Actual ratings of pain and state and trait anxiety)

	Predictor variable	β*	t	R	Adj R^2	*F* change	Sig *F* change
Step 1	PRI Actual	.70	9.25	.80	.64	173.57	.00
Step 2	PRI Expectations	.17	2.15	.81	.66	4.01	.05
Step 3	Trait anxiety	-.07	-1.02	.81	.65	<.01	.97
Step 4	State anxiety	.03	.53	.81	.65	.05	.82

* Standardised coefficients

Table 5.17. Summary table of hierarchical regression analysis predicting Retrospective ratings of pain using the PRI

5.3.8 <u>Results pertaining to Aim Five</u>

The fifth aim of this study was to investigate memory for the qualitative nature of taste, in comparison to memory for the qualitative nature of CP pain. Summary statistics and screening details for taste data are shown in Appendix 3.6. In the taste test, participants were able to pick any of the 57 taste descriptors as they were being read to them. The numbers of words used to describe the drink whilst tasting it was 10.8 (sd 4.36, range 3 – 22) and two weeks later was 10.0 (sd 4.63, range 3 – 24). The correlation between the numbers of words selected at each rating time was highly significant, $r = 0.76$, $p<0.001$. However, a paired t test revealed that the difference between the numbers of taste descriptors used on each rating time was significant (t (2.48), $p=0.015$); that is, participants used significantly fewer words to describe the taste of the vegetable drink retrospectively than when they were actually tasting it.

5.3.8.1 Most frequently used taste descriptors:

The pattern of the taste descriptors selected by more than 10% of participants whilst tasting the drink or retrospectively, is shown graphically in Figure 5.6.

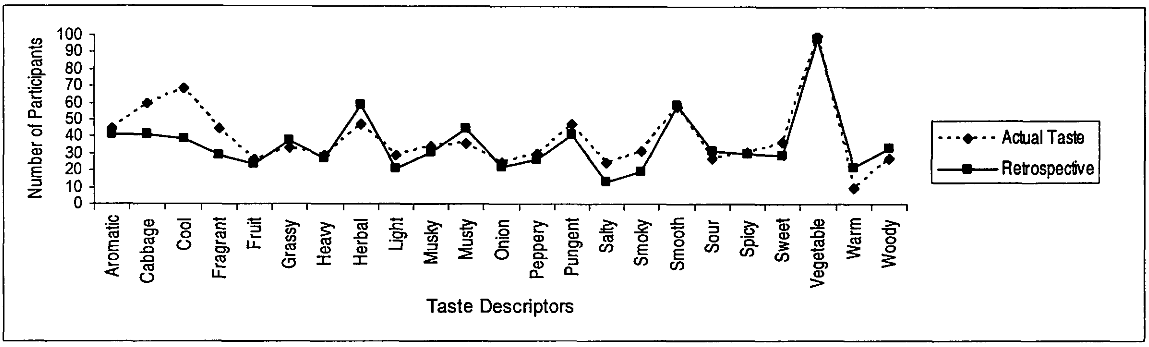
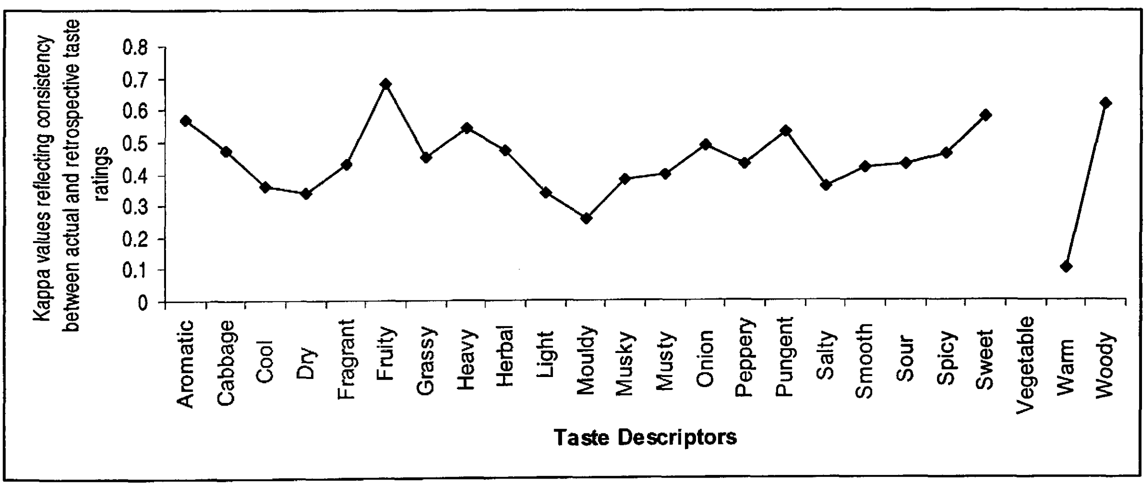


Figure 5.6: Taste descriptors selected by 10% or more of participants whilst tasting the drink and retrospectively

Figure 5.7 shows the Kappa values reflecting the agreement between individual taste descriptor use.



* Kappa cannot be calculated for the descriptor 'Vegetable'. All participants chose descriptors from this category. There is no variation, and therefore no shared variation; thus there is no 'evidence' on which to base whether or not there is agreement between assessment times

Figure 5.7: Kappa values reflecting agreement between individual taste descriptor use.

5.3.8.2 Kappa for consistency of taste descriptions

Kappa was calculated for each participant to assess the agreement between the Actual and Retrospective ratings of the drink. Mean Kappa emerged as .55 (sd .18).

5.3.8.3 Remembering and knowing in recollections of taste

The proportion of taste descriptors endorsed as remember sensation, remember word and know are detailed in Table 5.18, along with the proportion of descriptors endorsed as remember sensation, remember word or know that corresponded to descriptors chosen whilst tasting the drink).

Endorsed as:	**Remember taste**	**Remember taste descriptors**	**Know**
Proportion endorsed	.74 (.20)	.26 (.27)	.24 (.20)
Proportion correctly endorsed	.72 (.21)	.81 (.26)	.56 (.38)

Table 5.18. Mean proportions (sd) of taste descriptors selected Retrospectively and endorsed as remember taste, remember word and know and mean proportion corresponding to descriptors selected whilst tasting the drink

5.3.8.4 Memory for taste compared to memory for pain

There was no significant difference between the Number of Words Chosen (NWC) for taste and NWC for pain, related to either Actual or Retrospective ratings (NWC Actual pain, 11.0 (sd 3.6) and NWC taste, 10.8 (sd 4.4): $t(95) = .55$, $p>0.05$; NWC Retrospective pain ratings, 10.6 (sd 3.4) and NWC taste, 10.0 (sd 4.7), $t(95) = 1.0$, $p>0.05$). NWC for pain and taste were significantly positively correlated (Actual ratings $r = 0.28$, $p=0.06$; Retrospective ratings $r = 0.37$, $p< 0.001$).

Table 5.19 shows a comparison between Kappa values reflecting agreement between MPQ pain descriptors, MPQ categories, and taste descriptors chosen to express Actual pain/taste experiences and to provide Retrospective ratings of pain and taste. A repeated measures ANOVA revealed significant differences between the Kappa values ($F(2,184) = 22.36, p<0.001$, Greenhouse-Geisser corrected). Pairwise comparisons found that Kappa values reflecting the consistency in taste descriptor use were significantly higher than the Kappa values obtained for MPQ descriptors, $p<0.001$ (Bonferroni adjusted). No significant differences were found between Kappa values for taste and Kappa values reflecting MPQ category selection ($p>0.1$).

Kappa values (Actual and Retrospective ratings)	**Taste**	**Pain (descriptors)**	**Pain (categories)**
	.56 (.18)	.45 (.18)	.61 (.16)

Table 5.19. Pain and taste Kappa values (agreement between Actual pain or taste ratings and Retrospective ratings)

There were no significant correlations between Kappa values for pain and taste. In other words, more consistent use of descriptors in one sensory modality (pain) was not associated with more consistent use of descriptors for the other (taste). Correlations between Kappa reflecting agreement between MPQ descriptors and Kappa reflecting taste descriptor consistency were very weak: $r = 0.079, p>0.05$. Similarly, the correlation between Kappa reflecting agreement between MPQ *categories* and Kappa reflecting taste descriptor consistency was $r = 0.015$, $p>0.05$.

5.3.8.5 Comparisons of remember and knowing in recollections of pain and taste

A higher proportion of taste descriptors endorsed as remember sensation, remember word and know judgements corresponded to the taste descriptors selected whilst tasting the drink compared to the proportion of pain descriptors corresponding to descriptors selected whilst using the CP test. But the proportion of 'correct' taste descriptors was lower than the proportion of correct pain *categories*, i.e. the proportion of categories which corresponded to those selected whilst in pain.

Three one-way ANOVAs were carried out to compare differences between the proportion of taste descriptors, pain descriptors and pain categories endorsed as remember sensation, remember word or know, which agreed with Actual ratings of pain or taste (means and standard deviations detailed in Table 5.20). A significant effect was observed for remember sensation ($F(2,180) = 74.3$, $p<0.001$). Post-hoc comparisons (Bonferroni adjusted) found that the proportion of taste descriptors endorsed as remember sensation which agreed with Actual taste ratings (0.72) was significantly higher than the proportion of *pain* descriptors endorsed as remember sensation which matched descriptors chosen to describe Actual pain experiences (0.57). But the proportion of taste descriptors endorsed as remember sensation which agreed with those selected those whilst tasting the drink, was significantly *lower* than the proportion of Retrospectively selected pain *categories* which agreed with those selected to describe Actual pain (0.87; $p<0.001$).

Similarly, a significant effect was observed for descriptors judged as remember word, ($F(2,88) = 16.0$, $p<0.001$). Post-hoc comparisons (Bonferroni adjusted) found that taste descriptors were remembered significantly better than pain descriptors (taste 0.81, pain .56: $p<0.001$), but not significantly worse than pain categories (pain categories 0.85, $p>0.05$).

A significant effect was observed for know judgements ($F(2,116) = 8.6$, $p=0.001$). However, post-hoc comparisons (Bonferroni adjusted) found that the differences between the proportions of taste and pain descriptors or categories correctly endorsed as know were not significant (taste descriptors 0.56, pain descriptors 0.47, $p=0.08$); the significant differences arising from the disparity between the proportion of correctly endorsed pain descriptors and pain categories.

Correctly **Endorsed as:**	**Remember Sensation/taste**	**Remember Word**	**Know**
Taste	.72	.81	.56
Pain (descriptors)	.57	.56	.47
Pain (categories)	.87	.85	.73

Table 5.20. Mean proportion of taste and pain descriptors correctly endorsed as remember sensation/taste, remember word and know

5.3.8.6 Gender and taste

Male participants made more 'know' judgements about the Retrospective descriptors used to express their recollections of the taste of the drink (0.28 for males, 0.2 for females, $p=0.046$). There were no other gender differences in taste ratings or memory for taste.

5.4 Discussion

A Cold Pressor (CP) test was used to induce a short episode of expected acute pain in an experimental setting. Using the MPQ and a VAS, participants rated their Expectations of pain prior to using the CP test, their Actual Pain whilst their hand was submerged in the cold water (the VAS immediately after), and Recollections of CP pain two weeks later. In order to compare memory for pain with memory for other sensory experiences, participants also tasted a vegetable drink and chose from a list of 57 taste descriptors to report their perception of the flavours of the drink and their memory of the taste two weeks later. In addition, participants' state (situational) and trait anxiety was measured using Speilberger's State-Trait Anxiety Inventory. The experimental design of the study allowed ratings of pain intensity and pain quality to be obtained whilst controlling for other potentially confounding variables such as analgesic use and patient distraction. A summary of aims, related hypotheses and whether these hypotheses are supported is set out in Table 5.21. The results are then discussed in relation to each of the study aims and the hypotheses outlined in the Introduction section of this chapter.

Aim	Hypotheses related to aim	Hypotheses supported/observations made
1. To investigate the consistency of ratings of Expectations of pain, Actual pain experienced and Retrospective ratings of CP pain.	1. Retrospective intensity ratings (VAS and PPI ratings), PRI ratings and NWC would be consistent with Actual ratings. 2. Expectations of pain and Actual pain ratings would predict Retrospective pain ratings (MPQ and VAS), but Actual pain would be the stronger predictor 3. Kappa values would be lower when assessing the consistency between MPQ *descriptors* used to express Actual pain experiences and Retrospective ratings, but higher for MPQ *category* selection	Yes. Partially. Only around 1% of the variance in Retrospective ratings can be explained by Expectations of pain, whilst nearly 70% of variance explained by Actual pain ratings. Yes. Kappa < 0.45 when comparing agreement between MPQ descriptors. But, when comparing MPQ categories, Kappa is >0.6 when comparing agreement between Actual and Retrospective ratings
2. To use the remember/ know paradigm to: a) assess the involvement of semantic and episodic memory in recollections of CP pain, and; b) investigate the extent to which participants remember pain *sensations* or previously selected pain *descriptors*.	4. Participants would be able to make a distinction between the phenomenological experience of 'remembering' and 'knowing' about a previously experienced pain, and between remembering the pain *sensation* and remembering selecting a particular MPQ *descriptor* to report pain experiences.	Yes. Participants were able to provide Retrospective judgements as to whether the MPQ selections reflected remembered sensations, remembered descriptors or were based on a 'feeling of knowing'. Central to this thesis is the finding that the majority of Retrospective MPQ descriptors were selected to reflect remembered *sensations* rather than remembering previously selecting the descriptor.
3. to carry out exploratory analyses of the usage of the sensory, affective/evaluative and miscellaneous dimensions of the MPQ when making reports of expected acute pain and subsequent recollections.	No specific hypothesis, but deemed necessary in order to investigate whether some aspects of pain were recalled differently to, or more accurately than others	No systematic differences found between the sensory and affective/evaluative categories, although differences were observed between these categories and the miscellaneous category.
4. The fourth aim of the study was to investigate the relationship between anxiety and i) ratings of acute pain, ii) Kappa values reflecting agreement between Actual and Retrospective ratings of CP pain and iii) the pattern of remember and know judgements.	5. Anxiety would influence recollections of pain quality in that participants with higher levels of anxiety would provide recollections of pain which are less similar to their real time ratings, reflected by lower Kappa values.	No support found.
5. To investigate memory for the taste of an unusual vegetable drink – in order to assess memory for pain relative to another similar subjective sensory experience	6. No differences in the numbers of descriptors chosen, the Kappa values (reflecting the consistency of taste descriptors chosen and the consistency of pain descriptors), and the pattern of remember/know judgements for each sensory modality, would be observed.	Partially: Participants were slightly better at recalling taste than pain, but many similarities were observed.

Table 5.21. Summary table of aims, related hypotheses and the extent to which these hypotheses can be supported or rejected

5.4.1 Aim One: To investigate the consistency of ratings of Expectations of pain, Actual pain experiences and Retrospective ratings of CP pain.

5.4.1.1 Ratings of Expected, Actual and Retrospective pain intensity (VAS and PPI ratings)

Although the participants were given details about the likely nature of CP sensations, and informed of the temperature of the water, the ratings of Expectations of pain showed that the intensity of CP pain was underestimated. The mean VAS rating to describe Expectations of pain intensity (29.6 mm) was in the lower range of potential intensity ratings, (possible VAS ratings ranging from 0 to 100 mm). Immediately after using the CP test, the mean VAS pain intensity was rated at 52.7 mm, whilst two weeks later the mean Retrospective rating was also 52.7 mm (see Table 5.1). Whilst ratings of Expectations of pain intensity were significantly lower than subsequent intensity ratings using the VAS, participants appeared to recall the intensity of CP very accurately. No differences between the VAS ratings made immediately after using the CP (Actual ratings) and those made two weeks later (Retrospective ratings) were observed, and the two ratings were highly significantly correlated (r = 0.8, $p<0.001$). An additional measure of pain intensity was obtained through the use of the MPQ Present Pain Intensity (PPI) rating which, like the VAS, is assumed to provide an indicator of overall pain intensity. Following the same pattern as the VAS ratings, PPI ratings to describe Expectations of pain were significantly lower than Actual and Retrospective ratings, whilst no significant differences were observed between the Actual and Retrospective PPI ratings. The finding that the intensity of the CP was underestimated is somewhat surprising; participants were told the temperature of the water, reminded of 'everyday' examples of having cold hands and told that as the water was circulated, it might feel colder than one would expect. As it is likely that all the participants had experienced painfully cold hands at some point in their past, the finding that Expectations of pain was underestimated is perhaps an indication that over time, pains which, in terms of biological warning, serve little purpose, (other than as a reminder to wear some gloves), are recalled as less severe over the longer term. Further research is underway to investigate the extent to which these participants can recall the intensity of the CP six to nine months after using the CP test.

The results of this study substantiate suggestions made by previous studies that acute pain intensity can be accurately recalled for at least a couple of weeks after the painful stimulus or event (Hunter *et al.*, 1979; Erskine *et al.*, 1993; Singer *et al.*, 2001). Although earlier studies have generally reported statistically significant correlations between Actual and Retrospective ratings of pain intensity, some have also reported tendencies to overestimate Retrospective ratings of pain intensity made after a longer interval (a number of months) between severe acute pain experiences and subsequent recollection (Everts *et al.*, 1999). Other research suggests that retrospective ratings of severe pain made some months after the painful event tend to be less accurate than the retrospective ratings of less severe pain (Sisk *et al.*, 1991). As noted above, further research is underway which will provide the opportunity to investigate whether more systematic variations such as overestimation or underestimation of pain intensity occurs with the progression of time, or whether the biases observed in prior research are due to other, as yet unknown, factors.

5.4.1.2 WR-PRI ratings to report Expected, Actual and Retrospective ratings of CP Pain

Like the PPI and VAS ratings, WR-PRI ratings of the participants' Expectations of CP pain were lower than their Actual and Retrospective ratings. The Actual and Retrospective WR-PRI ratings indicate that the CP Pain was experienced and recalled as moderately severe (with a WR-PRI value of around 29 out of a total of 88.06), comparable with previous studies which reported similar PRI ratings for arthritis and neuralgia (Melzack and Wall, 1996). Similarly, significantly fewer MPQ descriptors were chosen (NWC) to describe the Expectations of pain (10.1), whilst no significant differences between NWC to describe Actual pain and to provide Retrospective ratings, (11.1 and 10.7 respectively) were found. The NWC were slightly higher than those reported in a review of eight studies of experimentally induced pain, which reported the NWC to be 8.6, (range 5.3-11.6) (Wilkie *et al.*, 1990).

