

**THE ROLE OF PSYCHOLOGICAL VARIABLES IN PAIN REPORT IN  
CHILDREN UNDERGOING FIXED APPLIANCE ORTHODONTIC  
TREATMENT**

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## **DECLARATION**

I declare that this thesis has been composed by myself and that the work is my own except where help has been acknowledged.

Tamesa A Spencer

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## **ABSTRACT**

The present study aimed to 1) examine the relationship between psychological factors (self esteem, child and parental anxiety, locus of control, family environment, expectation of pain, motivation to receive treatment) and pain report in children undergoing fixed appliance orthodontic therapy; 2) identify the specific factors which help to predict pain report; 3) to investigate the use and value of enhancing children's control/coping with pain when they are having fixed appliance orthodontic therapy. This research was considered to be clinically relevant as pain due to the appliance has been found to be a one of the major causes of discontinuation of treatment. This results in a lack of gain for the individual in addition to unnecessary cost to the health service. It was anticipated that knowledge gained from this research may help dentists to target individuals who are at increased risk of suffering more distress or of discontinuing their treatment. Over forty parents and children participated in the study. Questionnaires examining the various psychological factors were given to children and their parents. In addition children were asked to keep a diary of their experience of wearing their brace until they no longer felt any discomfort.

Results indicate that psychological factors which may influence the acute dental pain reported in the first few days of wearing the appliance are different to those influencing longer lasting pain.

Pain report over the initial few days appeared to be influenced by factors internal to the child (self esteem, locus of control, child trait anxiety and expectation of pain), however as time went on external factors became more important (family environment and parental state and trait anxiety). Three subscales from the Harter Self Esteem Questionnaire were found to account for a substantial amount of the variance in pain report over the first few days of wearing the appliance. The extent to which an individual attributed orthodontic status and treatment to chance also contributed significantly to the variance of pain reported over this time. Parental anxiety and cultural-intellectual orientation of the family as a whole contributed significantly to the variation in how long pain was reported for.

Children who were given additional information about ways to cope with pain reported no less pain than children who were not given this information. Results were discussed with reference to possible future research.



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## INTRODUCTION

The International Association for the Study of Pain (IASP, 1979) has defined pain as “ an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.” Pain is always subjective and each individual learns the application of the word through experiences related to injury in early life. It is now widely recognized that pain is a complex experience often unrelated to physical indices. Differences in reported pain do not always appear to be due to differences in treatment characteristics or to differences in the use of analgesics (Brown and Moerenhout, 1991).

In order to examine pain report in a homogenous group, this thesis set out to identify the factors which may influence pain report in children undergoing fixed appliance therapy (children who have fixed braces fitted). It has been known for some time that a clinically significant percentage of patients who have fixed appliances experience pain shortly after they are fitted. This is important as research has shown that pain from the appliance is one of the major causes of discontinuation of treatment (Haynes, 1974, 1982). This results in wasted time and a lack of gain for the individual in addition to unnecessary cost to the health service. In a study of patients undergoing active orthodontic therapy, 28% reported wanting to discontinue appliance wear because of pain intensity, and 39 % reported that the worst thing about appliance wear was the intensity of the pain (Oliver, 1985). The duration of pain has also been studied.

Scheurer et al (1997) reported that in a study of 170 patients aged 8-53 years, 65% reported pain after four hours, 95% reported pain after 24 hours and 25% reported discomfort after seven days. The highest frequency of pain was found in the 13-16 year olds, however the pain intensity did not differ between age groups. The reasons for this variation in children's experience remains unclear and to date, few studies have examined the role of psychological variables in pain report in this patient group.

### ***1.1 Acute versus Chronic Pain***

Jay (1986) makes the distinction between acute and chronic pain. *Acute pain* is caused by "noxious or tissue damaging stimulation resulting from bodily insult or disease". It is rarely caused primarily by psychological factors, although anxiety often plays a prominent role. It is linked to intense emotional arousal and tissue pathology and is usually characterized by clear, well focused sensory characteristics. Acute pain states can be brief, lasting moments or hours, or they can be persistent lasting weeks or several months until the disease or injury heals. *Chronic pain* refers to long-standing (>3-6 months) intractable pain caused by progressive disease and often becomes a stable element in the daily life of the patient. Chronic pain often fails to respond to treatment and may lead to changes that have been termed, "abnormal illness behaviours", which include physical deterioration (sleep and appetite disturbance) decreased physical and social activity, and emotional problems including depression, anxiety, hypochondriasis and somatic preoccupation.

## 1.2 PAIN MODELS-THEORY

In an attempt to understand pain and improve treatment for pain sufferers, a number of models have been used to conceptualize pain. Most have been developed into models relevant to chronic pain patients but nonetheless, still provide a useful understanding of acute pain

### *1.2.1 Early models of pain*

The earliest of the pain models dates back several hundred years and takes the sensory-physiological view that assumes that the severity of the pain is proportional to the amount of tissue damage. Clinical findings at the time however suggested that this model was too simplistic. It is in fact a widely observed finding that patients with objectively the same physical pathology and treated with the identical intervention often report very different responses. Pain as an indicator of pathology is today seen as unreliable (Horowitz et al, 1991). In an attempt to understand pain report in the absence of objective medical data, a *psychogenic model of pain* was introduced. This model suggests that emotional factors, personality characteristics or psychiatric disorder can account for pain which cannot be explained by tissue damage. Although the psychogenic model was seen by many as an advancement on the purely sensory-physical model of pain, the usefulness of this model has been questioned. This arose partly because the model made the unwarranted assumption that there are adequate means for reliably measuring the amount of 'pain' experienced. It also assumes that normative



data are available for various pain syndromes to determine whether an individual's report is excessive. This is clearly not the case as it is well recognized that people with similar medical findings show very diverse pain response, (Howowitz et al, 1991), hence the lack of normative data. Finally, the psychogenic model of pain assumes that current medical and diagnostic procedures can identify all sources of pathology likely to cause the pain reported by the patient. This does not appear to be the case. Diagnostic tools such as physical examination, laboratory tests and imaging procedures, can for example, only lead to a definite diagnosis in 20 % of patients with chronic back pain.

A variation of this psychogenic model, the *motivational conceptualization model* of pain has been suggested. This model advocates that pain report which cannot adequately be explained by physical pathology is invalid and is motivated by secondary gain which is often assumed to be financial. If this was the case, one might expect to find a dramatic improvement in pain following the receipt of disability awards. However this is not a finding which has been substantiated by research evidence (Turk, 1994). Dissatisfaction with these early models of pain thus led to the development of *multicomponent models of pain*.

The three main models of pain which are still prominent today are the *Operant Conditioning Model* (Fordyce 1976), the *Gate Control Model* (Melzack and Wall, 1965) and the *Cognitive-Behavioural Model* (Turk and Ruddy, 1992).

### 1.2.2 Gate Control Model:

The concept of pain as a perceptual event was first described in the Gate Control Model (GCM), by Melzack & Wall, 1965 (Figure 1).

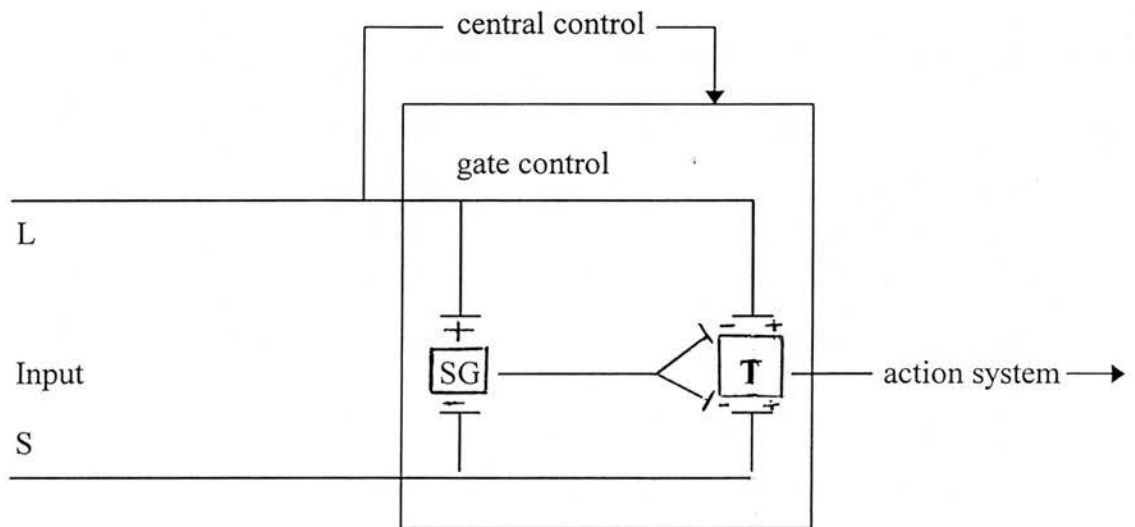


Fig 1. The gate-control model of pain (mark I). From Melzack, R., and Wall, P.D. Pain mechanisms: A new theory. *Science*, 150: 971, 1965