So what do WR-PRI ratings reflect in terms of the pain experience? As the WR-PRI score is made up of descriptors assigned a value to represent their relative intensity, the resulting WR-PRI score may be expected to reflect the 'severity' of the CP, but not just pain intensity. Correlations between intensity ratings and WR-PRI values to assess different types of acute and chronic pain have varied considerably (Wilkie *et al.,* 1990) and in the present study ranged from .53 – .58), which suggests that the WR-PRI values reflect the pain experience as something which varies in dimensions other than intensity. Whatever aspects of pain the PRI ratings reflect, it is a notable finding that participants are able to consistently select the appropriate descriptors from the large number of choices available on the MPQ in order to provide Retrospective ratings that correlate so highly with those made whilst in pain.

5.4.1.3 To what extent can Expectations of pain and Actual ratings of pain predict Retrospective ratings of pain intensity and pain quality?

The sample size of this current study allowed for multiple regression analyses to be used to investigate the extent to which Expectations of pain and Actual ratings of pain were able to predict Retrospective ratings of pain. Using the VAS, whilst Expectations of pain were not significant predictors of Retrospective ratings, VAS ratings of Actual pain accounted for almost 70% of the variance in Retrospective ratings (see Tables 5.14 and 5.16). WR-PRI ratings of Expectations of pain were found to significantly account for around 1.5% of the variance in Retrospective MPQ ratings (Tables 5.15 and 5.17). As with VAS ratings, most of the variance in Retrospective MPQ ratings can be explained by Actual pain experiences (around 65%), and the difference between the extent to which VAS and WR-PRI Expectations of pain are able to predict Retrospective ratings is less than 1%.

The strengths of the correlations between Actual pain and Retrospective ratings of pain intensity are a notable aspect of the present study. Gracely and Kwilosz (1988) assessed the psychometric properties of the Descriptor Differential Scale (DDS) and found that correlations between participants' pain ratings made one hour apart following dental extraction was .92 for pain intensity and .78 for pain unpleasantness. Correlation coefficients such as these are considered to reflect adequate test-retest abilities of psychometric tests (e.g. the DDS or the STAI). Using such criteria, correlations in the present study indicate that participants' Retrospective ratings of CP pain are reliable, when using the MPQ-PPI, the WR-PRI and VAS.

Erskine *et al.*, (1990) caution against the assumption that significant correlations between pain ratings made whilst in pain and subsequent ratings (when pain free) reflect accurate recollections of pain. It has also been argued that correlations between Actual pain ratings and Retrospective ratings reflect participants' reporting biases rather than causal associations (Munafó and Stephenson, 2001). Finding statistically significant correlations between Actual pain and Retrospective ratings may therefore be expected. However, one indication in this study which suggests that the correlations between Actual pain and Retrospective pain ratings do infer a causal relationship between the two rating times is the finding that Retrospective scores were much more closely correlated with Actual pain ratings than the other comparisons between rating times (i.e., the relationship between Expectations of pain and Actual rating and Expectations of pain and Retrospective ratings, as detailed in Table 5.2).

Of course, it could be argued that in an experimental situation, there are fewer variables which may have a detrimental effect on pain recall. Such a research paradigm, then, may artificially facilitate pain intensity recall. But it was an intentional design of the study to reduce the number of extraneous variables which may result in discrepancies in pain recollections. Although the findings of this study need to be verified in clinical settings, as such, they are able to provide additional evidence that individuals are able to reliably recall the intensity of a short, novel and distinct pain, at least for one or two weeks, using either the MPQ or a VAS, in order to accurately communicate 'how much' pain was experienced.

The high levels of association between Actual and Retrospective WR-PRI and VAS ratings do not, however, mean that the details of the *qualitative* nature of the pain can be recalled when these Retrospective ratings are provided. In addition, these associations cannot indicate whether or not previous experiences of acute pain are being 'remembered'. Clark and Bennett-Clark (1993) assert that the conclusion that memory for pain is 'reasonably accurate' (e.g. Salovey *et al.*, 1993) is too broad a generalisation. The ability to recall qualitative aspects of pain and the phenomenological awareness which accompanies recollections of previously experienced acute pain are examined in some depth in the following sections.

5.4.1.4 Assessing agreement between ratings of the quality of expected acute pain

Kappa was used to assess the level of agreement between the descriptors chosen from the MPQ to express Expectations of pain, Actual pain and Retrospective ratings using the MPQ. The mean Kappa values reflecting the agreement between MPQ descriptors selected to describe Actual pain and Retrospective ratings were broadly similar to those obtained in previous studies (0.45, or 'fair', according to Fleiss' categorisation of Kappa; see Table 5.2). Although the research methodologies and pain types have differed in all of these studies, the Kappa values have been found to be similar, ranging from 0.34 – 0.53). On the basis of these Kappa values, it has been suggested that memory for the specific qualities of acute pain might be unreliable. In the present study, although the Kappa values obtained when comparing Actual pain ratings and Retrospective ratings were significantly higher than when comparing Expectations of pain with Retrospective ratings, and Expectations of pain with Actual ratings, they were nonetheless only 'fair'. On the basis of these observed Kappa values, there appears to be less agreement between Actual and Retrospective qualitative ratings of pain than the agreement between the numerical ratings of pain (i.e. the VAS, MPQ and PRI) which can be inferred from the correlation analyses and ANOVAs.

However, to conclude that pain quality is recalled less accurately than pain intensity might be premature. The use of Kappa can only indirectly assess memory for pain by providing a measure of agreement between descriptors selected (or not selected) at two rating times whilst controlling for 'chance' selection of the same descriptors. If patients or participants do not encode and/or recall their experiences of pain at the same 'fine-grained' level of MPQ descriptors, the Kappa values may underestimate the participants' ability to recall a prior pain experience. Thus, the use of Kappa only to compare MPQ descriptor choice may be an over-stringent method of assessing memory for pain.

On the other hand, it may be more appropriate to use Kappa to assess the agreement between MPQ *category* use, as these are held to reflect different types of pain. Kappa values reflecting the agreement between the participants' MPQ category use (to describe their Actual pain experiences and to provide Retrospective ratings) can be categorised as 'good' according to Fleiss' classification. In line with the third hypothesis, the agreement between MPQ category use is better than agreement between the 78 descriptors use. This finding should not be due to 'chance'; one of the features of Kappa is to control for this. Rather, our data indicate that instead of pain being recalled at the very detailed level of the MPQ descriptors, Kappa analyses of MPQ category selection suggest that pain qualities might be recalled more accurately at a 'type of pain' level (reflected by the 20 MPQ categories), whether the pain is an incisive pain, or a pressure pain and so on. By way of comparison, Kappa to assess the consistency between Actual pain ratings and Retrospective ratings is also significantly better than the Kappa values obtained for the other comparisons (between Expectations of pain and Actual pain ratings, and between Expectations of pain and Retrospective ratings).

Prior research has raised the concern that presenting the MPQ in its categorised format may cue participants to recall the descriptors selected whilst in pain (Brodie and Niven, 2000; Beese and Morley, 1993). However, the findings of the present study gave no indication that Kappa values have been amplified by the MPQ descriptors being categorised; mean Kappa values for descriptor selection consistency were similar to (or lower than) those obtained in prior research (e.g. Beese and Morley, 1993). It is also possible to argue that as there are only 20 MPQ categories to choose from, the agreement in the MPQ category use would be high as participants used around 10 MPQ descriptors to express their pain ratings. However, the value of Kappa for agreement between Actual and Retrospective category use in this study (κ=.61) can be compared with Niven and Brodie's (1995) study which found that the agreement between MPQ categories used in labour and some years later was poor (κ = .36). It may be expected that recollections of labour pain occurring some years previously would be more distorted than the recollections of CP pain under laboratory conditions. The comparison between the two Kappa values highlights that Kappa is sensitive enough to reflect differences in the recall consistency of diverse pain conditions, over different lengths of time.

In summary, the Kappa values obtained in this study appear to demonstrate that although participants are not necessarily consistent in their choice of specific MPQ descriptors whilst in pain and at some later time, they are generally consistent in their ratings of the *type* of pain quality (i.e., the MPQ category selection; whether or not the pain included 'thermal', 'incisive', 'temporal' aspects and so on). The 'good' agreement between the categories of pain descriptors used to describe Actual pain and Retrospective ratings suggests that participants are able to provide a fairly comprehensive summary of the defining qualities of the pain experienced. The finding that individual MPQ descriptors were used less consistently than MPQ categories may reflect the way language is used to express subjective experiences, rather than indicating deficiencies in recollective ability. Participants were making an 'on line' report of the sensations being experienced and were required to choose between descriptors from each category which are often synonymous (e.g. Melzack and Katz, 1994). It might be expected then, that participants would use descriptors interchangeably which may result in apparent inconsistencies between ratings.

5.4.1.5 Comparison of individual MPQ descriptor and category use across rating times using Kappa

The Pain Profiles (Figures 5.2 and 5.3) provide a method of illustrating broad similarities between the MPQ descriptors and categories used to express Expectations of pain, Actual pain and Retrospective ratings of pain induced by the CP. One of the features of the MPQ is that different constellations of MPQ descriptors appear to differentiate between distinct pain experiences or syndromes (see e.g., Melzack and Wall, 1996; Gagliese and Melzack, 2003). The most frequently selected descriptors to describe CP pain were freezing, numb, throbbing, sharp, intense, penetrating, aching and tingling. Although all of the MPQ descriptors were used by at least one or two participants in this study, these Profiles show that only 20 descriptors were used by at least 10% of participants to describe their Expectations of pain, Actual pain and/or Retrospective ratings of pain.

However, these Pain Profiles are unable to inform us of the consistency with which descriptors are being selected by the same participants. Prior research using Kappa to assess memory for pain has only investigated how consistently each participant uses the whole of the MPQ to rate their pain experiences or recollections of pain. But it is also possible to use Kappa to assess the extent to which the individual MPQ descriptors and categories are used across each rating time and in this way can supplement the information in the Pain Profiles. Kappa values for each of the 20 most frequently used MPQ descriptors ranged from 0.07 to 0.54 (detailed in Figures 5.4 and 5.5 and Appendix 3.7). Only the descriptors freezing, tingling, nagging, cold, shooting, piercing and agonizing were remembered with a 'fair' degree of accuracy ($\kappa \geq .40$); for the remainder of the most frequently selected descriptors, Kappa was 'poor'. However, Kappa values reflecting agreement between descriptors chosen to describe Actual pain and Retrospective ratings were significantly better than the other comparisons (Expectations of pain and Actual pain, and Expectations of pain and Retrospective ratings of pain). A similar pattern of results emerged when MPQ category selection was investigated (see Appendix 3.7).

These generally low Kappa values observed in the individual MPQ descriptor and category use are somewhat at odds with the pattern of descriptor use shown on the Pain Profiles and it is also to some extent difficult to reconcile these findings with the higher Kappa values reflecting agreement between each of the participant's ratings of the total experience of pain. These findings may highlight the possible over-stringent correction for chance which is incorporated into Kappa. In this context, the restrictions imposed by inferring recollective experience from verbal ratings and statistical tests – without requiring participants to provide additional information about the phenomenological experience of their recollections – are highlighted.

5.4.1.6 Summary of findings related to Aim One

The first aim of the study was to assess Expectations of pain, Actual pain and Retrospective ratings of the qualitative and quantitative dimensions of acute CP pain, using correlation analyses, the comparison of mean ratings, and Kappa analyses. In summary, correlation analysis suggests that recollections of pain intensity are consistent with those made whilst in pain, whether assessed using a VAS and the PPI. The mean Retrospective global measure of the 'multidimensional' nature of pain that is, the WR-PRI, was also highly consistent with those made whilst in pain.

The Kappa values reflecting the agreement between Actual pain and Retrospective ratings were significantly better than other comparisons, but were comparable with the Kappa values obtained in previous research investigating memory for pain. However, using Kappa values to infer the extent to which the qualities of pain can be recalled seems to be an over-stringent method of assessment if only MPQ descriptor consistency is considered. It appears that it may be more appropriate to consider the pattern of agreement between MPQ category use. Descriptors from the same MPQ category may be synonymous and used interchangeably; at the level of the MPQ categories, agreement between Actual and Retrospective ratings is 'good'.

However, neither correlation methods of assessment nor Kappa allow an insight into what is actually being *remembered* about a pain experience. It was therefore necessary to investigate participants' reports of the phenomenological nature of their pain memories by asking them to indicate what is 'remembered' about the pain and what is 'known' to have occurred.

5.4.2 Aim Two: To use the remember/know paradigm to assess of the subjective experience of recalling pain

The mean numbers and proportions of MPQ descriptors and categories endorsed as remember sensation, remember word and know are shown in Table 5.3. The proportions of Retrospective ratings that agree with Actual Pain ratings are shown in Table 5.4 (MPQ descriptors) and Table 5.6 (MPQ categories). The proportions of Retrospective ratings that agree with Expectations of pain are shown in Tables 5.5 and 5.7. The use of the remember/know paradigm is central to this investigation in order to examine the phenomenological awareness which accompanies recollections of expected acute pain. This approach has not been employed in prior studies of pain memory, although it has been widely used in cognitive memory research for 20 years (see e.g. Gardiner and Richardson-Klavehn, 1999; Gardiner *et al.*, 2002). The use of the remember/know paradigm allows for the investigation of two specific issues that have been a cause for concern in previous studies, by more directly assessing the subjective experiences of recalling pain. One of these issues is the extent to which pain recollections rely upon or involve episodic and semantic memory systems. The other is the extent to which Retrospective ratings of pain reflect prior pain *experiences* or prior pain *ratings*.

Remembering the sensation of the CP pain refers to a conscious recollection of some aspect of the pain, but not a *re-experiencing* of the pain sensations. It was essential to ensure that participants in this study were able to distinguish between remembering and simply knowing about past experiences, and did not confuse remembering with 'sensory re-experiencing'. Participants appeared to understand that it is very unusual to re-experience pain, and gave their own (correct) interpretations of the differences between re-experiencing, and remembering and knowing.

The second hypothesis was supported by the finding that participants were clearly able to make a distinction between remembering their CP pain and simply knowing that pain occurred when using the CP. By and large, participants reported remembering the CP pain (see Table 5.3). Nearly three quarters of the MPQ descriptors chosen retrospectively to describe the CP were selected because the participants felt they specifically remembered the pain sensation which they perceived was implied by that descriptor. Conversely, participants reported remembering less than one quarter of the MPQ pain descriptors (either as well as, or instead of, recalling the actual CP sensations). Similarly, less than one quarter of the descriptors selected to describe CP pain were selected because the participants knew that the descriptor was appropriate, but could not remember anything specific about the sensation implied by the descriptor or having selected that descriptor previously.

5.4.2.1 Accuracy rates in remembering and knowing

Once the proportions of remember sensation, remember word and know judgements had been calculated, a further step in the analyses was to calculate the extent to which Retrospective descriptors actually matched those selected whilst using the CP (see Table 5.4). The proportion of MPQ descriptors judged as remember sensation which matched those selected whilst in pain, was 0.57. The proportion of descriptors endorsed as remember word which matched those selected whilst in pain, was 0.58. Correspondingly, 0.43 and 0.42 of the MPQ descriptors endorsed as remember sensation and remember word did not match those selected to describe actual pain ratings, that is, were 'false alarms' (see e.g., Rajaram, 1993). Thus, participants reported that they clearly and consciously 'remembered' a high proportion of sensations and descriptors which they did not report whilst in pain. This finding requires careful consideration and is central to furthering an understanding of how pain is remembered. In the section below, some possible explanations for this finding are considered.

5.4.2.2 'False alarms' in remember judgements

The first possible explanation for the high levels of false alarms occurring in remember judgements is that participants did not understand the distinction between remembering and knowing. However, as discussed in the preceding section, there is evidence to refute this proposition. In the remember/know instructions, participants were asked to make a remember judgement only if they could clearly and consciously recall the pain and/or selecting the pain descriptor. As an example for the participants, it was explained that a specific sensation might be remembered to correspond with a particular moment, such as when their hand was initially submerged in the water, or immediately after removing their hand from the cold water. Participants were instructed that a remember judgement should be made *only* if they could clearly imagine themselves experiencing particular sensations of the CP test, (remember sensation) or remember selecting a particular MPQ descriptor (remember word). Anecdotally, the participants often endorsed their remember judgements with detailed descriptions of their recollection, pointing to a specific location where a sensation was experienced, or justifying why a particular pain descriptor was chosen by making comparisons to other pain experiences. If participants made a know judgement, they were generally very quick to assert that they did not remember either experiencing the sensation, or selecting the descriptor whilst in pain, but that they 'just knew' the descriptor was appropriate. None of the participants in this study appeared to have any difficulty in making the distinction between whether a remember or a know judgement was appropriate to describe their recollections of CP pain.

5.4.2.2.1 False alarms in descriptors endorsed as 'remember word'

Studies using the remember/know distinction to assess memory do not tend to produce many false alarms, particularly in responses endorsed as 'remember'. The proportions of false alarm rates across conditions vary, but are generally less than 0.1 (Gardiner *et al.*, 2002). But most of these have involved recall (for example, of previously presented words or pictures) over a very short time interval – minutes or hours rather than weeks (Rajaram 1993), and false alarms in such research refer to the endorsement of stimuli which had not been previously presented, but subsequently recognised as having been previously presented. On the other hand, false memory research frequently finds that participants recognise – often with high levels of confidence – items which had never previously been presented (Roediger and McDermott, 1995; Holmes *et al.,* 1998).

False memory research has demonstrated that items not previously presented to participants in a test phase, but semantically related to the previously presented words, can be subsequently 'remembered' (Holmes *et al.*, 1998; McDermott, 1996). Roediger and McDermott (1995) suggest that these false memories occur to participants during the study phase and are 'remembered' through a failure of reality monitoring or semantic integration (Holmes *et al.*, 1998, see also Johnson and Raye, 1981). In the present study, false alarms refer to the MPQ descriptors chosen retrospectively that were not selected whilst in pain, but *had* previously been presented. Pertinent to this study are the findings from experimental studies which demonstrate that false memories can share phenomenological characteristics with true memories (Loftus, 1992; Roediger and McDermott, 1996; Holmes *et al.*, 1998). As the MPQ is made up of categories of descriptors which have similar meanings, it is possible that the false alarms in the remember word judgements were due to the kind of failures in reality monitoring observed in false memory research (e.g. Roediger and McDermott, 1995). Thus, whilst the MPQ is being read to the participant using the CP test, he or she generates semantically similar pain descriptors. When selecting the descriptor 'intense', for example, the participant may also be thinking that the descriptor 'miserable' is relevant, but perhaps associate that particular descriptor with negative emotions which (hopefully) did not occur as a result of taking part in the study. At recall, the participant may select and judge as 'remember' the word 'miserable' instead of the descriptor 'intense' if it were semantically more salient to the participant than the descriptor 'intense'. Thus, at recall, the descriptors incorrectly judged as 'remembered' when they were not actually selected whilst in pain, might be due to reality monitoring failure, or semantic integration.