With reference to the above diagram, impulses evoked by peripheral stimulation are transmitted to three systems: 1) cells in the substantia gelatinosa of the spinal cord; 2) the dorsal column fibres that project towards the brain; 3) the spinal cord transmission (T) cells that mediate information to the brain. The model proposes that a spinal gating mechanism in the dorsal horn modulates the transmission of nerve impulses from afferent fibres to the spinal cord T cells. The proposed spinal gating mechanism, is

influenced by the relative amount of activity in the large diameter (L) and small diameter (S) fibres. Activity in the large fibres tends to inhibit transmission (close the gates), whereas activity in the small fibres tends to facilitate transmission (open the gates). Nerve impulses which descend from the brain influence this gating mechanism. A specialized system of rapidly conducting fibres labelled the 'central control trigger' activates selective cognitive processes which in turn influence, by way of descending fibres, the modulating properties of the spinal gating mechanism. This rapid transmission makes it possible for the brain to identify, evaluate, localise and selectively modulate the sensory input before the action system is activated. When the output of the spinal cord transmission T cells exceeds a critical level, it activates the action system i.e. those neural areas that underline the complex sequential pattern of behaviour and experience characteristics of pain.

The Gate Control Model of pain has proved to be one of the most important developments in the field of pain research and therapy and has stimulated much physiological and psychological research in this area. Although the specifics of the Gate Control Model have, to a large extent been dismantled, the model remains largely intact today. In 1982, Melzack and Wall modified their theory to take account of information acquired since the original proposal. The new model is depicted in figure 2.

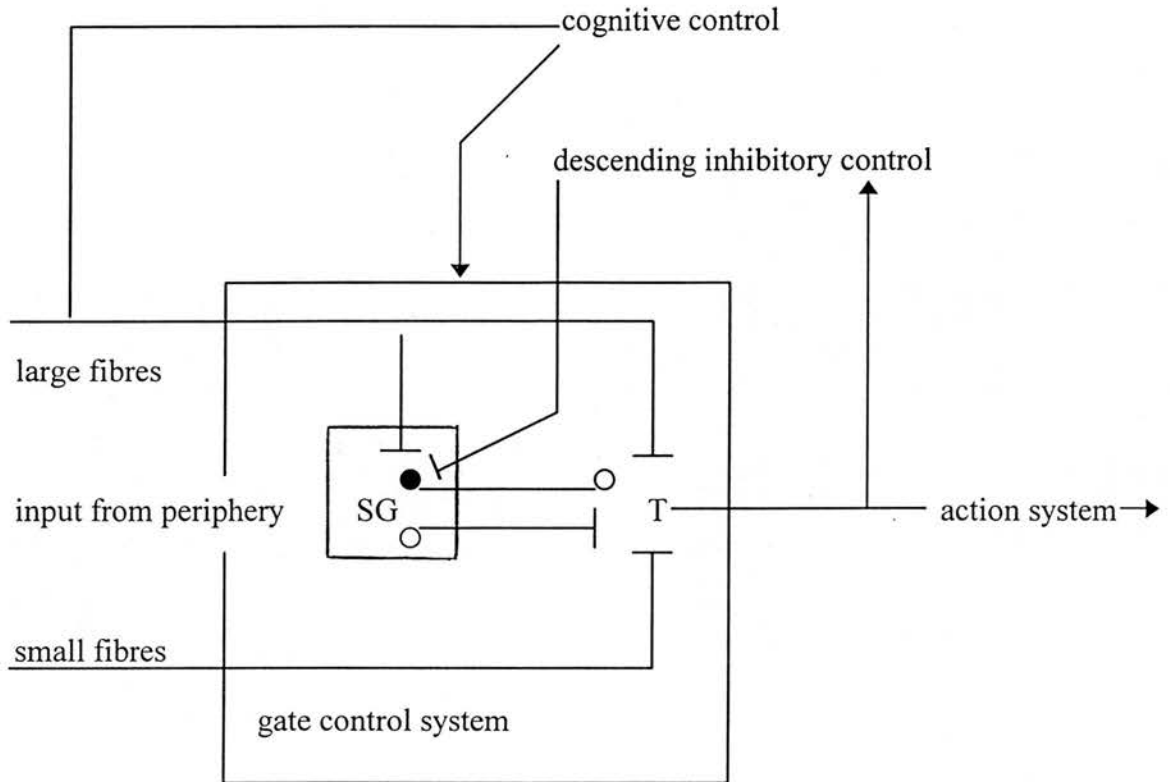


Fig 2. The gate-control model of pain (mark II). Modified from Melzack, R., and Wall, P.D., Pain mechanisms: The Challenge of Pain. New York ; Basic Books; 1983.

Major expansions to the model over the years emphasized further the motivational, affective and cognitive aspects of pain experience (Melzack & Wall, 1982). In addition to nociceptive input (the sensory descriptive component of the gate control model), the perception of pain also involves the simultaneous integration of motivational- affective and cognitive-evaluative components. Pain perception depends on complex gating mechanisms whereby impulses generated by tissue damage are modulated by both ascending systems activated by innocuous stimuli and descending pain inhibitory

systems activated by varied environmental and psychological factors (Basbaum & Fields 1984; Wall 1984; Willis 1985; Fitzgerald 1993).

*Interim Summary:* The Gate Control Theory of pain has been one of the most important developments in the field of pain research acknowledging for the first time that the nociceptive system functions as an active and complex integrative system, not just as a rigid system that passively relays information from the site of the noxious stimulus. Although the Gate Control Model goes some way to explain the interaction between psychological and physiological components of pain, it cannot adequately explain the psychosocial and developmental aspects of pain. In addition to giving little attention to interactions of environmental influences on pain perception it does not adequately explain pain perceptions and responses over time. The model is also unable to explain the experience of chronic pain. The two most prominent theories which have helped to expand further our understanding of pain are 1) the operant model, (Fordyce, 1976), which focuses on the individual's pain behaviour in the context of environmental contingencies, and 2) the cognitive-behavioural model (Turk and Meichenbaum, 1989), which highlights the importance of an individual's appraisal of the situation.

### ***1.2.2 Operant Conditioning Model***

The operant conditioning model of pain (Fordyce, 1976) distinguishes between pain which it describes as a subjective state and pain behaviour. Pain behaviours include

those behaviours which patients experiencing pain engage in, such as, verbally complaining about pain, facial grimacing, taking pain medication or moving in a slow and guarded fashion. Fordyce (1976) postulated that these pain behaviours serve to communicate to those around the patient the fact that pain is being experienced. The model also proposes that these behaviours are subject to environmental contingencies of reinforcement i.e. that behaviour is controlled by its consequences. The theoretical principal that outlines how consequences of behaviour can alter future behaviour was first described by Thorndike (1913) in the Law of Effect. This law states that the probability of a behaviour can be increased or decreased depending on its immediate consequences. Fordyce (1976) described four major types of behaviour consequence relationship that may be important in the acquisition and maintenance of pain and well behaviours. These are depicted in figure 3.

		Nature of environmental stimulus	
		Positive	Aversive
Deliver		<i>Positive reinforcement</i> Increase in the probability of behaviour being repeated	<i>Punishment</i> Decrease in the probability of behaviour being repeated
	Withdraw	<i>Extinction</i> Decrease in the probability of behaviour being repeated	<i>Negative reinforcement</i> Increase in the probability of behaviour being repeated

Fig 3. Behaviour -consequence relations in operant conditioning

Pain behaviours that are positively reinforced have a higher probability of being repeated. For example, a patient who complains about pain which results in added attention and sympathy, may be more likely to complain about pain in the future. Financial incentives contingent upon the expression of pain behaviours may also serve to reinforce such behaviour. When behaviour leads to an aversive outcome (punishment) it is less likely to reoccur. For example, the back pain patient who is criticised for digging the garden by her husband will be less likely to engage in such behaviour again. Pain behaviour may also result from a withdrawal of the positive stimulus (extinction). An example of this may be a highly dependent patient with chronic pain who has been praised frequently by his doctor for exercising may stop exercising when the doctor fails to ask about the patient's exercising. A further type of behaviour-consequence relationship is negative reinforcement. This involves the withdrawal of a negative or aversive stimulus and increases the probability that a behaviour will be repeated. Someone who has constant pain while sitting or walking is likely to find lying down in bed reinforcing. Lying down in bed is therefore negatively reinforced by its pain relieving effects. In this way the operant model of pain provides rationale for the persistence of pain behaviours even after the original cause of pain has been eliminated.

*Interim Summary:* The operant model of pain helps to explain the persistence of pain behaviours even in the absence of a noxious stimulus. It can be however be argued that the operant model de-emphasises the physical contributions to pain and gives no

consideration to perceptual processes and individuals cognitive appraisal of pain. Although there is much support for the view that operant factors can induce or sustain pain behaviours, other factors which are not considered in the operant model may also be important. The operant model fails in that it does not attempt to describe the process involved in the initial stimulus of acute pain, instead it focuses on pain behaviour. The behaviour may result from physical pathology or structural abnormalities rather than solely being a response to external contingencies of reinforcement.

### ***1.2.3 Cognitive Behavioural Conceptualization***

Turk (1994) argues that although the operant and gate control models depart significantly from the sensory-physiological models, they still have a limited view and are unable to explain the experience of chronic pain. and pain perceptions and responses over time. Due to dissatisfaction with aspects of both the gate control and operant models of pain, a cognitive-behavioural model of pain is proposed. According to the cognitive-behavioural conceptualization, behaviour, emotions and in some cases physiology are influenced by interpretations of events rather than physiological factors and characteristics of events per se. Patient's perspectives based on their schema, attitudes and beliefs filter and interact reciprocally with emotional factors, sensory phenomena and behavioural responses. In addition patient's behaviours elicit responses from others that can reinforce both adaptive and maladaptive modes of thinking, feeling and behaving (Turk 1994). A growing body of research has demonstrated the important



roles that cognitive factors ( appraisals, beliefs, expectancies) play in exacerbating pain and suffering, and in influencing responses to treatment (Turk & Ruddy 1992).

In relation to appraisals, Moos (1982) states that an individual's cognitive appraisal of how a potential stressor is perceived is usually a critical mediating factor between the stressor and the individual's response to it. An illustration of this comes from a study by Hall 1954 in which subjects who received instructions using the word pain responded with lower pain thresholds than those who received a neutral instructional set. It is widely agreed that how the patient evaluates the meaning of his or her pain, affects how he or she responds to it (Turk, 1983). As Beecher states, "we all know that a small ache in the finger may be a trivial annoyance , easily disregarded, whereas the same duration and intensity of an ache beneath the sternum, if it connotes the possibility of sudden death from heart failure, may be a wholly unsettling experience." This generally accepted clinical observation has considerable importance in critical care situations, where many patients fear the connotations of their pain.

The importance of expectation can clearly be seen in the placebo response literature. Beecher (1955, 1975) and Evans (1974), in reviewing clinical studies of the placebo effect of patients suffering from severe pain, found an average of 35 percent of patients obtained significant pain relief from placebo medication. The effectiveness of a placebo is directly proportional to the apparent effectiveness of the active analgesic agent. Evidence suggests that under appropriate conditions a placebo is about half as effective

as morphine in relieving pain and paradoxically, is also about half as effective as a mild analgesic, such as aspirin. It appears that when the physician administering the analgesic knows that a powerful analgesic is being used (e.g. morphine), a strong placebo effect is obtained in a double blind administration. If, however, it is assumed that the analgesic is less effective (e.g. aspirin), a much smaller placebo effect is obtained. The conviction of the physician that the analgesic is effective or not seems to be communicated to the patient and affects the latter's expectation of the level of pain relieving properties of the drug (Evans, 1974). The expectations of both the health care professional and the patient appear to be important in generating the placebo effect.

The cognitive-behavioural model of pain has been supported by recent studies which have demonstrated the importance of cognitive distortions, coping strategies, and self efficacy in the experience of pain (Turk and Ruddy in press). For example a study of patients with chronic low back pain, showed that the primary difference between patients who had many 'medically incongruent signs' i.e, complaints not consistent with the identified physical pathology and those who did not display these signs, was maladaptive thoughts (Reesor and Craig, 1988). A person's belief in their ability to control their pain is an important aspect of the cognitive behavioural model of pain and its management. The cognitive control of pain has received much interest in recent years and cognitive strategies have been found to be effective in pain reduction (e.g. Barber et al, 1975), Neufielf et al, 1977). The means by which cognitive strategies mediate pain reduction are not well understood. The nature of the coping strategy per se

does not appear to account for the generally beneficial effects. (Turk et al 1983). Perceived self efficacy and perceived control (Turk, 1983) are two cognitive constructs that have generated much interest recently. Bandura (1977) describes self efficacy as “ones confidence in his /her ability to behave in such a way as to produce a desirable outcome”. He makes the distinction between self efficacy and perceived control. Perceived control is described as, “ones perception of the availability of a response whereas self efficacy refers to ones confidence in the ability to effect that response”. Other authors writing in the field of pain make this distinction less clear. Research has shown that people with high efficacy beliefs are better able to control pain than those with lower self efficacy (Manning and Wright 1983; Litt 1988; Altmaier et al 1993) and perceived self efficacy has also been shown to be a powerful personal resource in coping with stress (Lazarus and Folkman 1987).

Research also supports the idea that cognitive factors such as efficacy beliefs have a direct effect on biochemical factors associated with pain. It has been demonstrated that the efficacy of cognitive coping strategies in studies of laboratory induced pain can be attenuated by injection of naloxone which is known to block the body's production of endorphins (Bandura, 1989). Cognitive coping strategies were taught to subjects with a resultant increased tolerance for noxious stimulation. Subjects were then injected with either naloxone or a placebo (saline) on a subsequent trial. Those subjects who were injected with naloxone showed a significant reduction in tolerance for noxious

stimulation. Those subjects injected with saline showed no reduction in tolerance for nociception.

*Interim Summary:* The cognitive behavioural model of pain takes a broad view of pain which helps to explain the dynamic interaction of ongoing physical, cognitive, affective and behavioural factors. In this way it can provide a useful framework on which to base our understanding of acute/procedural and chronic pain. It does this rather than focusing on cognitive and affective components of pain in a static manner, as in the gate control model, or exclusively on behavioural responses and physical pathology, as the operant and sensory physiological conceptualizations, respectively do.

#### ***1.2.4 A model of children's pain***

While both the operant model (Fordyce, 1976) and the cognitive behavioural model have served to increase our understanding of pain generally, a broader and perhaps more comprehensive attempt to clarify our understanding of children's pain in particular, has been put forward by McGrath (1983). Research studies and clinical reports indicate that children's pain is modified by several situational, behavioural and emotional factors (Routh et al 1991; Mc Grath 1993).

Various psycho-physiological experiments in which adults rate the painfulness of noxious stimuli administered in different contexts, have evaluated the pain reducing effects of various situational factors including understanding, predictability, expectation,

attention, control and relevance (Craig et al 1977, Dworkin et al, 1981; Johnson 1973; McGrath, 1981; Price et al 1980). Animal behavioural studies using monkeys, in which the physiological responses activated by a noxious stimulus are directly recorded, have demonstrated that certain situational variables such as attention, predictability and relevance can directly modify the physiological responses evoked by a constant noxious stimulus (Hayes et al 1981; Hoffman et al 1981; Dubner et al 1981). The results of both the psychophysiological studies with humans and the behavioural studies with animals demonstrate the profound impact of situational factors on pain perception and nociceptive activity. Subsequent research studies and clinical reports indicate that children's pains are modified by these same factors ( Kavanagh et al, 1991; Routh & Sanfilippo, 1991; McGrath, 1993).