5.4.2.2.2 False alarms in sensations judged as 'remember sensation'

However, the above explanations seem less likely to be able to account for the pattern of false alarms observed in descriptors endorsed as remember *sensation*. An alternative suggestion is that participants used synonymous MPQ descriptors to express their memories of the pain sensation. The proportion of MPQ categories containing descriptors that were endorsed as 'remember sensation' that corresponded to those used to express Actual pain was very high (detailed in Table 5.6). If some of the descriptors in the categories were synonymous, it seems reasonable to suggest that the 'inaccuracies' in descriptor re-selection are a reflection of the use of normal everyday language; similar - but not identical - descriptors to report the same incidents tend to be used interchangeably. Thus, if a participant selects the descriptor 'sore' whilst their hand was in the cold water, and selected the descriptor 'hurting' to describe their memory of the pain, it may be that the qualitative nature of the pain was being accurately recalled but verbalised using a synonymous pain descriptor.

In part, these discrepancies between descriptors selected whilst in pain and those selected retrospectively may also be due to limitations in the ability to verbally express the subjective experience of pain. Participants sometimes had difficulty in selecting an appropriate descriptor from a MPQ category, and would ask for them to be read again in order to select the one most fitting to express their pain experience. Redelmeier and Kahneman (1996) also noted that pain experiences are 'extremely complex and storing all the details might be overwhelming' (Redelmeier and Kahneman, 1996, p.7) and Niven and Gijsbers (1984) found that when participants were asked to describe pain using their own vocabulary, only three or four words were used. In the present study, the mean numbers of words used from the MPQ was just over ten, around seven of which were subsequently endorsed as remembered, whilst just over half of these correctly corresponded to MPQ descriptors chosen whilst using the CP. Thus, around three or four of the ten descriptors selected correctly corresponded to MPQ descriptors chosen whilst in pain. Interestingly, this is around the same number of descriptors which Niven and Gijsbers found participants tended to generate when not prompted with a verbal assessment tool such as the MPQ. Brodie and Niven (2000) argue that a reductive process occurs in pain recall quality, with only the defining qualities being retained. The Kappa analyses also add weight to the suggestion that words are being used interchangeably to provide a reasonably accurate report of the qualitative dimensions of previously experience pain. Whilst there are discrepancies between the MPQ *descriptors* to report Actual and Retrospective pain, MPQ *categories* were used consistently.

It is also possible that when providing Retrospective ratings of pain, participants might attempt to summarise their experiences and select words which provide an 'average' of the different sensations experienced. A study of acoustic memory (Lu *et al.*, 1992) demonstrated that decay in neural activity in the auditory cortex paralleled the loss in echoic memory for loudness of tone. After the presentation of the stimulus (around four seconds later, as opposed to two weeks in the present study) the subjective loudness match decayed towards the mean of all the sound intensities presented. The authors concluded that it is the mean intensity that is stored in long-term memory. Thus, general information about the experiences is retained, whilst specific information about the fluctuating sensation intensities is lost. If these findings could be extrapolated to memory for pain, this could provide some explanation of why there is apparently such a high 'false alarm' rate. These so-called false alarms, which are clearly, consciously recalled, may be the participants' attempts to provide a summary description for the remembered sensory experiences. The fact that the MPQ categories were used much more consistently than individual descriptors supports this notion. The MPQ contains similar 'type of pain' descriptors, ranked in order of intensity. The discrepancies between descriptor use may reflect participants' attempts to provide an 'average' of the prior pain experience, or express the recollection of more memorable specific moments of the pain experience. This possibility was highlighted by Redelmeier and Kahneman (1996) who suggest that 'even perfect recall of selected moments would not imply that patients accurately remember an entire episode of pain' (p.7). Stone *et al.*, (2000) found that memory for chronic pain experienced over the preceding week was influenced by a combination of peak and recent pain, rather than a simple average of all momentary pain ratings.

5.4.2.3 What is being reported in the know responses?

Around a quarter of the MPQ descriptors selected were not remembered but were simply 'known' by the participants to be appropriate to use. Originally, Tulving (1985) conceptualised know judgements to represent semantic memory. Other researchers have proposed that whilst remember judgements reflect explicit memory, know judgements reflect implicit memory (Gardiner, 1988). In the context of the present study, know judgements may reflect recollections of the pain episode but without the feelings which accompany the 'remember' responses (semantic and/or implicit memory). They may also represent descriptions of pain which were based upon previously held notions of what cold 'should' be like, selected in an attempt to provide plausible Retrospective ratings of CP pain. It is necessary to consider the possible influences of implicit, non-declarative memories, which may be reflected by the participants 'know' judgements. According to Tulving, episodic and semantic memory are hierarchically arranged and episodic memory is supported by semantic and procedural (or implicit) memory (Tulving, 1985). These non-declarative memories may be highly influential in the formation of declared, explicit recollections and the extent to which implicit memories in adults are involved in the reconstructive and constructive processes of memory requires further exploration. Some evidence for the importance of non-declarative/implicit memories comes from studies of pain in children where memory is often expressed through changes in performance and behaviour rather than recall using words. For example, the preverbal child might 'remember' to be hyper-vigilant about white coats or some related aspect of hospitals after a painful experience whilst in hospital (von Bayer *et al.*, 2005). Although such recollections of prior pain experiences are not specifically verbalised, the child 'knows' to associate white coats and unpleasant experiences, and such knowledge is powerful in its ability to shape behavioural responses to future pain events.

5.4.2.4 False alarms in know responses

It has been argued that the distinction between remembering and knowing simply reflects the degree of confidence a participant has in his or her response (Donaldson, 1996). There is substantial evidence to refute this suggestion, that, for example, recognition in list learning tasks in the absence of remembering (know judgements) simply reflects low confidence, whilst the remember judgements reflect higher levels of certainty (see Hamilton and Rajaram, 2003, for a review). However, some research using the remember/know paradigm has more recently allowed participants to make additional 'familiarity' judgements (Conway *et al.*, 1997) or have provided the option of describing their responses as 'guesses' (Gardiner, 1988), in addition to the 'know' judgements. In the present study, because participants were recalling an internal subjective state and the descriptors selected were approximations of this state rather than a word recall task, 'familiarity' and 'guess' responses would not have been appropriate. The know judgements in this study may well have included more 'inappropriate' descriptors, and some participants indicated that they did not know why they had selected the descriptor in question. However, differences between MPQ descriptors and categories endorsed as remember and those endorsed as know which corresponded to Actual pain ratings were small, which may indicate that these 'mistakes' in the know judgements did not happen very often. Rather, participants may have experienced a 'feeling-of-knowing' that a particular sensation was experienced, and may simply be trying to select a descriptor which 'seemed appropriate'.

5.4.2.5 *The role of semantic and episodic memory in recollections of acute pain*

Recent research suggests that remember judgements provide a 'pure' measure of episodic memory whereas noetic (knowing) and anoetic (nonknowing) consciousness, arising from the semantic and procedural memory systems respectively, can be measured by know judgements (Hamilton and Rajaram, 2003). The study reported here is the first to have attempted to investigate the pattern of remembering and knowing in recollections of pain (which are assumed to reflect episodic and semantic memory, or autonoetic and noetic awareness), rather than simply inferring recollective experience or recall accuracy by comparing repeated pain ratings using parametric or Kappa statistics. The present findings using the remember/know paradigm supplement those reported by Brodie and Niven (2000) and Niven and Brodie (1995) which question the role of episodic memory in Retrospective ratings of pain. The remember/know paradigm found that the participants' phenomenological experience of recalling CP pain (some two weeks after the event) was largely one of conscious episodic recollection. Around a quarter of the descriptors retrospectively chosen were endorsed as 'know' judgements, which are assumed to reflect semantic memory (Hamilton and Rajaram, 2003). Semantic memory reflects recollections of previously experienced events, which are recalled without any conscious recollection of any aspects of the event, or may reflect previously held non-experiential knowledge about what an event 'should' be like.

The results of this study show that subjective pain experiences appear to remain largely episodic in nature over a period of weeks, but as time progresses recollections are likely to become more semantic in nature (the participants know they used the CP test and that it was painful, but have less *conscious recollection* of specific aspects of the event). Future research is required to investigate the shift from remembering to knowing over time and factors which may affect this process. This remember-to-know shift has been found to occur in other 'real world' learning situations where the proportions of 'remember' judgements decrease over time and know judgements increase through the process of schematisation (Conway *et al.*, 1997; Conway, 2001).

5.4.2.6 Recalling prior pain or recalling prior pain ratings?

Smith *et al.*, (1993) point out that verbal ratings of pain are only an approximation of the subjective experience of pain. Whether the participant or patient feels that they are remembering the nature of a pain itself, or some previous description of the pain, requires investigation. Participants endorsed only a small proportion of the 'remember' judgements as 'remember word' (around 22% of retrospectively selected descriptors). That is, participants did not tend to select a descriptor retrospectively because they remembered selecting that descriptor whilst using the CP. The majority of words picked retrospectively reflected the participants' attempts to describe a remembered subjective sensory experience. Moreover, when participants did indicate that a MPQ descriptor had been selected retrospectively because they remembered selecting the descriptor whilst in pain, participants often reported that remembering the descriptor was also accompanied by a conscious recollection of the sensation. These findings indicate that the participants did not, by and large, attempt to remember their pain by recalling previously made verbal ratings.

5.4.2.7 Remember and know judgements in comparison to ratings of Expectations of pain

A significantly higher proportion of descriptors endorsed as remember sensation and know matched Actual pain ratings than ratings of Expectations of pain. No significant differences were found however, between the descriptors retrospectively endorsed as remember *word* that matched those used to describe Actual pain and those used to describe Expectations of pain. This suggests that when the participants remember previously selecting MPQ descriptors, they appear to be just as likely to be remembering descriptors first chosen to describe their Expectations of pain as remembering the descriptor selected to express their Actual pain experiences. On the other hand, if it were the *sensations* that were being remembered, or if descriptor choices were simply 'known', these were significantly more likely to correspond to descriptors chosen to describe Actual CP pain.

5.4.2.8 Summary relating to Aim Two

Participants generally remembered the sensations of pain experienced when using the CP test. This finding indicates that sensations of pain are recalled rather than prior *descriptors* for at least two weeks after the pain event. However, a high proportion of descriptors that were selected retrospectively did not match those used to describe Actual experiences of acute pain, which may reflect the reconstructive nature of memory as well as the possibility that it is the broad defining qualitative which are clearly, consciously recalled. Evidence for this stems from the high proportion of categories selected retrospectively that were also selected whilst in pain.

5.4.3 Aim Three: To carry out exploratory analyses of the usage of the sensory, affective/evaluative and miscellaneous dimensions of the MPQ when making reports of expected acute pain and subsequent recollections

The MPQ is purportedly able to distinguish between the sensory, affective and evaluative dimensions of pain. Prior research has addressed the issue of whether one or other of these different dimensions of pain might be recalled more accurately (Hunter *et al.*, 1979; Roche and Gijsbers 1985; Beese and Morley, 1993) but the findings have been equivocal. The WR-PRI ratings for the sensory affective/evaluative and miscellaneous categories are shown in Table 5.8, and the correlations between all three comparisons (between Expectations of pain and Actual pain, Actual pain ratings and Retrospective ratings and Expectations of pain and Retrospective ratings) are shown in Table 5.9. The miscellaneous dimensions were more poorly correlated than the other MPQ dimensions. Although this difference was only significant when the correlations between Actual and Retrospective affective/evaluative and miscellaneous WR-PRI ratings were compared, it is unclear why this effect was observed as the miscellaneous categories contain a combination of affective/evaluative and sensory descriptors. Some previous research (Hunter *et al.*, 1979; Roche and Gijsbers, 1986) has observed differences in the strengths of correlations obtained for the sensory and affective/evaluative components of the MPQ, but this finding was not observed in the present study. Roche and Gijsbers suggest that these differences may be related to mood congruency and suggest that differences in mood when the pain is experienced to that when it is recalled may be a crucial factor in recall accuracy. This issue might be better addressed in a clinical setting, when the differences between moods whilst experiencing pain and some later time when pain free may be more obvious than in an experimental situation.

5.4.3.1 Investigating differences in the sensory and total MPQ WR-PRI scores using Kappa

Kappa analysis of the sensory dimension of the MPQ suggested that participants were less consistent in their use of sensory descriptors and categories than the non-sensory dimensions (Table 5.10 and Table 5.11). Morley (1993) suggests that evaluative judgements of pain intensity and distress may be encoded independently of the qualities of pain and that the evaluative summary is more available to verbal recall than the details of the sensory qualities of pain. Although the small number of times participants selected the affective/evaluative pain descriptors prevented the separate calculation of Kappa for these categories, the data could provide some support for this suggestion, inasmuch as the Kappa values for sensory descriptors were consistently less than the Kappa values obtained for the whole of the MPQ. However, the differences between the sensory and the total MPQ Kappa values were observed for all Kappa comparisons, and therefore do not appear to reflect sensory and non-sensory differences in *recollections* of pain. Rather, it appears that sensory descriptors and categories are being used more interchangeably to describe the specific sensations of pain, in comparison with those descriptors and categories that have been termed as 'non-sensory'. Therefore, analysis of the whole MPQ results in higher Kappa values than analysis of the sensory component alone. As this finding was observed for all Kappa comparisons, these differences may reflect the underlying properties of the MPQ. For example, the sensory descriptors may be more analogous to one another than the non-sensory descriptors and, therefore, substituting one for another is more likely to occur than in the non-sensory dimensions.

5.4.3.2 Investigating differences in the sensory, affective/evaluative and miscellaneous dimensions of the MPQ using the remember/know distinction.

Differences were also observed in the way the sensory, affective/evaluative and miscellaneous dimensions of pain were endorsed as remember and know. Again, the differences appeared to lie between the miscellaneous group and the other dimensions of the MPQ. Whilst participants endorsed significantly fewer miscellaneous descriptors as know, and correspondingly more as remember, miscellaneous descriptors endorsed were more likely to match those chosen to describe Actual pain. Miscellaneous descriptors were also more likely to match those chosen to describe Expectations of CP pain than the sensory or affective/evaluative dimensions. Again it is unclear why the differences in the proportions of remembering and knowing should be observed between the miscellaneous dimensions and the other dimensions, and requires further investigation in different pain situations.

5.4.3.3 Summary relating to Aim Three

It is hard to know what to make of the differences observed between the miscellaneous categories of the MPQ and the other MPQ categories, given that the miscellaneous categories contain both sensory and affective/evaluative descriptors. Perhaps more pertinent to the research question was the issue of whether the sensory or affective/evaluative dimensions of the MPQ are differentially recalled, rather than the miscellaneous dimension, which is a combination of sensory and affective descriptors. There are no data from the present study to suggest significant differences between the way the sensory and affective/evaluative dimensions are recalled. These findings need to be further investigated in clinical settings but may also call into question the theoretical distinction between the sensory, affective, evaluative and miscellaneous dimensions of the MPQ.

5.4.4 Aim Four: To investigate the relationship between ratings of anxiety and ratings of expected acute pain

State anxiety was generally low (29.9) whilst trait anxiety (38.0) was within the normal range of adult scores defined by Speilberger *et al.*, (1983). The experimental nature of the study imposed some limitations on the investigation of anxiety as situational (state) anxiety should be low. On the other hand, the use of the STAI allowed for an investigation of the extent to which individuals' levels of non-situational trait anxiety might be related to their Expectations of CP pain, Actual pain experiences and Retrospective ratings of CP pain.

Prior research has often found an association between anxiety and pain, but the association has not always been positive (see Taenzer *et al.*, 1984; Weisenberg, 1994). In the present study, no linear associations were observed between VAS ratings and state or trait anxiety (see Table 5.14). Thus, approximations of the participants' anxiety, gauged using the STAI, are not related to the ratings of CP pain intensity, reported on a VAS. It is possible that anxiety is more able to predict recalled pain after a longer delay between pain experience and recollection. Gedney *et al.,* (2003) provided some evidence for this conjecture and found that the intensity of pain experienced at the time of treatment was able to predict recalled pain one week later, but found that 18 months after the painful event, it was anxiety at the time of treatment which was the single significant independent predictor of recalled pain. The authors suggested that as the explicit memory for the sensory experience diminishes over the course of time, individuals attempt to reconstruct their recollections of the pain by using cues such as that provided by the negative affect associated with the pain. Gedney and Logan (2004) also found a mediational relationship between negative emotions at the time of experimentally induced acute pain and recollection of the experienced pain intensity six months later and suggest that over time, it is the aversive nature of the pain experience – and not the pain intensity *per se* – that will be remembered. Kent (1985) also pointed out that patients' memories may change over time to be consistent with their anxiety, which will in turn influence their expectations regarding the prospect of any future similar pain episodes. This issue could be explored in more depth by investigating the relationship between anxiety, multidimensional pain ratings such as those available using the MPQ, and the remember/know paradigm over a longer period of time than in the present study. Perhaps, over time, as the proportion of remember judgements decrease and the proportion of know judgements increase, the participants' anxiety may be more influential in the provision of retrospective ratings of pain.

On the other hand, some significant associations between the PRI ratings and anxiety ratings were observed; higher levels of anxiety tended to be related to higher ratings of pain on the MPQ to report Expectations of pain and Actual pain ratings. The findings of the present study provide some evidence for a positive association between anxiety and the experience of pain, rather than, for example, anxiety and the fear of a particular clinical procedure. In addition, finding significant associations between anxiety and PRI ratings, whilst no such finding was observed between VAS intensity ratings and anxiety, provides some indication that anxiety may be related to aspects of pain other than its intensity. Anxiety and Retrospective PRI ratings were not significantly associated and, as found when comparing anxiety with VAS ratings, provided no evidence that anxiety (either situational or trait), is associated with recollections of expected acute pain.

Kent (1985) provided some indication that the relationship between expectations of pain and retrospective ratings of pain is mediated by anxiety. In the present study, the relationship between Expectations of pain, anxiety and Retrospective ratings of pain were investigated using two hierarchical regression models which found that Retrospective ratings of anxiety were not associated with the anxiety measures used. Of course, the use of other measures of anxiety or negative affect may have been more appropriate to investigate the relationship between anxiety states and pain ratings that the measures employed in the present study. Kent, for example, (1985) assessed anxiety and affect using a four item dental anxiety scale, and Taenzer *et al.*, (1986) used a battery of self-report psychological tests including the STAI, the Beck Depression Inventory (BDI), the Eysenck Personality Inventory (EPI), the Rotter Locus of Control, the Health Locus of Control Scale (HLOC), and the Repressing-Sensitizing Defense Style. Prior research has also demonstrated that *differences* in mood when the to-be-remembered material is encoded and at recall can significantly affect memory (Roche and Gijsbers, 1986; Ross, 1989). In the present study, no measures of state anxiety were obtained retrospectively. It is also possible that differences in affective state whilst using the CP and when providing Retrospective ratings of pain are more influential in pain recall than mood state at the time of the pain stimulus. However, in the present study, assessing differences in affective state was not considered to be appropriate as there were no reasons to expect that state anxiety or other affective state would be any different whilst using the CP than retrospectively.

In this study, an attempt was made to investigate the relationship between anxiety and memory for pain by using Kappa as a derived measure of pain memory accuracy. The fifth hypothesis was that there might be less agreement between Actual pain ratings and Retrospective pain ratings (reflected in lower Kappa values) in participants exhibiting higher levels of anxiety compared to participants reporting lower levels of anxiety. There was little evidence from our results to support this hypothesis which suggests that, in experimental settings, anxiety and recall accuracy are not associated.

5.4.5 Aim Five: To investigate memory for the taste of an unusual vegetable drink in order to assess memory for pain relative to another similar subjective sensory experience

There is a paucity of research which has investigated the extent to which pain can be recalled relative to other sensory experiences. The experimental design of this study provided an ideal opportunity to investigate memory for another type of sensory experience in the same setting as the pain stimulus. Tasting the drink also provided an appropriate 'filler' task between rating Expectations of CP pain, and using the CP test and providing ratings of Actual pain.

The most frequently selected descriptors to describe the taste of the drink were 'vegetable, cool, cabbage and smooth'. At recall, participants described the drink as 'vegetable, smooth and herbal'. The mean number of words chosen (NWC) to describe the taste of the drink was 10.8 whilst the mean NWC two weeks later to retrospectively describe the taste of the drink was 10.

The NWC to describe the taste of the drink was very similar to the NWC to describe CP pain. However, whilst there were no significant differences between the NWC to describe Actual and Retrospective ratings of pain, the NWC to describe Actual ratings of taste was significantly greater than the NWC whilst tasting the drink. On the other hand, Kappa analysis indicates that the consistency with which taste descriptors were selected was significantly greater than pain descriptor use (Table 19), although the mean Kappa values for taste still fell within the 'fair' range of values. There was no significant difference in Kappa values reflecting MPQ category agreement and those reflecting taste descriptor agreement between Actual and Retrospective ratings.

The proportions of descriptors endorsed as remember, remember sensation and know in the taste test and the CP test were very similar. A significantly greater proportion of retrospectively selected taste descriptors endorsed as 'remember' (both remembering taste *sensation* and remembering taste *descriptors*) correctly corresponded to words selected whilst tasting the drink than was observed for the CP test. There was no significant difference between the 'know' judgements made for taste and pain. The proportions of remember and know judgements for CP pain and taste were notably similar; it was the extent to which the participants' Retrospective judgements *correctly* matched those selected whilst in pain which was significantly greater for taste than for pain. The reason for the slightly better recall of the taste might have been that it involved three sensory modalities; taste, smell and vision (a strongly tasting and smelling, distinctive dark red drink in a plastic cup).

Making direct comparisons between the data obtained for pain and taste might be considered to be questionable given the differences in the make-up of the MPQ and the list of taste descriptors. The numbers of adjectives available to describe taste was fewer than those available on the MPQ; 57 taste descriptors were available whilst 72 pain descriptors were available. In addition, it could be argued that some of the taste words are simply more memorable and distinct from one another than the pain words. There is some evidence that this may be the case, given the higher number of taste descriptors endorsed as 'remember word' matching those selected when tasting the drink (Table 5.20), compared to the number of pain words selected as 'remember word' which matched those selected whilst in pain. However, the proportions of descriptors that the participants endorsed as remember word were similar for both taste and pain (.26 for taste and .2 for pain)

Partially supporting the sixth hypothesis, there appears to be a number of similarities in the way taste and pain are remembered, and any increase in recall accuracy may be due to the memorability of the taste descriptors rather than the taste experience, or perhaps, the fact that the taste test involved more than one sensory modality (taste, smell and vision). In addition, although the participants were more consistent in their choice of taste descriptors than for MPQ pain descriptors, they were not more consistent in their use of taste words than in their use of MPQ categories.

5.4.6 Other findings: age and gender differences

There was some tendency for older participants to report greater levels of pain on the VAS immediately after using the CP test (i.e. Actual pain) and Retrospectively. Gagliese and Melzack (2003) found that older chronic pain patients had significantly lower MPQ total scores and sensory scores and chose fewer descriptors than the younger group. The contrary findings in the present study may be due to the differences arising from the chronic versus acute nature of pain in the current study. There is, however, no evidence to suggest that age and memory for pain are associated. In terms of gender, independent *t* tests were used to investigate differences in all pain, taste and anxiety measures. All WR-PRI, PPI and VAS ratings of Expected, Actual and Retrospective ratings were slightly higher for women than for men, but this only reached significance for the PPI ratings to describe Expectations of CP pain.

5.4.7 Limitations

The study here has been able to achieve its aims and has been able to provide data in order to accept or reject the hypotheses of the study. There are, however, a number of limitations and these are discussed below.

5.4.7.1 The use of an experimental research design

The experimental design of the present study could be criticised for lacking clinical relevance or applicability and its inability to reflect 'real' pain events. This is a fundamental concern and the decision to employ an experimental research design was taken after much consideration. However, the research investigated pain memory using a paradigm developed in experimental settings and one which had never previously been employed in a pain memory context. For this reason, it was considered necessary to investigate pain recall ability within a controlled environment which could allow for the control of many extraneous and possibly confounding variables. This research is able to provide some theoretical 'building blocks' for future studies to investigate the use of the remember/know design to assess memory for pain in a clinical setting.

A number of steps were taken to minimise the limitations arising from the experimental nature of the study. Participants recruited were primarily university staff rather than undergraduate students, who often comprise the majority of participants in experimental pain research studies (e.g. Keogh *et al.*, 2001; Keogh and Herdenfeldt, 2002). Very few of the participants involved in this study had previous experience of taking part in research studies and may have been generally quite naïve to the processes involved in participating in research. Thus, although participants clearly knew they would not be at risk of any harm, they were perhaps generally less aware of what the study would involve than undergraduate students who often take part in such research motivated by financial gain or as a required aspect of their course of study. The participants were not told prior to participating in the study that they would be paid. The requirements of the study were explained verbally and in writing to the participants in a similar way that verbal and written information might be provided in a clinical setting, perhaps prior to a routine clinical screening procedure.

One limitation which cannot easily be circumvented within an experimental research design is that participants know they can remove themselves from the pain stimulus at any time. One or two participants mentioned that if the pain they had experienced was not controllable, the situation would be much more distressing. However, it could be argued that the present experimental research paradigm may bear some similarities to expected acute pain events in clinical settings inasmuch as patients can often ask for a procedure to be halted or analgesics can be requested if the pain or discomfort reaches an unacceptable level.

5.4.7.2 Making only a single rating of pain

Participants made only one Retrospective rating of their pain using the MPQ. Therefore, this study can only provide an indication of the participants' performance at one specific time point. Memory research has shown quite conclusively that the conscious recollection of previously experienced or learned episodes changes over time (Conway 2001; Conway *et al.*, 1997). Previous research has also shown that remember judgements decline as the interval between a study episode and test lengthens (Gardiner and Java, 1991; Conway 2001; Rajaram and Hamilton, 2001), and that primarily episodic memories become more semantic as time progresses (Conway *et al.*, 1997; Herbert and Bert, 1998; Conway *et al.*, 2001). In the first study to employ the remember/know paradigm, Tulving (1985) demonstrated how remember judgements declined with more retention interval, relative to overall recognition performance. It is clear that, as we think back to moments in our personal past, events which are initially remembered vividly (such as a recent trip to a theatre production) fade after a period of days, weeks and months. The data obtained in this study were only able to demonstrate that two weeks after experiencing a short acute pain episode, recollections of the qualitative nature of pain are primarily episodic in nature. Future research needs to investigate the pattern of remembering and knowing about prior pain events at different time points. In the longer term, recollections of pain intensity and its affective qualities may not involve 'remembering' or episodic recall, but become a 'life story' that one simply 'knows' occurred.

In addition, further research is required to investigate whether, over time, participants ratings are more closely associated with their ratings given prior to the CP test (that is, their expectations) as the memories shift from being primarily episodic to more semantic in nature. On the other hand, according to Tulving, it is the episodic memory system which allows for 'mental time travel'. Perhaps, rather than Expectations of pain relying upon the semantic 'general knowledge' held about related events, it is the episodic memory system (which is supported by semantic knowledge and memory) which allows us to project ourselves into the future and imagine the likely nature of a forthcoming expected acute pain event.

5.4.7.3 Presentation of the MPQ

Prior researchers (e.g. Beese and Morley, 1993) have been concerned with the possibility that the presentation of the MPQ in its standard categorised format might artificially augment the Kappa values, as categorising similar descriptors has been found to improve memory (Bower *et al.*, 1969). However, it could also be argued that the presentation of MPQ descriptors in their categories may have resulted in participants substituting synonymous descriptors with others from the same category, which would *negatively* affect Kappa values. Although presenting the MPQ in a single list circumvents cueing issues and allows participants to describe their pain in a more flexible way, such presentation may have a detrimental effect on the psychometric properties of the MPQ. In addition, the presentation of the MPQ in categories allowed for an investigation of the qualitative nature of pain in addition to the 'fine-grained' analysis of individual MPQ descriptors.

5.4.7.4 Requiring participants to make judgements about sensory experiences whilst focussing on the CP pain

Gardiner and Parkin, (1990) found that remember responses are negatively affected by divided attention during learning, whilst 'knowing' is unaffected by this variable. When using the CP test, participants were told that they could remove their hand when the pain became intolerable but, whilst their hand was in the cold water, to try to focus upon the sensations being experienced. Obtaining 'on line' reports of pain was therefore an intentional design of the study, in order to capture descriptions of the quality and intensity of the pain experience whist it was occurring. In clinical situations, patients often utilise either taught or self-generated distraction techniques (e.g. imagery or relaxation techniques), and are likely to employ various coping methods to help 'get through' the experience. The fact that participants were asked not to use such distraction techniques in the present study may mean that they were focussing on the CP sensations more than they would if it were a clinical situation. On the other hand, in health-related situations, we might expect this kind of focussing on pain to occur, especially if participants are intending to report their experiences to health professionals at some late time.

5.4.7.5 Pain extraneous to the CP pain

It has been noted that memory for pain can be influenced by being in pain at the time when Retrospective ratings of pain are made (Smith and Safer, 1993). Although none of the participants were experiencing chronic pain, a record was made of any pain extraneous to that induced by the CP. Some pain other than that arising from the CP use was experienced by seven participants whilst using the CP, and fourteen participants were experiencing some kind of pain or were feeling unwell when providing Retrospective ratings of pain. However, in the present study, this extraneous pain appeared not to have influenced memory for CP pain.

5.4.7.6 Unknown factors which may be able to predict memory for pain

There are countless variables which may contribute to the variance observed in Retrospective ratings of pain. For example, Gedney and Logan (2004) considered the menstrual cycle of female participants and the gender of the researcher in their research investigating memory for pain. Future studies investigating the variance in remembering and knowing may benefit from a more comprehensive exploration of these and other factors.

5.5 Conclusions

Retrospective ratings of the intensity of CP pain recalled over a period of weeks accurately reflected those made whilst in pain. This finding, which agrees with prior research, confirms that retrospective ratings of pain intensity can be reliable in settings where extraneous variables can be controlled to some extent. In addition, the broad defining qualities of pain also appear to be recalled well. The use of Kappa statistics to assess the consistency between Actual pain ratings and Retrospective ratings may provide an over-stringent assessment of pain recall accuracy, whereas Kappa to assess agreement between MPQ category use may be more appropriate.

Not only is it important from a clinical perspective to investigate the phenomenological experience of pain memories, but this approach also allows for an investigation of the extent to which the pain experience, as opposed to the pain rating, is remembered. As far as we know, this is the first study to investigate the states of awareness that accompany recollections of pain and taste using the remember/know procedure. Our data indicate that recollections of the qualitative dimensions of pain are generally of an episodic nature for up to two weeks following the pain experience.

The remember/know research paradigm was extended to investigate whether descriptors retrospectively judged as 'remember' reflect recollections of the pain *per se* or a recollection of the prior description of pain. The findings indicate that participants do not generally rely upon previous word use or prior pain ratings to provide Retrospective ratings of pain and do attempt to provide a description of remembered pain sensation. The fact that descriptors used to describe remembered sensations often do not match those used whilst in pain further suggests that pain is remembered at a broader level than the fine-grained MPQ descriptors.

Participants' state and trait anxiety, and their previously held Expectations, were not found to be significantly related to pain recall accuracy. There was little evidence from the study to implicate either of these variables as factors affecting either pain recall accuracy or recollections of pain intensity and quality.

Comparing the phenomenological experience of recalling pain with that which occurs when recalling the taste and smell of an unusual drink provides little indication that pain memory is a 'special case' of recollective experience. Although more systematic comparisons between recollections of sensory experiences is required, perhaps using free recall techniques, the comparisons made in this study allow the relative extent of 'memory for pain' to be gauged. Further research using the remember/know paradigm might help to understand factors which affect the phenomenological awareness that accompanies recollections of expected acute pain events. In the final chapter, the issues addressed in this thesis are reviewed, and the limitations of the currently employed research design are discussed in relation to possibilities for future investigations of memory for pain.

CHAPTER SIX: GENERAL DISCUSSION, FUTURE DIRECTIONS AND CONCLUSIONS

6.1 Summary of research process

This thesis has reported a series of studies which have investigated the extent to which the intensity and qualitative nature of expected acute pain events can be recalled. An examination of the relevant literature highlighted a number of issues which needed to be addressed in order to properly investigate memory for expected acute pain events. Previously published research has suggested that the intensity of acute pain can be recalled reasonably accurately, whilst recollections of the quality of the pain experience may be less reliable. The first preliminary study challenged this conjecture, and suggested that it may be inappropriate to assess memory for the qualitative nature of pain by comparing the fine-grained MPQ descriptors selected whilst in pain with those selected at some later point and inferring 'memory' for the qualitative nature of an expected acute pain experience. In addition, whilst adding to the literature by investigating recall of pain intensity and quality in a different setting and using the SF-MPQ as a pain assessment tool, the preliminary studies confirmed the need to investigate the phenomenological awareness which accompanies recollections of acute pain.

The main study for this thesis assessed memory for experimentally induced acute pain through the use of remember/know research paradigm. As the focus of this thesis was memory for *expected* acute pain, a further aspect of the research was to consider the influence of the participants' expectations and anxiety on subsequent recollections of the pain.

Finally, the extent to which pain can be recalled relative to another sensory experience was assessed by requiring participants to taste and subsequently recall the flavours of an unusual vegetable drink. In this General Discussion, the central findings to emerge from this thesis are examined and reiterated, whilst possibilities for future research and the limitations of the current research are explored.

6.2 Summary of findings

6.2.1 Preliminary studies

The findings of the preliminary studies reported in Chapter Two and Chapter Three were largely in agreement with prior research. In the first study, which assessed the extent to which postoperative pain intensity and pain quality could be recalled, ratings of pain intensity in the 48 postoperative hours and those made some weeks later were significantly correlated. On the other hand Kappa values, reflecting the agreement between the MPQ descriptors selected to whilst in pain and those selected retrospectively, suggested discrepancies in the recollection of the qualitative aspects of pain. However, it was proposed that Kappa might be more appropriately used to assess recall of pain at a broader 'type of pain' level than at the level of the individual MPQ descriptors.

In the second preliminary study, non-patient participants were required to provide estimates of the likely nature of postoperative pain following vascular surgery. Broad similarities were observed between ratings of pain made by the patient participants and the estimates made by the non-patient participants, which confirmed the need to assess memory for expected acute pain more directly. It was argued that the retrospective reports of pain actually provided little information about the recollective experience of recalling pain and that it is difficult to decipher whether retrospective ratings of pain reflect the pain experience, or reflect previously held knowledge about what a particular pain 'should' be like. In addition, even if participants *were* recalling aspects of the pain episode, questions relating to the extent to which the recollections reflect memory for the pain *per se*, or memory for the previously made pain *ratings*, remained unanswered.

In addition, expectations of pain and anxiety were considered as factors which may influence retrospective reports of the pain. The data from the preliminary studies provided some indication that participants' anxiety was related to their retrospective ratings of pain, but the small sample sizes prohibited all but the most tentative of conclusions.

6.2.2 Study Three: The main study

Using a larger sample size and more rigorous methodology (facilitated by the use of an experimental research setting) the main study for this thesis (reported in Chapter Five), was designed to address the issues outlined at the end of Chapter Three and to investigate the phenomenological awareness that accompanies memory for pain. These issues are summarised and discussed below.

6.2.2.1 Issue One: Is the intensity of acute pain recalled more accurately than the qualitative aspects of pain? In addition, how detailed or 'fine-grained' are recollections of the qualitative nature of pain?

Clark and Bennett-Clark (1993, p. 198) assert that memory for past acute pain seems to be 'extremely poor'. The data from the CP study suggest that, on the contrary, retrospective ratings of the intensity of a previously experienced expected acute pain, and recollections of the broad qualitative dimensions of the pain, can be reliable over a period of weeks. Highly significant correlations between Actual pain ratings and Retrospective ratings of pain intensity were observed. The use of Kappa to analyse the agreement between MPQ category use suggested that the defining qualitative nature of pain was recalled with a greater degree of accuracy than has been concluded by prior research (e.g. Beese and Morley, 1993; Brodie and Niven, 2000; Terry and Gijsbers, 2000). The data from the CP study suggest that memories of the qualitative dimensions of pain may be retrieved, and possibly encoded, at a broader 'type of pain' level (thermal, incisive and so on) rather than at the fine-grained level of the individual MPQ descriptors. The MPQ provides a large number of descriptors which can be used to verbally report the subtle nuances of a pain but also contains words which are 'undoubtedly synonyms' (Melzack and Wall, 1996, p. 38). The finding that somewhat different descriptors are being used retrospectively does not necessarily mean the pain is being inaccurately recalled. Instead, it may be that synonymous words are being used interchangeably to describe the same *type* of pain both perceived and recalled.