## CONTEXT SPECIFIC FACTORS

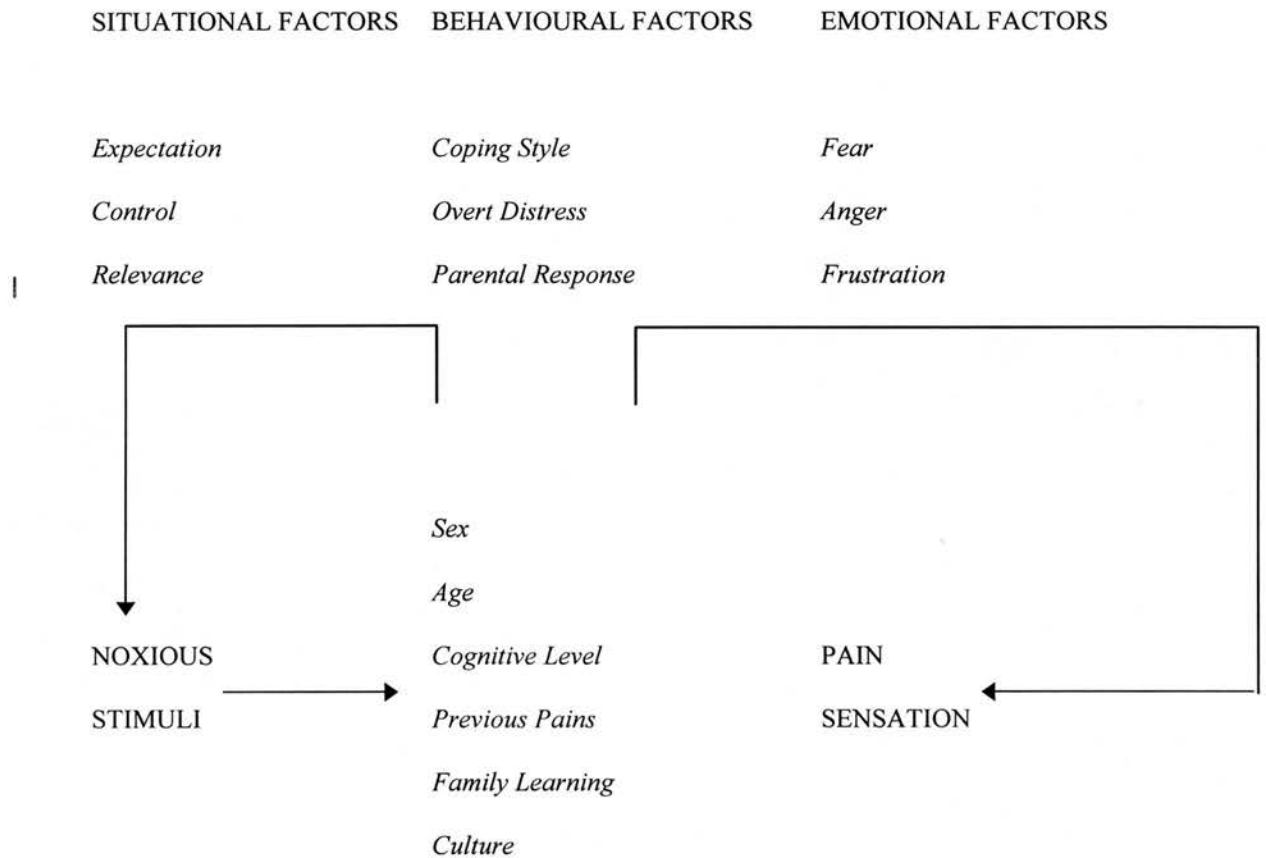


Fig. 4. A model of the situational, behavioural and emotional factors that modify a child's pain perception (from McGrath, 1990b).

*Relatively stable influencing factors:* The variables, sex, age, cognitive level, previous pain experience, family and cultural background, all represent relatively stable influencing factors and can shape how children generally interpret the sensations caused by tissue damage. Children's understanding and description of pain depends on their age, cognitive level and previous pain experience. Children will judge the strength and

unpleasantness of any pain in comparison to sensations they have already experienced and therefore, this frame of reference will be continually changing as they mature and sustain more diverse types of tissue damage. For example, a recent study surveyed children's understanding and experiences of pain to evaluate how sex, age and health status influenced children's perceptions (McGrath unpublished paper). Children from 4-17 years of age defined pain, described their strongest and least painful experience and then rated the intensity of any pain that they experienced in a pain diary for a month. Descriptions obtained clearly indicated that children begin to understand pain by their own experiences and describe pain in a language which represents those experiences. As children mature they rely less frequently on concrete analogies drawn from their own experience and demonstrate their understanding of pain in more abstract concepts.

Studies evaluating sex related trends in children's pain perception have been somewhat less conclusive. One study by Schechter et al (1991), identified subtle sex differences in children's reactions to diphtheria-tetanus-pertussis (DPT) immunization. Girls required more time to calm down after immunization. In contrast a study by Grunau and Craig (1987) monitored the responses of 140 infants during heel lance procedures and found that boys cried sooner and with significantly more cry cycles than girls. However, Ross and Ross (1984) interviewed 994 children from 5 to 12 years old about their pain experiences, pain language, reactions to pain and coping strategies. They found that children's responses were not consistently related to their age or sex. At present there is insufficient evidence to support specific age or sex related differences in

children's sensitivity to pain. Instead as McGrath (1993) suggests, boys and girls may learn to express and cope with pain as a result of differing societal expectations. McGrath (1993) suggests that girls may be subtly reinforced for their pain complaints while boys may be discouraged from expressing such complaints. To date however there is no convincing evidence to support such assertions.

With regard to family learning and culture, Mc Grath suggests that these factors have an important role in shaping what children learn about pain, how they express their pain, and how they cope with different types of pain. Some parents reassure children and encourage them to get up and continue playing, while other parents smother the child with attention. Although it is clear that family exerts a powerful influence on how children learn to express and cope with pain it is not clear to what extent familial responses and familial pain experience affect the nature and severity of children's actual pain experience. Some studies have reported a relationship between pain symptoms or somatic concerns among families (Routh, 1984). Nevertheless it remains unclear whether apparent trends in pain symptoms are caused by specific in-family learning, or stressors which are common within the family. Cultural beliefs affect how children are raised and therefore there will be cultural differences in what children learn about pain and how to behave when in pain.



*Context specific factors:* Situational, behavioural and emotional factors vary dramatically depending on the *context* in which the child experiences pain. These are the context specific factors and they can have a profound impact on children's pain report. What children understand about tissue damage, how they and their parents behave and how they feel all effect their pain report. These factors mutually influence one another to modify children's pain report through complex interactions that occur at spinal and supraspinal levels in the nociceptive system. Context specific factors can account for why the same tissue damage can evoke different pains and can partially explain why the effectiveness of proven analgesic interventions (pharmacological and nonpharmacological) may vary among children and vary for the same child at different times (McGrath, 1994).

*Situational factors:* Situational factors represent an interaction between the child experiencing pain and the context in which the pain is experienced and refer to the particular combination of psychological and contextual factors that exist in a specific pain situation (McGrath 1983, 1990b; Ross & Ross 1988). Situational factors vary extensively not only for different children experiencing the same tissue damage but also for the same child experiencing the same tissue damage at different times. Included in this category are expectation of pain, perceived control and relevance (McGrath, 1983; 1991). These include children's understanding about the pain source, their expectation regarding the quality and intensity of pain sensations, their ability to control what will happen, their primary focus of attention, their ability to use a pain reducing strategy and

the relevance or meaning of the pain to them. For example, a study by McGrath (1990) revealed that children not understanding the cause for their pain and the uncertainty about obtaining eventual pain relief, were the most common situational factors exhibited by the children referred for pain management, regardless of the particular kind of pain problem. Children's lack of understanding about their pain exacerbated acute treatment related pain (e.g. cancer treatments, growth hormone injections, diabetic injections, multi invasive procedures during prolonged hospitalization), recurrent pain syndromes (i.e. headaches, abdominal pain, and limb pain) and chronic pain (e.g. cancer, reflex sympathetic dystrophy, arthritis). All the children had experienced many pain episodes prior to their referral, few children had an age appropriate understanding of the source of pain, probable contributing factors, and the rationale for selected treatments. Most children did not know of any pain reducing strategies that they could use and as a result children lacked any real control over pain, intensifying their emotional distress and the aversiveness of the experience.

The understanding a child has of a situation may vary depending on the origin of the pain, for example, whether it is as a result of accidental injury or whether it was induced by medical procedure/ treatment. Acute pain signals a warning about physical injury, so that the pain usually has an adaptive biological significance. Children quickly learn that the cause of their pain is physical damage which is often easily visible. They learn that their pain is relatively brief and they often have developed some pain reducing strategies such as seeking a parent for a hug and bandage. The aversive significance is determined

more by the actual pain intensity and by any disruption in children's normal activities, than by concerns of continued pain and disability. Research has shown however that the situational factors present for acute treatment induced pain are quite different (McGrath 1990b; Anderson et al 1993, Carr et al, 1993). Children often believe that they have no control in a medical situation (Anderson 1993). They may be uncertain about what to expect, they may not understand the need for treatment that will hurt, particularly if they do not feel sick and they may not know any simple tools to use to help them cope with their anxiety and pain.

The importance of expectations has been highlighted in a number of studies examining distress when undergoing surgery or painful medical procedures. Research examining children's distress when undergoing painful bone marrow aspirations found that three predictor variables ( child's age, parental anticipation of child's pain and number of previous BMA's ) accounted for 86% of the variance in children's distress scores.

*Behavioural Factors:* Behavioural factors include children's overt behaviours when they experience pain and their parents or health professionals behaviours in response to the child. Like situational factors, behavioural factors have a powerful modulating role in children's pain. With regard to the child's overt behaviour, specific physical behaviour may exacerbate pain intensity, for example, by tensing specific muscle groups for extended periods (McGrath 1990b, 1992). Other behavioural factors such as

limited physical activity or peer and social activities may also increase children's pain perception (McGrath, 1993a). Some behaviours promote a healthy recovery while others may initiate, exacerbate or maintain children's pain. Distress behaviours may reflect a child's underlying emotional distress or a conditioned response. With regard to the behaviour of others, children learn about pain from their own experience and from the responses of their parents and families. Parent's own behaviours are therefore important determinants of children's behaviours when they experience pain (Ross & Ross 1988). Several studies have suggested that children are more likely to inhibit behavioural expression of their distress if they are not accompanied by a parent during the procedure (Gross et al 1983; Shaw et al 1982; Gonzalez et al 1989) This is not to say that children unaccompanied by their parent feel less pain.

A study by Ross and Ross (1984) found that 99% of 720 children (aged 9-12 years) reported that the 'thing that helped most' regardless of the type of pain experienced, was to have one parent present. If the parent present is anxious however research has shown that the child is significantly more likely to show anxiety than a child of a non anxious parent. Studies have shown that young children in particular will model an emotion observed in someone else experiencing that emotion (Ost & Hugdahl 1985). The role of parental anxiety as a mediator for a child's anxiety may also be important. It has been shown that the psychological state of the parent, in particular trait anxiety, interacts with that of the child and affects the child's ability to cope with hospital procedures (Gil et al

1992). Parental anxiety and children's distress during bone marrow aspirations have been found to be positively related (Jay 1983).

With regards to recurrent pain in particular, research has shown that children are at risk of developing heightened pain complaints and pain behaviours due to parental response (McGrath 1990). For example, parents may inadvertently increase children's recurrent pains when they allow children to miss school or relieve them from their usual family duties. The effect of the family environment on pain report is one area in which research has been lacking. Indeed, a frequent criticism of traditional psychological assessment techniques concerns their failure to evaluate systematically the impact of environmental factors on behaviour. Mischel (1968), noted that by ignoring the context in which behaviour occurs, individual characteristics yield only limited validity. Clinicians have suggested that many types of pain problems aggregate or cluster in families. Apley and Hale (1973) refer to the 'painful family' in their study of recurrent abdominal pain in children. There is however little research exploring the way in which pain is transmitted within families and across generations (McGrath, 1990).

*Emotional factors:* Pain caused by minor injuries during normal play provide children with a warning to teach them about potentially harmful activities. There are no prolonged emotional consequences from these protective acute pains. However acute pain evoked by serious injury, or acute treatment induced pain, recurrent pain syndrome and chronic pain have the potential to cause prolonged emotional distress to the children

and their families. Children can become anxious, frightened, frustrated, angry, sad and depressed -emotions which can exacerbate pain. Children's emotions affect their ability to understand what is happening, their ability to cope in a particular situation, their behavioural responses and their pain experience. In general, the more fearful and anxious a child is the stronger and more unpleasant the pain (McGrath, 1993). When children lack understanding, control and positive coping behaviours, their emotional distress increases and their pain intensifies. As the pain continues, children's emotional distress intensifies, creating a steadily increasing pain-emotional, distress-pain cycle (McGrath, 1993).

*Interim Summary:* McGrath's model of the situational, behavioural and emotional factors that modify a child's pain perception provides a useful framework on which our understanding of children's pain can be based. The model takes psychosocial, developmental, psychological and physiological factors on board. In this way it provides a broader and perhaps more comprehensive model for understanding children's pain than do the other models. As in the cognitive behavioural model of pain (Turk, 1994) McGrath's model helps to explain the dynamic interaction of ongoing physical, cognitive, affective and behavioural factors. However as McGrath's model was specifically developed to help increase our understanding of children's pain, more emphasis is placed on developmental factors and family factors.

### 1.3.0 ASSESSMENT OF CHILDREN'S PAIN

Several pain assessments methods have been reported in the literature. These can be grouped into self report, behavioral, and physiological measures.

#### *1.3.1 Self report measures:*

Self report measures rely on children reporting their own subjective pain experience and are restricted to children who have the necessary verbal and cognitive communication skills. The lower age limit for use of these measures is approximately three or four. Self report measures have been highly correlated with direct overt behaviours and with adult ratings however, the child's report of pain must be used with some caution as environmental factors may influence a child's report. For instance, a child may be influenced to answer in a socially desirable way or may feel reluctant to report pain because of fear of injections and/or having to stay longer in hospital. In contrast, pain complaints may result in increased attention and consequently be reinforced. Self report measures may be unidimensional or multidimensional in nature. Unidimensional methods have been used successfully in children as young as three years of age and include the following. The Poker Chip Tool(Hester 1979) which asks children to rate pain concretely as 'pieces of hurt'. Faces scales (Bieri et al, 1990) provide a series of facial expressions depicting graduations of pain, the child chooses the face that closely approximates the intensity of their pain experience. These scales are appealing and can be used easily with school aged children. Various visual analogue

scales can be used for children over the age of five (Abu-Saad 1984). A line with verbal, facial or numerical anchors along a continuum of pain intensity is presented visually and the child is asked to indicate on the line their current level of pain. Ideally the child should be given a choice of whether to use a faces scale or visual analogue scale and both types of scales should give equivalent levels of validity and reliability.

Older children and adolescents respond well to numerical visual analogue scales and these have a major advantage of ease of use and charting. However it is important to remember that the intervals along the scale may not necessarily be equal from a child's perspective; for example, a change from 2 to 4 may not be the same as a change from 8-10. Multidimensional methods require more developed communication skills and abstract thinking and are therefore suited to children six years of age or older. These measures include the Varni Thompson Pediatric Pain Questionnaire (Varni et al 1987) and the short form of the McGill pain Questionnaire (Savendra et al, 1993). Pain diaries can be either unidimensional or multidimensional and are useful as they can provide information on patterns of pain. They can also allow the individual to develop self management strategies and communicate constructively about their pain.

Behavioural and physiological measures are generally used when self report cannot be obtained for example, when children are unable to speak, when they are too ill, or when they are under the influence of anesthesia.



### *1.3.2 Behavioural measures*

Indicators using crying, (Johnston et al 1988, 1990) body movement, (Franck 1986) and facial expressions (Grunau and Craig 1987) have been commonly used to assess paediatric pain. With preschoolers and older children several behavioural rating scales are used to measure pain in response to medical procedures. A widely used example of a behavioural rating scales is the Procedural Rating Scale (Katz et al, 1980). Katz et al, 1980, originally derived the scale from observations made of children aged 8 months to fifteen years 9 months, who underwent bone marrow aspirations. Although the scale demonstrated inter-rater reliability above 0.85 and good evidence of validity several of the items were found to be specific to the BMA procedure and would not be of use in rating pain or distress in other situations. The scale was therefore updated and renamed, the Observational Scale of Procedural Distress (Jay et al, 1983) Unfortunately, the authors of the updated scale chose to combine the concepts of pain and anxiety using the term 'behavioural distress'. It can be argued that this only serves to compound the concept of pain per se.

A lack of validation of the above measures led to the development of the Children's Hospital of Eastern Ontario Scale (CHEOPS) (McGrath et al, 1985). The CHEOPS has been shown to be appropriate for measuring postoperative pain in young children undergoing surgery and has been shown to have excellent inter-rater reliability and good validity when used for children following surgery. One of the main difficulties in using

behavioural measures of pain however is that observers usually require specific training in their use which makes these scales more time consuming than self report

### *1.3.3 Physiological measures*

Physiological measures used to assess pain in children include variability of heart beat, respiratory rate, blood pressure, intracranial pressure, oxygen saturation, and stress hormones. A common experimental design used in studies to assess children's pain report and ability to cope with pain is known as the 'cold pressor test' and involves asking the child to immerse his/her hand into icy cold water for as long as he/she can bear it. Physiological and self report measures can then be taken (Zeltzer et al, 1992). A disadvantage with both behavioural and physiological measures of pain is that they cannot discriminate well between physical responses to pain and responses to other forms of stress to the body.