6.2.2.2 Issue Two: To what extent is previous pain remembered or simply known to have occurred and to what extent do retrospective ratings involve episodic and semantic memory?

Over a decade ago, Morley (1993) pointed out the paucity of research which has considered the phenomenal experience accompanying recollections of previously experienced pain. The third study presented in this thesis is the first to use the remember/know distinction to investigate the extent of conscious awareness in memory for pain. By comparing MPQ descriptors selected retrospectively and endorsed as either remember or know with those chosen whilst in pain (Actual pain ratings), it was possible to assess the extent to which the pain was consciously remembered and to assess the extent to which these memories were consistent with real time reports (that is, to investigate how accurate these recollections were). In addition, assessing the extent to which pain is remembered, or simply known to have occurred, can assist in furthering our understanding of the extent to which recollections of pain rely upon episodic or semantic memory. Remember judgements are conceptualised as reflecting episodic memories and autonoetic consciousness, whilst know judgements are perceived as reflecting semantic and/or procedural memories and noetic or anoetic consciousness. Cognitive research has indicated that remember judgements appear to provide a more 'pure' measure of conscious recollection in comparison to other measures of explicit memory (Hamilton and Rajaram, 2003).

Most (over 70%) of the MPQ descriptors chosen retrospectively were selected because participants remembered the sensations conveyed by the descriptors. Around one quarter of the MPQ descriptors used to describe recollections of the CP pain were endorsed as 'know'; that is, participants felt that although these descriptors selected were appropriate to describe their recollections of pain, they had no conscious recollection of having experienced the sensations implied by the descriptors.

It is only possible to speculate on the influence of the extent to which know judgements reflect semantic or implicit recollections of the pain experience. Know judgements may reflect recollections which have 'shifted' from being episodic in nature to a more semantic form. For example, I might remember a particularly severe headache the day after it was experienced, but, some weeks later might simply know I recently experienced a headache. Prior research has suggested that the episodic memory of previously experienced sensory information tends to last only for a short time after the event in question; at best, for a few days or weeks (Brewer, 1986; Conway 2001). The shift from remembering and knowing in the hours, days, and weeks after a pain experience requires further investigation.

Nearly half of the MPQ descriptors retrospectively endorsed as remember were not selected whilst in pain. On the other hand, almost 90% of the MPQ *categories* retrospectively endorsed as remember corresponded to categories used whilst in pain. This finding, in agreement with the data obtained from Kappa analysis, suggests that participants were recalling the defining qualitative nature of the pain, rather than the 'fine-grained' pain descriptors.

Recently, D'Argembeau and Van der Linden (2004) proposed that the cognitive processes involved in remembering the past and imagining the future are closely related, and for Tulving (1985), this kind of 'mental time travel' is facilitated by episodic memory and related to autonoetic (self-knowing) consciousness. Autonoetic consciousness, which is the 'kind of consciousness that mediates an individual's awareness of his or her existence and identity in subjective time, from the personal past through the present to the personal future' (Tulving, 1985, p. 1), allows for the subjective experience of remembering and for the mental 'pre-experiencing' of future events (Wheeler *et al.*, 1997). In this thesis, the possible role of semantic and episodic knowledge has been discussed in relation to memory for pain. Prior research has suggested that when episodic memory is limited, ratings of pain rely upon semantic knowledge of what a pain 'should' be like. However, perhaps it is *episodic* memory that is responsible for imagining what a pain was like, and imagining what a future pain might be like. This possibility highlights the 'bi-directional effects of episodic and semantic memory', postulated by Brodie and Niven, when thinking about prior pain episodes, or indeed, those that have never been experienced.

6.2.2.3 Issue Three: Do retrospective ratings reflect recollections of pain per se or prior pain ratings?

Prior research investigating memory for pain has generally concluded that if ratings of pain made whilst in pain matched ratings of pain made some time later when pain free, memory for pain was reliable, whilst inconsistencies between the two times of assessment reflected poorer recollective ability. But these studies have been unable to demonstrate whether retrospective ratings of pain reflect recollections of the pain *per se* or recollection of the rating previously used to report the pain. In the present research, the remember/know paradigm was extended in order to specifically address this issue. To recap, if participants indicated that their choice of MPQ descriptors was based on remembering some aspect of the cold pressor experience, participants were then required to distinguish between whether they remembered the *sensations* of pain (judged as remember sensation) and/or whether they remembered selecting the MPQ *descriptors* (judged as remember word) whilst using the CP. Participants seemed to be able to make this distinction easily and generally remembered the sensation expressed by the chosen MPQ descriptor. In addition, participants did not usually recall whether or not they had previously used a particular descriptor to report the pain. That is, participants apparently were able to consciously recall the nature of their pain, rather than a recollection only of the words chosen to describe it. This finding is noteworthy in that it provides the first direct evidence of the extent to which participants are recalling prior pain experience or prior pain ratings.

However, although participants generally reported remembering the sensations experienced when using the CP test, almost half of these descriptors chosen retrospectively were *not* selected by the participants when using CP test. This finding may provide further evidence that participants were attempting to recall sensations rather than prior pain descriptors. That is, participants were trying to select appropriate words to match their recollection of the pain *per se*, rather than previously selected MPQ descriptors.

6.2.2.4 Issue Four: Are some aspects of the pain experiences, for example the affective or sensory components, recalled more accurately the others?

Overall, no systematic differences were found between the sensory and affective/evaluative components of pain. As this study was experimental in nature and CP pain lacks much of the affective nature of clinical pain, additional research is required to investigate the extent to which the present findings can be replicated in clinical settings. There were, however, significant differences between the miscellaneous MPQ categories and the sensory and affective/evaluative categories. Why such differences were found is unclear; the miscellaneous categories contain both sensory and affective pain descriptors. In addition, it is notable that differences between the sensory and miscellaneous components of the MPQ were observed for all comparisons, (between Expectations of pain, Actual pain and Retrospective ratings). Further research needs to ascertain whether the recall differences observed in this study between the dimensions of the MPQ reflect that these aspects of pain are being encoded and/or recalled differentially, or arise for some other reason, for example due to the way language is used to express these aspects of pain.

6.2.2.5 Issue Five: To what extent are Expectations of pain able to predict Retrospective ratings of expected acute pain?

The findings of the first preliminary study and the main study suggest that Expectations of both expected clinical and experimental pain had little influence on subsequent recollections. In the main study it was possible to employ multiple regression analyses which demonstrated that expectations accounted for only about 1% of the variance in the Retrospective ratings. Thus, although numerous variables, including past experience and expectations, have been found to influence the perception of acute pain, (see e.g., Melzack and Wall, 1996), the evidence presented in this thesis indicates that prior expectations of pain were not influential in the construction of retrospective reports. On the other hand, in the longer term, prior expectations of an anticipated acute pain event may become more influential. The finding that the participants' Expectations of the CP pain were so at odds with their Actual pain experiences, in spite of the fact that probably all of the participants had experienced painfully cold hands in some other context prior to participating in the study, adds some weight to this conjecture. Participants' expectations would, to some extent, have been based on recollections of other similar experiences. Perhaps over time, as episodic memories shift to becoming more semantic in nature, there is more opportunity for discrepancies to occur. Again, this finding highlights the need for further research needs to investigate the changes in or remembering and knowing about previously experienced pain over time.

6.2.2.6 Issue Six: Is there an association between measures of anxiety and measures of pain recall consistency?

There was some evidence from the first preliminary study to suggest that the consistency of MPQ descriptor selection and anxiety might be negatively related, whilst ratings of pain and anxiety might be positively related. In the main study, no support for these preliminary findings could be found. However, further research is required to investigate a possible relationship between negative affect related to the individual's experience of the pain and rehearsal and memory for pain. Prior research has found that distress directly associated with, or as a result of, a painful experience was positively associated to the frequency with which the experience was rehearsed (Morley, 1993). In turn, this frequency of rehearsal may influence the accuracy of retrospective reports of pain (Niven and Brodie, 1995). Factors such as frequency of rehearsal and other issues related to anxiety should be systematically assessed before it can be claimed that anxiety does not influence memory for pain. In addition, the possibility that anxiety becomes more influential in retrospective reports of pain over time (perhaps as recollections shift from being primarily episodic to semantic) requires further investigation.

6.2.2.7 Issue Seven: Is pain recalled more or less accurately than taste or smell?

Our understanding of memory for pain can be advanced by the comparison of patients' or participants' relative ability to recall pain with their ability to recall other sensory experiences. Prior research has acknowledged that this issue requires investigation and has compared memory for pain with memory for the weather and for mood (Beese and Morley, 1993; Hunter *et al.*, 1979). There has been apparently no research which has investigated memory for pain and compared this with memory for other sensory experiences – such as taste or smell – which might be considered to be a more 'like with like' comparison than those made in prior research. The data from Study Three indicate many similarities between recollections of pain and taste. For both pain and taste, participants mostly reported remembering their sensory experiences and the proportion of taste and pain descriptors endorsed as remember was the same. Taste seems to be recalled slightly more accurately, but this may be expected since the stimulus involved three sensory modalities; taste, smell and vision.

Given the differences between the taste and pain questionnaires, the assertions that taste and pain are similarly remembered are tentative. The 'taste questionnaire' consists of a simple list of descriptors which can be used to report taste and smell and does not possess the psychometric properties that have been demonstrated in the MPQ. In addition, no VAS or linear rating scales were used to measure aspects of the taste such as pleasantness – unpleasantness. However, notwithstanding the differences in assessment tools, the similarities are notable, and suggest that both sensory experiences may shift from remembering to knowing over similar timescales. The comparisons made between pain and taste also indicate that memory for pain is not some kind of 'special case' of recollective experience, (e.g. Jones, 1957) and that discrepancies observed between real time and retrospective ratings of pain may be equally observed in retrospective ratings of other subjective experiences. Future research might explore memory for different sensory modalities more systematically by using a combination of VAS and verbal descriptors for both pain and taste, or relying on participants' own qualitative descriptors of the two experiences and their subsequent recollections.

6.3 Methodological and statistical issues

Section 6.2. above summarises the main findings arising from this thesis. However, in order to investigate memory for acute pain properly, a number of methodological and statistical issues also needed to be considered. These are discussed in the following section.

6.3.1 Statistical issues

6.3.1.1 Cohen's Kappa as a measure of recall accuracy

Kappa reflects the agreement between responses made on two occasions over and above that which would be expected to occur by chance. One of the limitations of using Kappa to investigate the pattern of responses given on more than one occasion is that it tells us nothing of where the differences between the ratings lie. For example, one could describe a headache as throbbing, aching and exhausting at one moment and as pounding, hurting and tiring the next. Both give a PRI score of 10, and both use the same MPQ descriptor categories. But Kappa analysis to compare the MPQ descriptors used would indicate that there is no agreement between the two ratings. It would clearly be inappropriate to assert that there was no recollection of the qualitative nature of the pain when comparing these two ratings. Thus, used in this way, Kappa appears to be over-stringent in its assessment of the agreement between two qualitative ratings of pain. Given the reconstructive and constructive nature of memory, and the 'everyday' use of language, it might be unreasonable to expect to observe agreement between ratings when 'chance' is controlled for. If Kappa is used to assess pain recall accuracy, analysis of the MPQ categories may be more representative of the individuals 'memory for pain'. Assessing how consistently participants use the same *types* of descriptors across assessment times (to describe temporal, spatial, pressure, thermal, tension, etc), might be more reasonable than expecting participants to provide verbatim retrospective reports.

In addition, it is difficult to know what is being controlled for when applying Kappa to investigate memory for pain. The data from this study suggest that participants generally do not make random selections of pain descriptors, but rather, attempt to provide a description of their subjective experiences of pain. As it is widely held that an individual's pain (and presumably memory of that pain) is whatever they report it to be, correcting these responses for 'chance' might be inappropriately stringent. On the other hand, it is also widely argued that comparing the percent agreement between two ratings can overestimate the true rate of concurrence (Altman, 1991). These issues reflect the difficulties that arise in inferring that explicit recall performance reflects a measure of conscious recollection, and highlights the need to adopt methods to more directly assess the nature of recollective experiences, such as the remember/know distinction used in this thesis.

6.3.2 Methodological issues

6.3.2.1 Use of the MPQ

The MPQ, and its Short Form, were used as pain assessment instruments throughout this thesis. Although their validity and reliability have been challenged, they remain the most widely used methods of investigating pain as a multidimensional experience (Wilkie *et al.*, 1990). Previous research has found that it is often difficult to describe pain by generating appropriate descriptors to describe a particular pain experience and has found that only three or four words tend to be used to express pain, such as the descriptors 'hurt', 'sore', 'ache' and, as would be expected, the word 'pain' (Fabriga and Tyma, 1976; Niven and Gijsbers, 1984). The use of the MPQ or its Short Form may encourage individuals to describe more specifically the nature of their pain.

On the other hand, encouraging participants or patients to describe their pain using the MPQ or the SF-MPQ, and using these ratings to assess memory, may also have some drawbacks. The use of the MPQ may encourage participants to use additional or inappropriate words to describe their pain, and the descriptors contained within the MPQ will not have the same meaning for everyone (Sriwatanakul 1983; Bergh *et al.*, 2005). Moreover, the MPQ is not an exhaustive list of pain descriptors and may constrain an individual to choose from a list of descriptors which may not be part of their normal vocabulary.

However, if it is generally the case that, without prompting, individuals can only generate a few words to describe their pain experience, the MPQ can help to encourage individuals to use the descriptors available to appropriately express their experiences. The fact that MPQ descriptors may have slightly different meanings for each individual may provide a further reason to consider descriptions at a 'type of pain' level than at the individual descriptor level.

6.3.2.2 Cueing

Prior research has considered the possibility that cueing may arise from presenting the MPQ in its standard format (Brodie and Niven, 2000; Beese and Morley, 1993). In this study, the possibility of cueing was reduced by reading the MPQ to participants and by randomising the order in which the categories were read at each assessment time, rather than presenting it in written form. However, our results suggest that, by and large, participants are trying to recall pain sensations rather than pain descriptors. The issue of cueing effects arising from the presentation of verbal descriptors, then, might not pose the same methodological problems in this kind of research as in cognitive memory research. On the other hand Conway (2001) points out that episodic and autobiographical memory are highly sensitive to internal and external cues, and an exploration of these in future research is warranted.

6.4 Limitations

6.4.1 Only one retrospective pain assessment was made

A limitation of this study is that only one retrospective assessment was made. As discussed above, obtaining more than one retrospective rating is required in order to provide data about how the experience of remembering pain shifts from being primarily episodic to being more semantic in nature. Participants recalled their experiences of the Cold Pressor test two weeks after the event which provided a single retrospective 'snapshot' of memory for pain. The study can therefore only provide information about memory at one particular moment in time and it remains unclear how these memories might decay (or otherwise change) over time. Future research also needs to investigate factors which may differentially affect remembering and knowing over the course of time.

6.4.2 Differences between clinical and experimental pain

A further limitation of this study, which has been discussed throughout, is the fact that the pain was experimentally induced. The applicability of the remember/know paradigm in clinical pain situations needs to be explored further.

6.5 Future research

In view of the limitations of the present study, and in the light of the findings, numerous possibilities for future research may be considered. Some of these are reviewed in the following section.

6.5.1 Use of the remember/know research design in a clinical setting

Although the remember/know research paradigm has been instrumental in furthering an understanding of the phenomenological awareness in memory for pain, a limitation of this study was the fact that an experimental research paradigm was used to investigate memory for pain. An exploration of the relative extent of remembering and knowing prior pain experiences occurring in different clinical situations would be of theoretical and practical relevance.

6.5.2 Assessing remembering and knowing about prior pain events using PET and fMRI studies

Imaging studies have indicated that when episodes are remembered, reactivation can include brain regions that are associated with the type of information being retrieved (Wheeler and Buckner, 2004; Nyberg *et al.*, 1996). Prior research has also demonstrated dissociations of remembering and knowing using electrophysiological measurements (Duzel *et al.*, 1997) and functional magnetic resonance imaging (Henson *et al.*, 1999). The extent of conscious awareness in recollections of the different qualities of pain may be further investigated by the use of such brain imaging techniques.

6.5.3 Qualitative analysis of pain reports

Assessment measures and tools which have been shown to be valid, reliable and appropriate are necessary to gauge the subjective experience of pain. Prior research has indicated that unprompted, few words tend to be used to describe the qualities of a pain experience (Fabrega and Tyma, 1976; Niven and Gijsbers, 1984). However, qualitative analysis techniques may be very valuable in supplementing the ratings of pain which can be numerically indexed (for example the PRI or a VAS). Melzack and Wall (1996) highlight the essential role played by 'as if' statements to convey the qualities of a pain experience. Erskine *et al.*, (1990, p. 265) also point out that future research could benefit from the 'careful documentation of patients accounts of their pain memories'. Future research should consider ways in which to incorporate the remember/know paradigm into qualitative analyses of memory for pain.

6.5.4 Investigating other factors influencing memory for pain

The research presented in this thesis provides evidence that retrospective ratings of acute pain can be reasonably accurate in terms of its intensity and broad defining qualities. Two possible factors, expectations of pain and anxiety, (assessed using a single anxiety rating tool) have been shown not to influence memory for the types of acute pain reported in this thesis. However, Linton (1993, p.201) reminds us of the numerous factors which affect recollection and memory and suggests that the question may not be 'if memory for pain is accurate or not, but rather the size of the discrepancy under specified conditions. For some purposes, and, in some conditions, pain recall may be sufficiently accurate, while in others it may lead to serious research or clinical complications'.

6.6 Conclusions

Memory for the intensity of expected acute pain appears to be reliable both in clinical and experimental settings over a number of weeks. Whilst prior research has also found this to be the case, in the present studies, using both clinical and experimental research paradigms, and a variety of statistical methods, the assumption that memory for pain intensity is reliable has been upheld.

In addition to the finding that retrospective ratings of pain intensity can be consistent with those made whilst in pain, this study adds to the previously available literature by demonstrating that memory for the broad defining aspects of the quality of pain can also be reliable. The present data indicate that recollections of the qualitative dimensions of pain are more appropriately assessed at a 'type of pain' level rather than the fine-grained level of individual MPQ descriptors.

As participants were readily able to distinguish between 'remembering' and 'knowing' when making judgements about their retrospective pain descriptions, the use of the remember/know distinction may allow considerable advances to be made into the assessment of memory for pain. The use of the remember/know paradigm has facilitated the gathering of new data relevant to how pain is remembered, and allows for a direct assessment of the participants' own reports of their memories, rather than inferring the likely nature of these experiences.