When choosing a method of pain assessment or indeed a combination of methods one should first consider the appropriateness of the measure for the age group and clinical situation and if the measure is valid and reliable the psychometric properties should be known. The clinical utility of the measure should also be tested such as time needed for use, clarity, ease of use and length.

#### **1.4: Assessment of Orthodontic Treatment Need**

The Index of Orthodontic Treatment (IOTN) is a index used by dentists and orthodontists to provide estimates of treatment need based on 1) the extent of malocclusion and 2) the aesthetic appearance of the patients mouth. The extent of malocclusion is graded on a scale of 1-5 ranging from no treatment need to very great treatment need respectively. Various occlusal features are considered details of which can be found in the appendix. The aesthetic appearance is graded on a ten point scale, where a score of 1 represents the most attractive teeth and 10 the least attractive, and judgement is made with reference to ten photographs illustrating the ten points on the scale. Variation between dentists on this scale, has found to be in significant.

#### **1.5.0 DENTAL TREATMENT -PAIN AND SELF PERCEPTION**

##### ***1.5.1 Pain in relation to dentistry:***

With regard to physiological factors contributing to pain report in children undergoing fixed appliance orthodontic therapy, the application of pressure caused by the appliance produces an inflammatory reaction in the periodontal ligament. The accompanying increase in vascularity and tenderness in the tooth contributes to the pain reaction (Proffit & Fields 1986). This pain typically lasts for 2-4 days, then disappears until the appliance is adjusted, at six months. However research has shown that as many as 12% of cases seen in general dental practice cannot be linked to any known

pathology. It has been postulated that in the context of acute stressors like dental pain, the most significant influences on eventual distress will probably be those specific to the situation, rather than trait or dispositional characteristics of the individual (Bandura, 1982; Lefcourt, 1982; Rotter, 1975). The individual's preexisting level of distress, appraisal and attributions about the situation, their specific self efficacy regarding their ability to cope with the stressor, and the external demands and contingencies applied by the dentist and others are likely to be among these influences. Although to date there has been little or no research examining the influence of motivation to receive treatment and pain report, this may be an area of interest for psychologists working in this field. It may be that the motivation to receive treatment is important factor influencing pain report. For example, it could be assumed that motivation to receive orthodontic treatment may be one important factor as it may affect how the child appraises the situation and the demands made upon him or her during treatment.

### ***1.5.2 Dental pain and anxiety***

It has been suggested that anxiety may be the most important of the non sensory components of dental pain (Gatchel, 1992). Launch (1971) used electric shock to the left upper incisor to detect tooth pain threshold and found that those with dental anxiety had lower pain thresholds. Other research has produced similar findings. Klepac et al (1982) conducted a similar type of study and found that anxious dental patients had lower tolerance for dental pain (but not for non dental pain ) than did non anxious

patients. Bernstein and Kleinknecht (1979) have also reported that more anxious patients report greater pain during dental procedures than do less anxious patients.

It has been argued that, in acute clinical pain situations, anxiety and pain may in fact be indistinguishable (Litt, 1994). Perceived or anticipated pain increases anxiety. Anxiety not only lowers pain threshold, but may actually lead to the perception of normally non-painful stimuli as painful. Cases have been cited in the literature in which patients complain of pain despite there being no apparent physical damage (Litt, 1994). Anxiety has been one factor which appears to have had a mediating role in some of these cases and when the patient has been treated for anxiety they have stopped reporting pain (Litt, 1994). Studying the relationship between pain and anxiety in the context of dental treatment has many benefits. Routine dental procedures tend to be for a predictable amount of time, with known little complications and seldom life threatening risks.

### ***1.5.3 Parental anxiety***

Rachman (1990b) showed correlations of between 0.65 and 0.74 with fears of mothers and children, dependent on what type of relationship they had. If the mother and child had a close relationship then the anxieties stemming from the mother were more likely to be transmitted to the child. Previous research has examined dental anxiety and the relationship between the mother and the child. Johnson, Dewitt & Baldwin (1968) looked at general anxiety in the mother and responses of the child in a

dental setting. They found a significant relationship between the level of anxiety in the mother and the child's behaviour in a dental situation. Children of mothers with high anxiety scores showed more negative behaviour and this was regardless of the type of treatment they were attending for or the patient's past experience. Other research supports the view that the anxiety of a child exhibited in the dental situation could be directly linked to trait anxiety in the mother (Johnson et al, 1969). Several researchers have shown that children of more anxious mothers are more distressed during painful medical procedures (Jay et al, 1983).

#### ***1.5.4 Effect of other mood states on pain report:***

Other affective states such as depression, frustration, anger, sadness may also lower pain threshold and increase distress in a dental encounter. It may be that positive emotions such as happiness may dampen pain response (Weinsberg et al, 1995).

#### ***1.5.5 Motivation to receive dental treatment***

*The child's motivation:* Self perception of dental appearance and attitude towards malocclusion and orthodontic treatment are important factors in an individual's decision to obtain treatment (Shaw et al, 1991). The desire for improvement in appearance is a common motivator in seeking orthodontic treatment. In a study which assessed the attitude of a sample of 385 American and Welsh school children, the strongest perceived

benefits of orthodontics was the opportunity for an improved appearance. Dental health and function were also referred to, but appeared to be secondary to the individuals personal priorities (Tulloch, 1984).

*The role of the dentist:* The crucial role of the dentist in the initiation of orthodontic treatment has been demonstrated in a survey of prospective patients in which 70% of referrals to orthodontics were initiated by the dentist (Shaw et al, 1980). Studies in the UK and in the Netherlands have shown that dentists and orthodontist are more critical than the general public about the acceptable range of dental irregularity (Shaw et al, 1975; Phahl-Andersen, 1978) reflecting an uncommon perception.

*The role of parents:* Early research indicated that the underlying motivation behind children seeking orthodontic treatment is often a reflection of parental anxiety, wishes of parents and their hope that their child will conform to both their own and societies ideal of beauty and facial attractiveness.(Storey, 1966). One study showed that 75% of British parents surveyed believed that orthodontic treatment was important for success in their child's future occupation and 92% believed that it would enhance dental health (Shaw et al, 1980). It may be important to establish the extent of parental influence over seeking orthodontic treatment for their child in the light of research examining the benefits of reconstructive surgery for children with disfigurements. This research has shown that children do not always benefit as much as their parents from surgery, particularly if they were having considerable social difficulties before the operation

(Bradbury, 1994c). The factors which influence outcome often relate to the persons premorbid psychological and social state, rather than the technical quality of the surgical result (Bradbury, 1992).

It is interesting to note that research tends to indicate that adult patients are usually highly self motivated to receive treatment and tend to be well adjusted and conscientious during orthodontic treatment (Tayer, 1981).

*Interim Summary:* The role of motivation to seek orthodontal treatment as a factor which may influence pain report has not been examined in previous research. Previous research suggests however that often motivation to receive orthodontic treatment comes from sources external to the child for example, from the dentist or parents. This may have implications regarding pain report, as it may affect the child's perceived relevance of the treatment or indeed perceived control over treatment. Motivation to receive treatment is one factor that is helpful to consider.

## 1.6 SELF CONCEPT AND SELF ESTEEM

Bee (1989) suggests that the attainment of a stable concept about oneself as an individual is an important stage in the cognitive development of children. By six or seven years of age most children have definite ideas about themselves and their attributes as a person. The self concept develops in response to maturational and



environmental experiences throughout childhood and adolescence. Bee (1989) describes three important dimensions of the self concept, the existential, the categorical and the evaluative. By existential, Bee means an individual's sense of oneself as a unique person who shows considerable continuity in behaviour over time. Categorical refers to an individual's categorization of his/herself in comparison to other people. The evaluative facet of self concept refers to the individual's favourable or unfavourable assessment of themselves. This aspect of the self concept has been referred to as self esteem. James (1980) has conceptualised self esteem as an individual's perception of the ratio of success to pretensions or of attainments to aspirations. In validation studies of the Harter Self Esteem Questionnaire (1983, 1993), measures of global self worth in 8-16 year old boys and girls has been found to correlate most strongly with physical appearance indicating that children attach much importance to appearance or attractiveness.

### ***1.6.1 Social desirability, malocclusion and self esteem:***

Research has shown that unattractive people are at a social disadvantage. They are perceived to be less liked, less preferred as friends and less desirable as marriage partners (Walster et al, 1966; Dion et al, 1972; Dion, 1973; Mathes and Kahn, 1975; Taylor and Glenn, 1976). Part of their unattractiveness is related to the dental appearance, which has been shown to be very important socially (Linn, 1966). Children with normal dental appearance are judged as better looking, more desirable as friends, more intelligent and less likely to behave aggressively (Shaw, 1981). The relationship

between self esteem and malocclusion is unclear. There is however support for the view that most orthodontic treatment is driven by subjective perception of dental appearance rather than for functional reasons (Albino, 1984; Jenny, 1986). It has been suggested that self esteem is lowered when malocclusion is present (Stricker, 1979; Weiss 1974; Shaw, 1981) but there is little evidence to support this hypothesis. Richards (1986) found an increase in self esteem in a group of patients who had received orthodontic treatment compared with a group who had not yet commenced orthodontic treatment. The numbers in this Richards study were however small and the results should therefore be interpreted with caution. Several authors have found no relationship between aesthetics and self esteem (Rosenberg, 1965; Coopersmith, 1967; Korabik and Pitt, 1980). O'Regan et al (1989) measured self esteem /self concept and aesthetics in three groups. One group prior to orthodontic treatment, one group following completion of active orthodontic treatment and an untreated group. Self esteem was not significantly increased in the post- treatment group, therefore the hypothesis that self esteem is lower in the presence of malocclusion was not supported.

Research has however shown that variations in self esteem may influence personal judgements of the severity of the malocclusion. In a study in which children were asked to place their own dental attractiveness on a rating scale of dental attractiveness, those children who underrated their dental attractiveness (in comparison to an orthodontist) had on average, a lower self esteem than those who were accurate in their assessment. With regards to adult patients those adults who do seek treatment tend to have a more

positive image than average and embarrassment has been cited as the main reason that adults do not readily seek orthodontic treatment (Breece & Nieberg, 1986).

### ***1.7 Age and the influence of psychological and emotional factors in pain report***

During adolescence, young people tend to become extremely concerned about physical appearance, especially if it relates to the reactions of significant others (Tierno, 1983). Given that the acceptability of occlusal conditions has been shown to be related to the acceptability of a general physical appearance, it is not surprising that adolescents form the largest age group seeking treatment to correct socially unacceptable occlusal conditions. Peer group influence has also been cited as significant in the uptake of orthodontic treatment.(Burden, 1995). Most children with self perceived anomalies want to be assimilated with other children through treatment. Their main dilemma is the anticipation of other children's responses to conspicuous appliances which will almost entirely depend on familiarity with appliances in the school and neighborhood (Tulloch et al, 1984). Patients often feel embarrassed or believe that they are being ridiculed by their peers because of the appearance of the orthodontic appliance.(Breece et al 1986; Shaw, 1980). This may be particularly important during adolescence when self concept can be highly susceptible to peer opinions (Coleman, 1981).

Recent research has shown that children with similar dental aesthetics will have similar perceptions of their malocclusions irrespective of their gender or social

background.(Burder& Pine, 1994). However research has also shown that girls exhibit greater motivation for orthodontic treatment than do boys regardless of any differences in occlusal irregularity (Baldwin & Barnes, 1965,1966; Shaw, 1981). However, age may influence self perceptions of malocclusions, with younger children likely to be less aware than older children of their dental aesthetics (Horowitz et al, 1970). Concern over appearance and facial attractiveness reaches a peak around early adolescence, (Hurrelmann, 1989).

Research has shown that there may be a relationship between age of patient and undesirable psychological effects of orthodontic treatment (Haynes, 1974,1982). Active orthodontic treatment was discontinued much less frequently in patients 5-9 years of age (11.5%) than in patients of 15 years of age(79.9%). This finding led Haynes to suggest that discontinuation of treatment may be due to essentially psychological and emotional factors. However, primarily pain from the appliance and the intrusion of treatment into the patients daily life were seen as major causes of discontinuation of treatment. The age of a child may also effect the anxiety felt in relation to treatment. More than 50 % of 218 patients less than 18 years of age undergoing active appliance therapy or in full time retention were reported to have experienced anxiety concerning treatment. Anxiety increased significantly with age of the patient and was reported more often by girls than boys.

In a study of 50 7-14 year olds and 50 6-14 year olds girls, Maj et al (1967) found that 77% of the children reported a high degree of difficulty in psychological adjustment to the treatment. Forty two percent of the sample reported that the appliance was painful and distress was particularly noted in the older children. Other research (Lewis & Brown, 1973) has found that the level of anxiety induced by appliance therapy was lower than that reported by Maj (1967).

In a comparison of pain report and well being in adolescents (14-17 years), preadolescents (11-13 years) and adults (18 years and over) undergoing fixed appliance orthodontic treatment, adolescents generally reported lower levels of psychological well-being and higher levels of pain than the other two groups (Brown et al, 1991). The higher levels of pain reported by the adolescent group did not appear to be due to differences in treatment characteristics or to differences in use of analgesics. The authors concluded that it was possible that the levels of reported pain may be confounded with, or mask, other affective reactions to treatment. Research has shown that reported pain can often be a somatization of either anxiety or depression (Elton et al, 1983).

It is therefore possible that reported pain may be the patient's attempt to translate feelings of anxiety or depression or perhaps even embarrassment from peers into a tangible physiologic problem. The age difference in adjustment to fixed orthodontic appliance suggests that adolescents are more vulnerable to undesirable psychological

effects of treatment(Brown et al, 1991). The higher levels of pain and the lower levels of psychological well being reported by the adolescent group may suggest a more traumatic reaction to treatment than seen in other age groups. It can be suggested that because of their critical period of psychological development, adolescents find it more difficult to adjust to the initial effects of fixed appliance orthodontic therapy.

Early adolescence often coincides with a change of school where the child is exposed to a new, more competitive and less protective environment. At the same time the child's body image is changing and unstable and the dissatisfaction many adolescents feel about their bodies can be more intense for those with visible deformities (Bradbury, 1996) Adolescents can be a very lonely time especially if the adolescent has not developed close confiding relationships. A greater emphasis is placed on the importance of friends and family cannot substitute for them. A lack of self confidence may prevent the adolescent from developing such relationships and may make it difficult for the adolescent to separate from the family effectively. During adolescence sexual awareness is developing and the process of dating may become more difficult when the adolescent lacks self esteem. (Bradbury, 1996).

Adams (1980) investigated the relationship between physical attractiveness and self esteem in a study of the socialisation process. He claims that because of their positive self concepts, attractive male and females are more assertive than their unattractive peers when faced with peer pressure. Goldman and Lewis (1977) suggest that social skills are of a higher level in attractive people which is perhaps due to the fact that attractive

individuals experience an encouraging social environment whereas those less attractive individuals have more negative experiences.

*Interim Summary:* Research has shown that children, particularly adolescents attach much importance to physical appearance. Although measures of global self worth have been found to correlate most strongly with physical appearance the relationship between self esteem and malocclusion is unclear. Studies have shown a relationship between age of patient and undesirable psychological effects of orthodontic treatment, with orthodontic treatment being discontinued more frequently in the adolescent age group than in younger children. Higher levels of pain report have also been found in the adolescent age group. This research however still needs further support.

## 1.8 CONTROL AND COPING WITH PAIN

The management of children's pain and distress associated with medical procedures is a major concern for health care professionals. A number of psychological interventions (e.g. imagery, hypnosis, relaxation, sensory and procedural information and positive self statements) have been shown to be effective in reducing children's procedure-related anxiety and discomfort. (Johnson et al 1975; Siegel and Paterson 1980,1981; Zeltzer and LeBaron 1982, 1986; Jay et al 1985; Dahlquist et al 1986). While intervention studies have found significant group effects, there is considerable variability in effectiveness found among children receiving the same intervention. For

example while hypnosis has been found to reduce pain in children, it is not uniformly effective for all children.(Zeltzer et al, 1989 Zeltzer and LeBaron 1982, 1986). It has been recommended that characteristics of the individual child must be examined to determine their role as moderators of the experience of pain and the impact of specific interventions on children's coping efficacy.