In addition, as this thesis has focussed upon memory for acute pain events which can be planned for and anticipated, the extent to which patients' or participants' expectations influenced memory for pain, also required consideration. Whilst the relationship between expectations, anxiety and pain experiences warrants further investigation, no evidence in the present research was found to indicate a relationship between expectations, anxiety and *memory* for pain. A further issue explored in this thesis was whether pain is recalled in a similar way to other events. The data obtained provide evidence that recollections of pain and recollections of other sensory experiences are broadly similar. This issue has not been addressed in prior research, and the findings suggest that pain is not some special case of recollective experience.

In conclusion, it is clear that each method of pain assessment and statistical procedure employed to investigate memory for pain has its problems and limitations, and our investigation of the subjective experience of recalling pain depends heavily upon these. However, the remember/know distinction appears to provide a method of more directly assessing the recollective experience of remembering pain than those which have inferred memory by comparing qualitative descriptions or ratings provided whilst in pain with those made later when pain free. As this study has shown that participants are clearly able to make a distinction between remembering and knowing, this method potentially provides the opportunity to investigate the myriad of variables which may affect the pattern of remembering and knowing about previously experienced pain, under diverse circumstances and conditions, and with different individuals, in order to further understand memory for pain.

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Our Ref: 2003/1/21

19 March 2003

Ms Rohini Terry
9 Okefield Road
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Devon
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Dear Ms Terry

Study 2003/1/21: Memory for Postoperative Experiences

You will recall that on the 3 March I wrote giving Chairman's Approval on research ethics grounds for this study.

I am writing to say that the Committee confirmed this action at its meeting on the 17 March 2003.

Yours sincerely

Terry Jones

Dr Terry Jones
Chairman
North and East Devon LREC

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***health topics** please contact the :*

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This leaflet has been written by:
Professor Bruce Campbell
(Consultant Surgeon)

as part of the patient information series by the Royal Devon and Exeter Healthcare NHS Trust.

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VARICOSE VEINS

Royal Devon and Exeter Healthcare NHS
NHS Trust

Information for Patients

Varicose Veins & Varicose Vein Operations

Updated January 2002

(Review date: January 2004)

Trust Approved Information

Varicose Veins
& Varicose Vein Operations

INTRODUCTION

We expect you to make a rapid recovery after your operation and to experience no serious problems. However, it is important that you should know about minor problems which are common after this operation, and also about more serious problems which can just occasionally occur. The section *"What problems can occur after the operation?"* describes these, and we would particularly ask you to read this.

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Q *What are varicose veins ?*

Varicose veins are veins under the skin of the legs which have become widened, bulging, and tortuous. They are very common and do not cause medical problems in most people.

Blood flows down the legs through the arteries, and back up the legs through the veins. There are two main systems of veins in the legs - the deep veins which carry most of the blood back up the legs to the heart, and the veins under the skin, which are less important and which can form varicose veins. All these veins contain valves which should only allow the blood to flow upwards. If the veins become widened and varicose these valves no longer work properly. Blood can then flow backwards down the veins and produce a head of pressure when standing, walking about, or sitting. Lying down or *"putting your foot up"* relieves this head of pressure and usually makes the legs feel better. Both symptoms and treatment depend on how badly the valves in the veins are working, although the trouble people get from their varicose veins is very variable.

Varicose veins often appear first in pregnancy, when hormones relax the walls of the veins and when the womb presses on the veins coming up from the legs. People who are overweight are more likely to get varicose veins and to find symptoms from them troublesome. There is some tendency for bad varicose veins to run in families,

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but this is by no means always the case. Usually there is no special cause for varicose veins.

Very many people have no symptoms at all from their varicose veins, except for the fact that they are noticeable, and their appearance can be embarrassing. Simply having varicose veins is not a good reason for going to a doctor or having treatment. Other than cosmetic embarassment the commonest symptoms from varicose veins are aching, discomfort, and heaviness of the legs, which are usually worse at the end of the day. Sometimes the ankle can swell, too. These symptoms are not medically serious, but can be treated if they are sufficiently troublesome.

Although varicose veins can get worse over the years, this often happens very slowly and worry that *"they might get worse"* is not a good reason for treatment if the veins are not causing symptoms.

In a few people the high pressure in the veins causes damage to the skin near the ankle, which can become brown in colour, sometimes with scarred white areas. Eczema (a red skin rash) can develop. If these changes are allowed to progress, or if the skin is injured, an ulcer may result. Skin changes are therefore a good reason for going to see your GP and for referral to a specialist. In the Exeter District there are special leg ulcer bandaging clinics, supervised by the skin specialists and run by specially trained nurses. Your GP may refer you there, rather than to a surgeon in the first instance.

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Other problems which varicose veins can occasionally produce, are phlebitis and bleeding. Phlebitis (sometimes called *thrombophlebitis*) means inflammation of the veins, and is often accompanied by some thrombosis (*clotting of blood*) inside the affected veins, which become hard and tender. This is not the same as deep vein thrombosis and is not usually dangerous. It does not mean that the varicose veins neccessarily have to be treated. The risk of bleeding as a result of knocking varicose veins worries many people, but this is very rare. It will always stop with firm pressure and the veins can then be treated to remove the risk of further bleeding.

Q *How can varicose veins be treated by an operation ?*

A cut is made over the top of the main varicose vein and it is tied off just where it joins the deep vein in the groin. This cut is closed with stitches, which are hidden under the skin.

The main vein under the skin is stripped out. This helps to guard against varicose veins forming again. Blood flows up the many other veins in the leg after this vein has been removed.

Varicose veins marked before the operation are removed through tiny cuts. These cuts can be closed with stitches or adhesive strips.

Other veins under the skin with important connections to the deep veins may need to be

dealt with - in particular one just above and behind the knee. If important veins other than the one on the inner side of the leg need to be tied off, this may require special scans before the operation, and we will explain this to you.

Some surgeons advise simply tying off the main vein in the groin at operation, and then treating veins further down the leg by injection treatment. Surgeons try to balance the amount you have done at operation against the long term result.

Q *How long will I have to wait for my varicose vein operation ?*

We do not like to keep people waiting for long periods of time, but have to deal with patients according to their medical priorities. Those with more serious symptoms, such as skin changes or ulcers as a result of varicose veins take priority over those with aching or cosmetic embarassment.

Delays are caused by heavy demands on staff and resources, and there are particular problems in dealing with varicose veins because large numbers of patients are referred to hospital with varicose veins and operating on them takes quite a long time. This means that there is a limit on the numbers of varicose vein operations which can be done, while dealing at the same time with other conditions which are a serious threat to life or health. Some health authorities have experienced such difficulty in offering treatment to all patients

referred with varicose veins that they will not treat people with "*cosmetic*" varicose veins at all (this applies to the Exeter and North Devon Health Authority).

Q *What about the anaesthetic ?*

The anaesthetic is one of the main concerns for all patients, stemming from the fact that many feel they are handing over control of their life to another person. This worry is understandable but modern anaesthetics are very safe, and serious complications are uncommon. The operation is usually conducted under a general anaesthetic, and lasts about one hour for each leg.

Q *Is there an alternative to having an operation ?*

Most varicose veins do not have to be treated at all unless they are causing serious symptoms such as skin trouble or ulcers. Aching and heaviness of the legs can often be relieved very well by support stockings or tights. Your GP can prescribe firmer and more effective "*graduated compression stockings*" if ordinary ones are not helpful enough: these usually need only to be below knee, rather than full length stockings.

Varicose veins can be dealt with by injection treatment. A substance is injected into the veins which works like glue, and seals the varicose veins off. You need to wear bandages for about three weeks after injections to be sure the veins

have become firmly sealed off. Injection treatment works well for small varicose veins, but larger ones with damaged valves and high pressure inside them sometimes reappear after a period of time.

Q *If I have an operation, how long will I spend in hospital ?*

This depends on whether you are able to have surgery as a day case.

Day-patient.
If you are medically fit and have somebody at home with you then a day case operation may well be possible. If you need an operation to one leg only, then you are more likely to be offered surgery as a day-patient than if you have a lot of varicose veins in both legs. As a day-patient you are able to return home on the day of your operation.

In-patient.
If it is thought best that you come into hospital as an in-patient, you will usually be admitted the day before your operation for the doctors and nurses to assess your needs.

BEFORE THE OPERATION.

After coming into hospital you will meet the nurses (one of whom will be specially allocated to look after you), junior doctors, and the anaesthetist. They will conduct some basic tests and will answer any questions for you.

The consultant or a member of his team will check that all the necessary preparations have been made and will mark your varicose veins with a felt tip pen. Be sure that all the veins you would like dealt with have been marked, and ask about any which have not.

The consent form
The hospital requires you to sign a consent form, as for any operation.

Food
Because an empty stomach is important for a general anaesthetic, you will not be allowed anything to eat or drink immediately before your operation. Usually you will be told to have no food for 6 hours before the operation, but you will be allowed clear fluids, tea or coffee up to 2 hours before the operation.

Shaving
If you are going to have a cut in the groin, this area will need to be shaved, but there will be no need to shave all the pubic hair. Usually, the whole of each leg requiring surgery needs to be shaved. This makes marking of your varicose

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veins easier and means that hairs do not get into the wounds during the operation. If you are a day-patient you may be asked to shave yourself before coming into hospital, but even if you are to be an in-patient it is often more convenient to have shaved yourself. The doctors and nurses will advise you whether your shave is sufficient.

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AFTER THE OPERATION.

Q *How much does it hurt afterwards ?*

We inject a long acting local anaesthetic into the groin wound at the end of the operation: this is usually the most uncomfortable area. People vary a lot in the amount of pain they experience after the operation, though most experience discomfort only. It is more uncomfortable to get up and walk after operation to both legs than when only one leg has been dealt with. In either case you will be allowed to get up and walk on the day of your operation when the effects of the anaesthetic have worn off sufficiently.

Painkillers (usually paracetamol or similar tablets) will be prescribed for you to take after the operation. You should ask the nurses for these in hospital, or take them yourself at home if you are uncomfortable. It is important that you should take painkillers if you need them to walk about and to rest with comfort. You should not need them for more than a few days, but the duration of discomfort varies from person to person.

It is common for the area under the groin wound to feel tender for a few days and thickened for a few weeks. Areas of tender lumpiness may also be felt elsewhere on the legs. This is caused by some blood clot under the skin in the places where varicose veins were removed. It is not harmful and will gradually go away, but this may take several weeks.

Q *Will I have dressings or stitches ?*

Often we do not use a dressing in the groin, but if a dressing has been used it can generally be taken off 2-3 days after the operation. From that time the groin wound can be washed normally with soap and water. Avoid talcum powder for the first few days.

Stitches are placed under the skin in the groin and do not have to be removed: they simply dissolve. The small cuts further down the leg are closed with adhesive strips. You should not bath or shower for about ten days, unless you can do so without getting the adhesive strips wet. About ten days after the operation you can remove the strips yourself: this is often easiest in a bath or shower which helps to loosen them.

Because adhesive strips are used to close the wounds, it is often not possible to wash off all traces of antiseptic or blood from your legs at the end of the operation. All this will be removed when you bath or shower ten days later.

Occasionally we use stitches which need to be removed. If this has been done, we will advise you clearly when they should be removed.

Q *How will I manage in the days following my operation ?*

In-patient
You will usually be able to get up within a few hours of the operation. The bandages on your leg will be changed on the day after operation for a special support stocking. You will be able to go home as soon as you and the doctors agree that you are sufficiently well and mobile - usually on the first or second day after the operation.

Day-patient
After two or three hours on the ward you should feel fit enough to go home. Before you leave the ward staff will check your leg. They will give you a note for your GP, and some painkillers to take with you. You will also be provided with an advice sheet. They will make arrangements for a nurse to call the next day, to check on you and change your bandages for a special support stocking.

Q *What about my wounds?*

Sometimes a little blood will ooze from the wounds during the first 12-24 hours after the operation. The amount is likely to be very small and bleeding usually stops on its own. If neccessary, press on the wound for ten minutes with a dressing or a pad of paper tissues. If bleeding continues after doing this twice, phone the ward or your GP. If you cannot get through to the ward, come to the Emergency Department (A&E) of the Royal Devon and Exeter Hospital.

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Q *What about bandages and support stockings ?*

Your bandages will be changed for special support stockings the day after the operation. These stockings may be worn all the time, but if you find them uncomfortable at night, they can be taken off before you go to bed and then put on again in the morning. They are mainly intended to support the leg while you are up and about during the day. There is no need to wear the stockings after removing the adhesive strips (*10 days after the operation*). Following your bath, 10 days after the operation, you can stop wearing the stockings (but if you feel more comfortable with them for another few days this is quite alright).

Q *Will my legs be bruised ?*

Bruising is common after varicose vein operations. This is sometimes quite extensive and may take a month or more to settle. In particular it can occur on the inner side of the thigh, where there *may be no cuts: this is caused by stripping out* the main vein under the skin from this area.

Q *How far should I walk ?*

You can start to walk about as soon after the operation as you are able. Getting up the next day is sometimes a little uncomfortable, particularly where the groin has been operated on. The whole leg may be stiff. and tender to the

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touch in places. You will not damage any of the wounds by walking. Take painkillers if you need them.

You should aim to walk about every half hour or so during the day for the first week or two. For many people this simply means getting back to their active daily routine as rapidly as possible. There is no special advantage in going for a single long walk during the day, although you may walk as far as you wish. Frequent walking is more important than walking a long distance.

When you are not walking about try to put your foot up - either on a couch or on your bed. Avoid standing, or sitting with the foot on the floor as much as you can for about two weeks after the operation.

Q *When will I be fully back to normal ?*

This varies a lot between different people, and depends on how large and extensive your varicose veins were, which dictates the size of operation you will have had. In particular your recovery will depend on whether you have had an operation on one leg or both legs.

If you have had surgery to one leg only:
You are likely to feel tired for the first two or three days after the operation, and your leg will be stiff after walking long distances.

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If you have had surgery to both legs:
You may feel quite tired for the first week, especially after walking a lot. You may need to rest two or three times a day for the first few days. By two weeks after the operation you are likely to be walking good distances with little discomfort. even though the leg may still be bruised and a little tender.

Q *When can I drive my car ?*

You can drive as soon as you feel confident that you can make an emergency stop without pain. This is often about a week after surgery to one leg, or ten days after surgery to both legs. If you have an automatic car and surgery to the left leg then driving may pose little problem! If you are concerned, check with your insurance company.

Q *When can I return to work and play sports ?*

You can return to work and sporting activity as soon after the operation as you feel sufficiently well and comfortable. If your job involves prolonged standing or driving, then you should not consider going back for at least two weeks. It is unusual to need more than about 3 weeks off work after surgery to one leg or 6 weeks after surgery to both legs.

Avoid violent sports while you are still in support stockings or bandages, and thereafter start with some gradual training, rather than in immediate

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competition. Do not go swimming until you are out of support stockings and all the wounds are dry.

Q *What problems can occur after the operation ?*

Serious complications are uncommon after operations for varicose veins. Some bruising is usual, and occasionally the leg becomes very bruised. This bruising may appear during the first few days after the operation: it will all go away over a period of weeks.

Aches, twinges, and areas of tenderness may all be felt in the legs for the first few weeks after the operation. These will all settle down, and should not discourage you from becoming fully active as soon as you are able.

Tender lumps under the skin are common and are caused by blood clot which has collected in the places where the veins were removed. They are not dangerous and will gradually be digested by the body, but this can take several weeks. Occasionally they can be quite painful during the first two weeks or more.

Infection is an occasional problem, particularly in groin wounds. It usually settles with antibiotic treatment. If the wound was closed by a stitch under the skin, this may need to be removed to allow the infection to clear up.

The scars on your legs are easily noticeable to start with, but will continue to fade for many months after the operation. Very occasionally, some people develop a little brown staining where the veins were removed, or areas of tiny veins appearing in the skin nearby: this is unpredictable and uncommon.

Nerves under the skin can be damaged when removing varicose veins close to them. This is uncommon, but will give an area of numbness on the leg, which settles or gets smaller over weeks or months. If varicose veins on the foot are removed, damage to small nerves is a special danger. If a nerve lying alongside one of the main veins under the skin is damaged, then a larger area of numbness can be caused. If this happens after stripping the main vein on the inner side of the leg, then numbness will result over the inner part of the lower leg and foot. If a main vein behind the knee needs to be dealt with, then there is a risk to the nerve which conducts feeling from the skin on the outer part of the lower leg and foot.

Damage to major arteries, veins, and the main nerve which allows the leg to move normally have all happened during varicose vein operations, but are very rare complications, which we take great pains to avoid.

Deep vein thrombosis causes swelling of the leg and can result in a blood clot passing to the lungs. It is a possible complication after varicose vein surgery, but is particularly unlikely if you start

moving your legs and walking frequently soon after the operation. Sometimes, injections are given to make the blood clot less than normal: these reduce the risk of thrombosis but increase bruising. If you are taking the contraceptive pill, your risk of thrombosis is increased, and the surgeon will discuss with you the pros and cons of stopping the pill or continuing it and taking special action to reduce your risk of a thrombosis. If you start taking the contraceptive pill while waiting for your operation, let the hospital know.

Any general anaesthetic carries risks, but considerable precautions are taken to keep these risks as low as possible.

Q *Will my varicose veins come back ?*

Some people develop new varicose veins during the years after a varicose vein operation, but this is uncommon after thorough surgery. Rarely, varicose veins simply re-grow in the areas which have been dealt with, or else they develop in a different system of veins which was normal at the time of the original operation. If veins develop again they can be dealt with by injections or a further operation should they be troublesome.

Q *What should I do if there is a problem?*

If there is an acute problem such as persistent severe pain, bleeding, fever, or an inflamed or discharging wound it is best to contact your own family doctor first. Your doctor may suggest that you see the surgeons at the hospital, and if this is neccesary, he/she will make the arrangements.

Should you be unable to get urgent medical help from a General Practitioner, then come to the Accident and Emergency Department of the Royal Devon and Exeter Hospital.

The surgical team who did your operation will always be prepared to see you at the request of your own doctor or the doctors who see you urgently in the hospital. If you attend hospital urgently, you may be looked after by a different surgical team initially. If there is any concern in the longer term, the surgeon responsible for your operation will see you in clinic at the request of your family doctor.

1. Have you received any information about vascular day surgery?

YES [ ]   NO [ ]

If YES, go to question 2: If NO, please go to question 5

2. Did you obtain information from:

Hospital Staff	[ ]
GP	[ ]
GP Nurse	[ ]
Internet	[ ]
Library	[ ]
Other (please specify)	
----------------------------	[ ]

3. Can you recall any information that changed the way you feel about your surgery, for example, made you feel less (or more) anxious?

4. Have you had information about the following things?

	Yes	Possibly	Not really	No
What to expect on the day	[ ]	[ ]	[ ]	[ ]
How to manage any postoperative discomfort	[ ]	[ ]	[ ]	[ ]
Wound healing and dressings	[ ]	[ ]	[ ]	[ ]
When to return to work	[ ]	[ ]	[ ]	[ ]
When to return to normal activities	[ ]	[ ]	[ ]	[ ]
Exercise and physiotherapy	[ ]	[ ]	[ ]	[ ]
Any other topics, please detail:				

5. In general, how much do you feel you understand about having varicose vein surgery?

[ ] don't understand at all
[ ] understand very little
[ ] unsure
[ ] understand some
[ ] understand fully

6. What other information would you like (if any)?

7. In general, are you satisfied with the information that you have been able to obtain?

[ ] Very satisfied [ ] Satisfied [ ] No opinion [ ] Dissatisfied [ ] Very dissatisfied

8. Are you satisfied with the <u>care</u> you have received?

[ ] Very satisfied [ ] Satisfied [ ] No opinion [ ] Dissatisfied [ ] Very dissatisfied

The next section is about your **expectations** of any postoperative discomfort following vascular surgery. This is a very general questionnaire, which is used in all types of clinical settings. Please remember that some of these descriptors are likely to be irrelevant for you. However, we need to use a standardized questionnaire which has been used in previous research.

Please read each description and tick in the boxes to indicate the sensations you think you might experience **AFTER** your surgery. If you do not think the descriptor is relevant, please tick the 'none' box.

	None (0)	**Mild (1)**	**Moderate (2)**	**Severe (3)**
Throbbing				
Shooting				
Stabbing				
Sharp				
Cramping				
Gnawing				
Hot -Burning				
Aching				
Heavy				
Tender				
Splitting				
Tiring-exhausting				
Sickening				
Fearful				
Punishing-Cruel				

Is there anything else you expect to feel that is not on this list?

On the line below please indicate if you expect to feel any postoperative discomfort.

NO DISCOMFORT ———————————————— WORST POSSIBLE DISCOMFORT

The last section is to ask you about how anxious you feel. Some people feel more anxious than others generally, and this is called Trait anxiety. Some people get anxious in certain situations, and we sometimes call this State anxiety. This last section of the questionnaire is to ask you about State and Trait anxiety.

Please read each statement below and tick the box to the right of that statement which indicates how you feel ***right now, at this moment.*** Again, there are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately	Very much
1) I feel calm				
2) I feel secure				
3) I am tense				
4) I feel strained				
5) I feel at ease				
6) I feel upset				
7) I am presently worrying over possible misfortunes				
8) I feel satisfied				
9) I feel frightened				
10) I feel comfortable				
11) I feel self-confident				
12) I feel nervous				
13) I am jittery				
14) I feel indecisive				
15) I am relaxed				
16) I feel content				
17) I am worried				
18) I feel confused				
19) I feel steady				
20) I feel pleasant				

Please read each statement below and then tick the box on the right of the statement to describe how ***you generally feel***

	Almost never	Sometimes	often	Almost always
21) I feel pleasant				
22) I feel nervous and restless				
23) I feel satisfied with myself				
24) I wish I could be as happy as others seem to be				
25) I feel like a failure				
26) I feel rested				
27) I am 'cool, calm and collected'				
28) I feel that difficulties are piling up so that I cannot overcome them				
29) I worry too much over something that really doesn't matter				
30) I am happy				
31) I have disturbing thoughts				
32) I lack self-confidence				
33) I feel secure				
34) I make decisions easily				
35) I feel inadequate				
36) I am content				
37) Some unimportant thought runs through my mind and bothers me				
38) I take disappointments so keenly that I can't put them out of my mind				
39) I am a steady person				
40) I get in a state of tension or turmoil as I think over my recent concerns and interests				

Thank you very much for your time.

Please return this form to Rohini when you have completed it. Rohini will then give you another questionnaire which should be completed at home about 48 hours after your surgery.

Appendix 1.4: Summary Data For Vascular Surgery Patients Participants

		mpq1	mpq2	mpq3
N	Valid	24	24	24
	Missing	0	0	0
Mean		9.54	8.04	9.08
Median		9.50	6.00	6.50
Mode		5.00	4.00	4.00
Std. Deviation		5.28	5.11	6.49
Variance		27.91	26.13	42.17
Skewness		.31	.46	.71
Std. Error of Skewness		.47	.47	.47
Kurtosis		-1.02	-1.32	-.72
Std. Error of Kurtosis		.92	.92	.92
Minimum		2.00	1.00	1.00
Maximum		20.00	17.00	23.00

		state1	trait1	state2	state3	trait3
N	Valid	24	24	24	24	24
	Missing	0	0	0	0	0
Mean		41.04	34.33	29.46	28.08	33.12
Median		40.50	34.00	27.50	26.00	33.00
Mode		20.00(a)	21.00(a)	20.00	20.00	33.00(a)
Std. Deviation		14.71	9.91	8.99	8.33	10.25
Variance		216.30	98.23	80.87	69.47	104.98
Skewness		.25	.49	.91	1.04	.71
Std. Error of Skewness		.47	.47	.47	.47	.47
Kurtosis		-.88	-.35	.14	.16	.09
Std. Error of Kurtosis		.92	.92	.92	.92	.92
Minimum		20.00	21.00	20.00	20.00	20.00
Maximum		69.00	57.00	52.00	47.00	59.00

a Multiple modes exist. The smallest value is shown

		vas1	vas2	vas3
N	Valid	24	24	24
	Missing	0	0	0
Mean		3.39	2.81	3.09
Median		3.25	3.00	2.80
Mode		2.70	3.90	1.70
Std. Deviation		1.75	1.62	1.73
Variance		3.06	2.64	2.30
Skewness		.95	-.03	.36
Std. Error of Skewness		.47	.47	.47
Kurtosis		1.93	-1.28	-1.16
Std. Error of Kurtosis		.92	.92	.92
Minimum		.00	.50	.60
Maximum		7.90	5.60	6.20

Pre and Post-Operative Information for Patients having Varicose Vein Surgery

PRE-OPERATIVE ADVICE

THE OPERATION

Operations for varicose veins are a common surgical procedure performed as a day case, under general anaesthetic. This means you will be asleep throughout the procedure. Most operations for varicose veins involve the removal of veins of the lower leg through small wounds and/or tying of larger veins in the groin through a small incision.

WHEN YOU ARRIVE AT THE DAY SURGERY UNIT

On arrival at the unit, you will check in at the reception desk, where you will be given a short questionnaire to complete. This is to ensure that you are fit and healthy on the day of the operation.

Once changed into theatre wear, you will be shown to a trolley bed, where you will be formally admitted by a member of the nursing staff and also be seen by the anaesthetist and surgeon.

The surgeon will examine your varicose veins and may mark the skin with a washable marker pen. The groin area may also require to be shaved, the nursing stiff will do this.

Once the admission process is complete, you may sit in the patient's waiting room, where magazines, newspapers and television are available until the nurse escorts you to theatre.

The general anaesthetic is administered in theatre and you will be asleep for the duration of your operation.

You will awaken in the recovery room where you will be cared for until it is time to go home.

POST-OPERATIVE INFORMATION

- You may feel tired for the first 48 hours following your operation. Rest for some of the time, but also try to gradually increase your mobilisation, until you feel fit to return to your normal activities.
- There may be some discomfort around the wound area. This is to be expected and the pain-killer tablets given to you on discharge should help.
- You will have a dressing covering your wound. Keep this clean and dry until instructed to remove it. The liaison nurse should visit you the next morning and will remove your bandages and help to apply your stockings.
- If the wound/s bleed, apply pressure with your hand for 10 minutes. If the bleeding persists seek advice in the first instance from the Day Surgery Unit.
- Usually dissolving stitches are used, these will dissolve gradually over a few weeks. If the stitches are not dissolvable, you will be given advice on when to visit your GP for removal. The small wounds in your lower leg may have paper stitches over them, you may remove these after 48 hours.
- Initially a light diet should be taken, along with plenty of fluids. On the second day following your operation you should start to walk short distances around the house, you should gradually increase the distance you walk each day.
- Remember when sitting or resting you should elevate your legs, on a footstool or in bed. You should continue to wear your support stocking/s for the next 3 weeks. The stockings should be removed before going to bed.
- If you have any further queries regarding your operation, please contact in the first instance the Day Surgery Unit during opening hours or the 'Nurse on call for Day Surgery Unit' via the hospital switchboard

- Research Project -

Memory for health related information in non-patient participants –

Instructions for completing the questionnaires

******

Please read the INFORMATION LEAFLET for Varicose Veins surgery before starting to complete the questionnaire. Please remember, there are no 'right' or 'wrong' answers, and the study is not trying to 'test' your memory for information given on the leaflets. If you have any queries about how to complete the questionnaire, please call Rohini on 01877 331757.

1) The first part of the questionnaire is made up of questions relating to patient information.

2) The second part of the questionnaire which starts on Page 3 asks you to provide an 'estimate' of how you would imagine postoperative discomfort or pain to be following varicose vein surgery.

3) The final part of the questionnaire starts on Page 4. This is about Anxiety. This will ask you about how anxious you feel RIGHT NOW, and, on Page 5, will ask you how anxious you feel GENERALLY. Some of the questions may seem rather odd, but it is a standard and widely used questionnaire, and found to be very reliable.

I will send you another very similar questionnaire in about 4 weeks time.

Thanks very much for taking the time to participate in the research. This study is following on from some research carried out with patients having surgery for varicose veins. It is hoped that this sort of research can indicate how information for patients may be better designed and delivered. It may also tell us how people perceive and remember different sorts of health-related information. In addition, this study should help us to interpret the results of the previous phase of the research with varicose veins surgery patients.

The study is being funded and supervised by the University of Plymouth, Faculty of Health and Social Work. The study has been fully approved by Stirling University Research Ethics Committee (Psychology Department). Please be assured that any information you give will be held in the **strictest confidence.** You are free to withdraw from the study at any time without giving a reason.

Appendix 2.3: Non-Patient Participants Questionnaire at Time One

---

PARTICIPANT NUMBER .... AGE ....

Please remember that this is not a 'memory test', rather it is aimed at looking at the effectiveness of different sorts of information.

1. What are varicose veins?

2. How are varicose veins treated?

3. Can you recall reading any information that might make you feel more or less anxious if you were shortly to undergo varicose vein surgery?

4. Did the information cover the following topics?

	Yes	Possibly	Not really	No
What to expect on the day	[ ]	[ ]	[ ]	[ ]
How to manage any postoperative discomfort	[ ]	[ ]	[ ]	[ ]
Wound healing and dressings	[ ]	[ ]	[ ]	[ ]
When to return to work	[ ]	[ ]	[ ]	[ ]
When to return to normal activities	[ ]	[ ]	[ ]	[ ]
Exercise and physiotherapy	[ ]	[ ]	[ ]	[ ]

5. Do you think any additional information would be useful, and if so, what would it be?

6. Where would you obtain this additional information from?

Hospital Staff	[ ]	Family/friends	[ ]
GP	[ ]	GP Nurse	[ ]
Internet	[ ]	NHS24	[ ]
Library	[ ]		

Other (please specify) ----------------------------

7. This study is also investigating other sources which may be used by people to gain information about health matters. Could you tell us which newspaper(s) you read?

8. If you were to undergo varicose vein surgery, would you find the information contained in the leaflet satisfactory?

[ ] Very satisfactory [ ] Satisfactory [ ] No opinion [ ] dissatisfactory [ ] Very dissatisfactory

The next section will ask you to estimate discomfort following surgery for varicose veins that might be experienced in the immediate postoperative period (within 48 hours of surgery).

The questionnaire below, called the McGill Pain Questionnaire (short form), is used in all types of clinical settings.

Please read each description and tick in the boxes to indicate the sensations you think people might experience **AFTER** varicose vein surgery. Please remember that some of these descriptors are likely to be irrelevant for you. If you do not think the descriptor is relevant, please tick the 'none' box.

	None (0)	**Mild (1)**	**Moderate (2)**	**Severe (3)**
Throbbing				
Shooting				
Stabbing				
Sharp				
Cramping				
Gnawing				
Hot/Burning				
Aching				
Heavy				
Tender				
Splitting				
Tiring-exhausting				
Sickening				
Fearful				
Punishing-Cruel				

Is there anything else you might expect to feel that is not on this list?

____

____

On the line below please indicate if you would expect to feel any postoperative discomfort.

NO DISCOMFORT |————————————————————| WORST POSSIBLE DISCOMFORT

This last section of the questionnaire is to ask you about State and Trait anxiety. Some situations may make people feel more, or less, anxious and this is sometimes called 'State' anxiety.

Please read each statement below and tick the box to the right of that statement which indicates how you feel ***right now, at this moment.*** There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately	Very much
1) I feel calm				
2) I feel secure				
3) I am tense				
4) I feel strained				
5) I feel at ease				
6) I feel upset				
7) I am presently worrying over possible misfortunes				
8) I feel satisfied				
9) I feel frightened				
10) I feel comfortable				
11) I feel self-confident				
12) I feel nervous				
13) I am jittery				
14) I feel indecisive				
15) I am relaxed				
16) I feel content				
17) I am worried				
18) I feel confused				
19) I feel steady				
20) I feel pleasant				

Some people feel generally more anxious than other people in all kinds of situation. This is sometimes called 'Trait' anxiety. Please remember there are no 'right' or 'wrong' answers. Please read each statement below and then tick the box to the right of the statement to describe how ***you generally feel***

	Almost never	Some-times	often	Almost always
21) I feel pleasant				
22) I feel nervous and restless				
23) I feel satisfied with myself				
24) I wish I could be as happy as others seem to be				
25) I feel like a failure				
26) I feel rested				
27) I am 'cool, calm and collected'				
28) I feel that difficulties are piling up so that I cannot overcome them				
29) I worry too much over something that really doesn't matter				
30) I am happy				
31) I have disturbing thoughts				
32) I lack self-confidence				
33) I feel secure				
34) I make decisions easily				
35) I feel inadequate				
36) I am content				
37) Some unimportant thought runs through my mind and bothers me				
38) I take disappointments so keenly that I can't put them out of my mind				
39) I am a steady person				
40) I get in a state of tension or turmoil as I think over my recent concerns and interests				

Thank you very much for your time.

Please return this form to Rohini when you have completed it. Rohini will send you another similar but shorter questionnaire in a few weeks time.

Data Screening

VAS at Time One and Time Two:

Two participants wrote on the VAS rather than bisecting the line to indicate severity. One participant wrote 'slight' on both VAS. One participant wrote 'No pain on the VAS at Time one and Worst Pain on Time Two. These participants' data were deleted.

LONG INFORMATION Leaflet Participants						
N=27	VAS – Time 1	VAS – Time 2	MPQ – Time 1	MPQ – Time 2	NWU – Time 1	NWU – Time 2
Mean	4.78	5.70	14.81	16.18	8.29	9.62
Median	5.00	5.90	15.00	16.00	9.00	10.00
Mode	6.50	4.50	19.00	5.00	10.00	10.00
Std. Deviation	1.87	2.02	6.99	7.82	3.67	3.70
Variance	3.51	4.10	48.85	61.16	13.52	13.70
Skewness	-.13	.12	.22	.44	-.00	-.35
SE of Skewness	.45	.45	.45	.45	.45	. .45
Kurtosis	-1.38	-.50	-.86	.12	-.97	-.92
S E of Kurtosis	.87	.87	.87	.87	.87	.87
Min-Max	1.7 – 7.5	2.3 – 9.7	4 - 29	4 - 34	2 - 15	3 - 16

SHORT INFORMATION LEAFLET PARTICIPANTS						
N=23	VAS – Time 1	VAS – Time 2	MPQ – Time 1	MPQ – Time 2	NWU – Time 1	NWU – Time 2
Mean	4.76	4.85	13.00	11.82	6.87	7.39
Median	4.40	4.70	10.00	9.00	7.00	7.00
Mode	3.20	.60	10.00	9.00	4.00	7.00
Std. Deviation	2.30	2.33	8.77	8.78	3.52	3.86
Variance	5.31	5.47	76.91	77.06	12.39	14.88
Skewness	-.14	.03	1.12	1.52	.12	.61
SE of Skewness	.48	.48	.48	.48	.48	.48
Kurtosis	-.26	-.93	1.02	2.20	-.57	-.09
SE of Kurtosis	.93	.93	.93	.93	.93	.93
Min-Max	0 – 9.00	0.6 - 9	0 – 35	2 - 37	0 - 14	2 - 16

Appendix 3.1: Recruitment Flyer For Study Three

University of Stirling Nursing and Midwifery Department (NMAHP)

Can you help in a research study?

We are trying to find out how peoples' expectations and personality affects memory for sensations and taste.

If you would like to take part, we will ask you to come to a research room in the Cottrell Building. You would be asked to:

1) complete a short questionnaire,
2) submerse your hand in a special container of cold water for about 2 minutes, and describe how this feels,
3) taste an unusual (but perfectly safe!) drink, and to describe its flavour.

This should take about ½ hour.

You will then be asked to complete another questionnaire about two weeks later. This should take about 15-20 minutes to complete.

We hope that the results of this study can help to improve communication between patients and health professionals, and therefore improve the way health care is delivered.

IF YOU WOULD LIKE MORE INFORMATION:

Please return the enclosed reply slip to Rohini Terry.

Rohini will then telephone you and explain the study in more detail.
Returning the reply slip does NOT oblige you to take part in the study.

The study has been fully approved by the Nursing and Midwifery Departmental Ethics Committee. Any information you give will be held in the **strictest confidence.** It is up to you whether or not you decide to take part. If you are a student, any involvement in the study is entirely independent of your studies, and will have no effect on academic credit. If you do decide to take part you will be asked to sign a consent form. However, **you would still be free to withdraw from the study at any time and without giving a reason.**

If you would like any further information, please telephone Rohini Terry, on 01877 331757, or email r.h.terry@stir.ac.uk

Appendix 3.2: Participant Information Sheet *(NOTE: INFORMATION SHEET PRESENTED TO PARTICIPANTS ON A SINGLE SHEET IN 12 POINT FONT)*

MEMORY FOR SENSATION AND TASTE RESEARCH STUDY - INFORMATION SHEET

This will tell you about the study and what you will be asked to do. Please take time to read this information sheet, and feel free to ask questions about any aspect of the research.

WHY IS THIS STUDY BEING CARRIED OUT?
Many personally experienced events are 'subjective'. How we describe and remember these types of events may be affected by the sort of person we are, and by our expectations of the event. For example, your description of a pain sensation or a taste, might be quite different to someone else's. We hope to find out more about the things that affect these 'subjective' experiences and the memory of them.

WHAT WILL I HAVE TO DO?
If you take part in the study, you will be asked to <u>place your hand into a container of cold water</u>. This is called the Cold Pressor test, and may feel a bit like the sensations experienced when scraping ice from a car in winter or handling ice-cubes. You will also be asked to <u>taste an unusual (but perfectly safe!) drink</u>, and to <u>complete three questionnaires,</u> one before, during and after using the cold pressor test. The procedure will be as follows:

1) You will be asked to complete the first questionnaire. This will ask you to describe your expectations of how putting your arm in the cold water will feel, by selecting from a list of pain-related words.

2) After this you would be asked to taste the unusual drink, and describe it using a taste questionnaire.

3) We will then ask you to put your hand into the container of cold water, and describe the sensations experienced.

4) About two weeks later, we will ask you to recall your experiences of the cold pressor test, and tasting the drink. On the first and last questionnaire, we will also ask you to complete a short questionnaire about yourself.

WHAT IS THE STUDY TRYING TO FIND OUT?
We hope that this study can help health professionals to meet patients' needs more effectively, and improve communication between health professionals and patients. This study aims to build upon previous research which has looked at how people expect experience and remember the subjective experience of pain. This study will also find out more how personality and expectations affect the way pain and taste is perceived and remembered.

ARE THERE ANY RISKS?
The cold pressor test has been used in a large number of studies. There are <u>no known instances</u> where this test has caused any harm whatsoever. However, as with all studies like this, we would ask that people with arthritis, diabetes or heart disease, or who have had any damage or surgery to their arm or hand do not take part in the research. This is simply a precautionary measure.

WHAT IF I CHANGE MY MIND ABOUT TAKING PART?
You will be asked to sign a consent from to say that you agree to take part in the study but you **may withdraw from the study <u>at any time</u>**, and without giving a reason.

IS ANY INFORMATION I GIVE KEPT CONFIDENIAL?
Yes. The consent form will have your name, signature and contact details on it. But this will be kept separate from the questionnaires, which will be identifiably only by a participant number. All the information you give will be kept STRICTLY CONFIDENTIAL. All your contact details will be destroyed after the study has been written up.
IS Ye qu
CONFIDENTIAL. All your contact

IS THIS STUDY ETHICALLY APPROVED?
Yes, the study has been fully approved by the University of Stirling Department of Nursing and Midwifery Ethics Committee.

Appendix 3.3: Consent Form

MEMORY FOR SENSATION AND TASTE RESEARCH STUDY

PARTICIPANT CONSENT FORM

	Please initial
I am willing to take part in this study	☐
I am willing to give my name and contact details to the researcher for the purposes of this study ONLY	☐
I confirm that I have read and understand the information sheet and have been given the opportunity to ask questions.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.	☐
I understand that any information I give will be kept STRICTLY CONFIDENTIAL, and will only be used for the purposes of this research.	☐

	Participant	Researcher
SIGNED	________________	________________
PRINT NAME	________________	________________
DATED	________________	________________

EXPECTATIONS OF COLD PRESSOR TEST:

Description of the CP, set at 5°C, circulating container of cold water

To be read to the participant:

1 Flickering ___ Quivering ___ Pulsing ___ Throbbing ___ Beating ___ Pounding ___	6 Tugging ___ Pulling ___ Wrenching ___	11 Tiring ___ Exhausting ___	16 Annoying ___ Troublesome ___ Miserable ___ Intense ___ Unbearable ___
2 Jumping ___ Flashing ___ Shooting ___	7 Hot ___ Burning ___ Scalding ___ Searing ___	12 Sickening ___ Suffocating ___	17 Spreading ___ Radiating ___ Penetrating ___ Piercing ___
3 Pricking ___ Boring ___ Drilling ___ Stabbing ___ Lancinating ___	8 Tingling ___ Itching ___ Smarting ___ Stinging ___	13 Fearful ___ Frightful ___ Terrifying ___	18 Tight ___ Numb ___ Drawing ___ Squeezing ___ Tearing ___
4 Sharp ___ Cutting ___ Lacerating ___	9 Dull ___ Sore ___ Hurting ___ Aching ___ Heavy ___	14 Punishing ___ Gruelling ___ Cruel ___ Vicious ___ Killing ___	19 Cool ___ Cold ___ Freezing ___
5 Pinching ___ Pressing ___ Gnawing ___ Cramping ___ Crushing ___	10 Tender ___ Taut ___ Rasping ___ Splitting ___	15 Wretched ___ Blinding ___	20 Nagging ___ Nauseating ___ Agonizing ___ Dreadful ___ Torturing ___
0. ___ No Pain 1. ___ Mild 2. ___ Discomforting 3. ___ Distressing 4. ___ Horrible 5. ___ Excruciating		Brief ___ Momentary ___ Transient ___ Rhythmic ___ Periodic ___	Intermittent ___ Continuous ___ Steady ___ Constant ___

Please could you indicate on the line below the level of discomfort that you think might be experienced when using the cold pressor

No Pain |————————————————————| **Worst Pain**

We would now like to ask you to complete a standard and widely used questionnaire which asks you a number of questions about yourself. Please read the directions below, and complete as described. The questionnaire below asks you to rate how you feel right now, at this moment

SELF-EVALUATION QUESTIONNAIRE

Developed by Charles D. Spielberger
in collaboration with
R. L. Gorsuch, R. Lushene, P. R. Vagg, and G. A. Jacobs

STAI Form Y-1

Name ____________ Date ________ S ____

Age ________ Sex: M ____ F ____ T ____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

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TASTE TEST: TO BE READ TO THE PARTICIPANT BY THE RESEARCHER AS DRINK IS TASTED

Fragrant____	Burnt ____	Putrid, ____	Sticky ____	Heavy ____
Almond ____	Smoky ____	Nauseous ____	Musty ____	Cool, ____
Herbal ____	Sour,	Phonolic ____	Mouldy ____	Warm ____
Vegetable ____	acid ___	Ammonia like ____	Acrid, ____	Metallic ____
Etherish ____	Dry, ____	Light ____	pungent ___	Oily, ____
Mothball-like	Powdery ____	Spicy ____	Camphor -like ___	fatty ____
Petrol-like____	Sweet ____	Paint-like ____	Sulphury ____	Woody, ____
Cooked Cabbage ____	Fishy ____	Rubbery ____	Fruity (citrus) ____	Resinous ____
Garlic, ____	Minty ____	Vanilla ____	Fruity (other) ____	Musky ____
Tarry _	onion ____	Pine-like ____	Floral ____	Soapy ____
Sweaty ____	Grassy ____	Meaty ____	Salty ____	Smooth ____
Aromatic ____	Peppery ____			

Appendix 3.4: (Cont.)

(Check participant is not experiencing any unrelated current pain (eg headache). If the participant does have pain, below).

Details

No pain |———————| **Worst pain**

16 Annoying ___ Troublesome ___ Miserable ___ Intense ___ Unbearable ___	1 Flickering ___ Quivering ___ Pulsing ___ Throbbing ___ Beating ___ Pounding ___	12 Sickening ___ Suffocating ___	6 Tugging ___ Pulling ___ Wrenching ___
17 Spreading ___ Radiating ___ Penetrating ___ Piercing ___	8 Tingling ___ Itching ___ Smarting ___ Stinging ___	11 Tiring ___ Exhausting ___	7 Hot ___ Burning ___ Scalding ___ Searing ___
4 Sharp ___ Cutting ___ Lacerating ___	3 Pricking ___ Boring ___ Drilling ___ Stabbing ___ Lancinating ___	19 Cool ___ Cold ___ Freezing ___	2 Jumping ___ Flashing ___ Shooting ___
14 Punishing ___ Gruelling ___ Cruel ___ Vicious ___ Killing ___	18 Tight ___ Numb ___ Drawing ___ Squeezing ___ Tearing ___	13 Fearful ___ Frightful ___ Terrifying ___	9 Dull ___ Sore ___ Hurting ___ Aching ___ Heavy ___
15 Wretched ___ Blinding ___	20 Nagging ___ Nauseating ___ Agonizing ___ Dreadful ___ Torturing ___	5 Pinching ___ Pressing ___ Gnawing ___ Cramping ___ Crushing ___	10 Tender ___ Taut ___ Rasping ___ Splitting ___
0. ___ No Pain 1. ___ Mild 2. ___ Discomforting 3. ___ Distressing 4. ___ Horrible 5. ___ Excruciating		Brief ___ Momentary ___ Transient ___ Rhythmic ___ Periodic ___	Intermittent ___ Continuous ___ Steady ___ Constant ___

Now could you please indicate on the line below how painful you found the cold pressor test to be.

No Pain |————————————————————| **Worst pain**

Appendix 3.5: Broad Description Of Participants By Occupation

DEPARTMENTS	Professional/ academic	Clerical/admin	Manual	PG/Mature Students
Academic registrar's office		2		
Accommodation			1	
Accounting finance, law		1		
Aquaculture	3	1		
Biological sciences	3			
Catering			1	
Communications and development office	1			
Dementia Centre		3		
Deputy Secretary's office		1		
DIACE	1			
Education	1	1		
English	2			
Estates and campus services		5	2	
Examinations office		1		
Finance office	1	3		
Film and media	1			
Information services	2	4		
Management/marketing	4			1
Nursing and midwifery	17	4		6
Planning and research				
Politics	1			
Psychology	3			4
Publishing				2
Registry		6		
Religious studies		1		
Applied social science/sociology	1	3		1
spanish		1		
Student info support		2		
SURE	2			
Travel agents		1		
Total	**43**	**40**	**4**	**14**

Outlying data removed:

MPQ PRI, VAS, Remember/Know data were transformed to z scores

Participant 67, 69, 87, 93, 112 and 113: Outliers in either remember sensation, remember word or Know judgement; all remember/know ratings removed for these participants

Participant 109: Outlier in WR-MPQ2 – Participant deleted

Participant 63: Outlier in State anxiety, replaced with highest State score, but within normal range.

Participant 113: outlier detected on Number of Taste Words selected (Retrospective); All Taste data were deleted.

Missing Data replacements

Participant 6: Missing VAS Time 2 replaced with mean.
Participant 49 and 72: Missing Trait anxiety replaced with mean.

SENSORY and Non-Sensory PRI ratings

Sensory and non sensory weighted rank scores were transformed to z scores and these inspected for outliers (>3.3). No outliers were found.

	PRIWR1	PRIWR2	PRIWR3	vas1	vas2	vas3	state1	trait2
Valid	97	97	97	97	97	97	99	99
Missing	2	2	2	2	2	2	0	0
Mean	24.00	29.01	28.69	2.96	5.27	5.27	29	38
Std. Error of Mean	1.01	1.33	1.31	.19	.23	.22	.66	.88
Median	22.81	26.29	26.12	2.50	5.55	5.80	28.00	36.00
Mode	6.45(a)	26.29	20.03(a)	1.00(a)	6.50(a)	5.80	24.00(a)	33.00
Std. Deviation	9.99	13.08	12.96	1.86	2.32	2.19	6.59	8.72
Variance	99.81	171.19	168.17	3.47	5.35	4.80	43.52	76.08
Skewness	.44	.75	.61	.55	-.34	-.48	.74	.77
Std. Error of Skewness	.24	.24	.24	.24	.24	.24	.24	.24
Kurtosis	-.07	.59	-.05	-.74	-.78	-.63	.24	.32
Std Error of Kurtosis	.48	.48	.48	.48	.48	.48	.48	.48
Range	45.54	67.04	56.83	7.10	9.60	9.00	29.00	40.00
Minimum	6.45	2.54	5.98	.10	.20	.40	20.00	24.00
Maximum	51.99	69.58	62.81	7.20	9.80	9.40	49.00	64.00

a Multiple modes exist. The smallest value is shown

	Remember sensation	Remember Word	Know	Proportion Rem. Sens	Proportion Rem. word	Proportion Know
Valid	91	91	91	91	91	91
Missing	8	8	8	8	8	8
Mean	7.31	2.03	2.48	.73	.20	.23
Std. Error of Mean	.26	.23	.22	.02	.02	.02
Median	7.00	1.00	2.00	.71	.13	.22
Mode	7.00(a)	.00	.00	1.00	.00	.00
Std. Deviation	2.46	2.20	2.09	.18	.21	.17
Variance	6.04	4.87	4.36	.03	.04	.02
Skewness	.23	.78	.66	.01	.81	.25
Std. Error of Skewness	.25	.25	.25	.25	.25	.25
Kurtosis	-.57	-.69	-.25	-.81	-.31	-.81
Std Error of Kurtosis	.50	.50	.50	.50	.50	.50
Minimum	3.00	.00	.00	.30	.00	.00
Range	10	7	8	.70	.75	.63
Maximum	13.00	7.00	8.00	1.00	.75	.63

a Multiple modes exist. The smallest value is shown

	Actual Taste - NWU	Retro taste - NWU	Remember sensation (taste) proportion	Remember Taste word	Know
Valid	98	98	98	98	98
Missing	1	1	1	1	1
Mean	10.82	10.03	.74	.26	.24
Std. Error of Mean	.44	.47	.02	.02	.02
Median	10.00	10.00	.75	.1900	.2222
Mode	8.00	7.00	1.00	.00	.00
Std. Deviation	4.36	4.63	.20	.27	.20
Variance	19.05	21.47	.04	.07	.04
Skewness	.43	.97	-.46	.79	.59
Std. Error of Skewness	.24	.24	.24	.24	.24
Kurtosis	-.57	.99	-.21	-.64	-.04
Std. Error of Kurtosis	.48	.48	.48	.48	.48
Range	19.00	21.00	.86	.88	.86
Minimum	3.00	3.00	.14	.00	.00
Maximum	22.00	24.00	1.00	.88	.86

Appendix 3.7: Kappa Values Reflecting Individual MPQ Descriptor & Category Selection Consistency Across Rating Times

	Total no of times selected	MPQ Category	Rank in MPQ	Kappa values		
				Expectation/ Actual	**Actual/ Retro.**	Expect/ retro
Throbbing	151	1	4	.20	**.14**	.40
Shooting	63	2	3	.30	**.53**	.19
Pricking	49	3	1	.10	**.15**	.28
Stabbing	86	3	4	.19	**.36**	.25
Sharp	150	4	1	.21	**.24**	.08
Cramping	69	5	4	.26	**.17**	.41
Gnawing	68	5	3	.31	**.34**	.46
Tingling	111	8	1	.35	**.53**	.41
Stinging	79	8	4	.14	**.33**	.18
Aching	124	9	4	.33	**.32**	.48
Punishing	50	14	1	.11	**.07**	.16
Wretched	34	15	1	.40	**.35**	.69
Intense	150	16	4	.26	**.38**	.30
Penetrating	137	17	3	.19	**.21**	.39
Piercing	51	17	4	.21	**.50**	.43
Numb	199	18	3	.06	**.29**	.23
Cold	83	19	2	.05	**.46**	.10
Freezing	201	19	2	.14	**.54**	.15
Nagging	84	20	1	.09	**.41**	.10
Agonizing	51	20	3	.25	**.47**	.28
Mean κ				0.21	0.34	0.30

Most frequently used pain descriptors and Kappa comparisons between Expectations of pain and Actual pain, between Actual pain and Retrospective reports and between Expectations of pain and Retrospective reports.

	Total no of times selected	No of Participants selecting descriptor			Kappa values (between Participants n=98)		
		Expect.	Actual	Retro	Expect/ Actual	**Actual/ Retro**	Expect/ Retro
SENS1	229	83	72	74	.24	**.36**	.27
SENS2	82	40	21	21	.29	**.58**	.16
SENS3	176	57	49	70	.55	**.45**	.45
SENS4	173	59	69	45	.33	**.25**	.12
SENS5	200	63	73	64	.24	**.40**	.31
SENS6	41	11	16	14	.10	**.76**	.22
SENS7	84	33	27	24	.43	**.34**	.44
SENS8	236	89	77	70	.16	**.43**	.28
SENS9	253	79	87	87	.22	**.18**	.46
SENS10	115	31	44	40	.47	**.54**	.45
AFF11	14	16	19	14	.45	**.62**	.38
AFF12	7	16	8	7	.28	**.53**	.50
AFF13	8	21	15	8	.26	**.53**	.37
AFF14	114	19	51	44	.28	**.49**	.20
AFF15	41	7	24	10	.38	**.45**	.55
EVAL16	261	78	91	92	-.04	**.09**	.15
MISC 17	263	81	91	91	.26	**.54**	.26
MISC18	257	91	82	84	.37	**.45**	.53
MISC19*	291	97	97	97	-	-	-
MISC20	179	37	68	74	.24	**.29**	.22
Mean κ					0.29	0.43	0.33

*** In Category 19, Kappa cannot be calculated. There is no variation, and therefore no shared variation; thus there is no 'evidence' on which to base whether or not there is agreement between assessment times**

Most frequently used ***categories*** *and Kappa comparisons between Expectations of pain and Actual pain, between Actual pain and Retrospective reports and between Expectations of pain and Retrospective reports.*

Appendix 3.7: (Cont.)

Taste descriptor	NWU Actual taste	NWU Recall ratings	Total No. of Words Used	Remember Taste	Remember Word	Know	Kappa: Actual/ Retrospective
Vegetable	98	98	196	88	47	8	.
Smooth	57	59	116	52	18	7	0.42
Cool	67	39	106	35	11	4	0.36
Herbal	46	59	105	38	19	17	0.47
Cabbage	58	41	99	32	11	9	0.47
Pungent	46	41	87	24	9	16	0.53
Aromatic	44	41	85	24	15	13	0.57
Musty	36	45	81	36	12	8	0.40
Fragrant	44	29	73	18	4	11	0.43
Grassy	33	38	71	26	10	12	0.45
Musky	34	31	65	23	8	8	0.38
Sweet	35	29	64	26	9	2	0.58
Spicy	31	30	61	24	13	4	0.46
Woody	27	33	60	24	9	8	0.62
Sour	26	32	58	19	4	12	0.43
Peppery	31	26	57	22	13	4	0.43
Heavy	28	26	54	17	4	9	0.54
Fruity	25	25	50	13	6	10	0.68
Light	28	20	48	17	6	2	0.34
Dry	24	24	48	17	3	7	0.34
Onion	24	22	46	18	8	3	0.49
Salty	25	13	38	10	4	3	0.36
Mouldy	10	23	33	17	5	6	0.26
Warm	9	22	31	18	2	4	0.10

Most frequently selected taste descriptors (>10% of participants at either rating time)

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