### *1.8.1 Coping style*

Children's coping style will to some extent be limited by their cognitive developmental level. In a study by Jeans et al, 54 healthy children were asked to draw a picture that shows pain and asked to describe coping with pain. Both the drawings and the coping strategies cited by the 5-9 year olds focused on physical aspects of pain; at age 11, psychological coping strategies and depictions of pain of psychological origins appeared. At age 13, 35% of coping strategies were psychological. The observed shift with increasing age from physical (concrete) to psychological (abstract) aspects of pain fits well with Piagetian theory. Further studies have also shown that children's ideas about pain change with increasing age in a developmental pattern consistent with Piagetian theory (Gaffney 1987; Hurley 1987). Coping style is an individual characteristic which has frequently been studied in adults in relation to pain, distress, medical outcome, and pain management techniques (Andrew 1970; DeLong 1971; Cohen and Lazarus 1973; Shipley et al 1978; Shipley et al 1979). There remain however few studies which systematically integrate coping style and specific treatment interventions for procedural related pain in children and findings have been inconsistent (Smith et al



1989; Fanurik et al 1992). It has been suggested that requiring individuals to adopt nonpreferred coping strategies can exacerbate stress (Burger, 1989; Miller, 1987). It may therefore be important to take into consideration a patient's preferred coping style when helping individuals to plan how they intend to control their pain. Teaching children to use coping strategies to reduce their pain may be beneficial for children who desire this control over their pain. Children need to learn simple methods to reduce their pain and distress. Even very young children can easily learn a variety of pain control strategies (McGrath 1990). It also seems to be the case that children seem to be more adept than adults at using non pharmacological interventions. It has been suggested that this may be because they are usually less biased than adults about the potential efficacy of non drug taking therapies. However, since adults teach children how to use these interventions, adult biases, either professionals or parents can weaken treatment efficacy. It is recommended that children should learn some of the principles of pain management so that he/she can naturally evolve their own technique for reducing pain (McGrath 1990). However, the same strategy is often not effective for all occurrences of pain since the strength, quality, extent and unpleasantness of the pain are likely to vary. It has therefore been suggested that several general methods should be taught to each child so that he/she can develop a flexible repertoire of pain coping strategies that will be individually tailored to suit individual needs.

### *1.8.2 Locus of control*

Health locus of control belief refers to a person's belief in his or her own control over illness episodes. The concept was introduced by Rotter (1966) who defined it as a general expectancy that reinforcing events are either contingent upon a person's own behaviour (internal control) or upon forces outside ones own control (external control). Since Rotter's construction of the internal-external scales, the construct has been developed further by various researchers. Levenson (1972) differentiated three components: internal control, chance locus of control and control by powerful others. Walston et al (1976,78) first constructed the Health Locus of Control scale(HLC) scale. A common finding is that health outcomes are more positive in persons who have strong beliefs in internal control over illness (Wallston & Wallston, 1982), although not all studies have confirmed this finding. More specific behaviours are better predicted by specific beliefs.

Several scales have been constructed to measure control beliefs in specific chronic conditions, such as the Back Pain Locus of Control Scale (BPLC) (Vakkari,1990) and the Orthodontic Locus of Control Scale- Child Form (Tedesco et al, 1985). Crisson, 1988 examined the relationship of locus of control orientation to pain coping strategies and psychological distress in chronic pain patients. Patients who viewed outcomes as controlled by chance factors such as fate or luck rather than being controlled internally, tended to rely on maladaptive pain coping strategies and rated their ability to control and decrease pain as poor. They also exhibited greater psychological distress, were more

likely to report depression and anxiety and reported feeling helpless to deal effectively with their pain problem.

### ***1.8.3 Perceived control***

Perceived control refers to a belief that one has at ones disposal a response that can influence the aversiveness of an event, (Thompson, 1981). Control need not actually be provided but only perceived to be available in order to be effective. (Averill, 1973). People who believe that they can exercise some control over aversive events display lower autonomic arousal and less impairment in performance than do those who believe they lack personal control, even though they are subjected to the same painful stimuli (Geer et al 1970; Glass et al 1973). If people believe they can deal effectively with potential stressors they are not so much perturbed by them. But if they believe they cannot control aversive circumstances, they become distressed. In this instance the person may dwell on their coping deficiencies and see the environment as threatening. In so doing distress arises and impairs their level of functioning (Beck et al 1985; Lazarus et al 1984).

### ***1.8.4 Desire for control***

The role of perceived control has been discussed in relationship to its mediating effect on pain report. Baron et al (1993), reviewed a series of studies examining how desire for control among dental patients affects their reaction to dental treatment. The

research carried out across eight samples indicated that low perceived control is associated with heightened stressful responding before and after dental treatment only among patients reporting “high desire for control”. The impact of low perceived control appears to be moderated by desire for control. Manipulations of control primarily impact patients reporting both a high desire for control (during treatment )and low initial perceived control. Results from this study suggest that considerations of patients desire for control in addition to their perceived control increases our ability to predict dental stress. Increasing or decreasing perceived control may primarily affect those patients who prefer to cope with stress using control related strategies (Burger, 1992). Therefore it has been suggested that evaluating subjects desire for control as well as level of perceived control is crucial in predicting the level of distress patients will experience during an aversive procedure.

*Interim Summary:* Just as there is considerable variation in children’s pain report undergoing similar medical procedures, there is also considerable variability in the effectiveness of interventions aimed at increasing coping with pain. Research suggests that individuals preferences in coping style, their locus of control, their perceived control and also their desire to achieve some control over their pain may be important factors influencing the adoption of a coping strategy and the successfulness of its use. It is therefore recommended that children are taught a variety of coping strategies which they can subsequently develop to suit themselves.

## 1.9 AIMS AND HYPOTHESES

The aims of this research are to: 1) examine the relationship between psychological factors (self esteem, child and parental anxiety, locus of control, family environment, motivation to receive treatment).and pain report (expected and actual) in children undergoing fixed appliance orthodontic therapy; 2) identify the specific factors which help to predict actual pain experience/report; 3) investigate the use and value of enhancing children's control/coping with pain when they are having fixed appliance orthodontic therapy.

This knowledge may then help dentists to target individuals who are at increased risk of suffering more distress or of discontinuing their treatment. This is important as careful consideration may need to be given regarding the suitability of such patients for application installation at that point in time and additional support of a psychological nature may be of benefit in these cases before and during treatment. Based on the literature and clinical experience the factors which are most useful to explore in relation to pain report following orthodontic treatment are self esteem, child and parental anxiety, locus of control and family environment.

Hypothesis 1: Children's pain report will be positively correlated with their state and trait anxiety.

Hypothesis 2: Parental trait and state anxiety will be positively correlated with child's pain report.

Hypothesis 3: Children's expectation of pain will be positively correlated with their actual pain report.

## 2. METHOD

### *2.1 Design: Study 1*

A prospective design was employed to examine the relationship between psychological variables and pain report in children undergoing fixed appliance orthodontic treatment. The variables examined were child and parental state and trait anxiety, child and parental motivation for treatment and expectations of pain during treatment, child and parental orthodontic locus of control, child self esteem, and family environment.

### *2.2 Criteria for subject selection*

With the exception of two subjects who were recruited from a private dental practice in Arbroath, the majority of subjects were recruited from the Orthodontic Clinic at Dundee Dental Hospital or Perth Royal Infirmary. Patients having fixed orthodontic appliances fitted in either their upper or lower jaw or both jaws, were invited to take part in the study, by either the orthodontist concerned or myself. Where possible this took place at their preliminary visit to the clinic (at the appointment prior to the fitting of the appliance). In order to maximise subject numbers, however approximately half the subjects were invited to participate on the day on which their appliance was fitted. Information concerning the study was given to both parent/guardian verbally and in writing and informed consent was obtained from both child and parents.

## *Subjects*

Male and female patients of nine to sixteen years of age, attending the Orthodontic Clinic at two local dental hospitals and one private dental practice were recruited into the study. Their accompanying parent/guardian was also invited to participate. Of the sixty three children and parents who were approached to take part in the study 18 either declined to participate or agreed to participate but failed to return any of their questionnaire. Of the 45 children and 47 parents who agreed to participate and did so, 29 complete sets of children's data were obtained. This group was comprised of seventeen girls and twelve boys. Ages ranged from 9-16 years with a mean of 13 years of age. In addition, data from three fathers and twenty four mothers of these children was obtained. Parental age ranged form 28-49 years with a mean age of 40 years. In addition forty five children's questionnaires were completed, without diaries being completed. In the majority of these cases diaries were not completed by these children during the duration of the study because due to unfortunate circumstances, such as cancellation of dental appointments, appliances were not fitted in the available time. In addition diaries were not returned by a further three children despite having had their appliance fitted and despite having completed the other questionnaires.





## 2.3 MEASURES

### *2.3.1 Measures completed by the child:*

Firstly the State-Trait Anxiety Inventory for Children (STAIC) (Spielberger, 1973) was presented. Form C-1 which provides a measure of state anxiety, was presented before Form C-2 which measures trait anxiety. This order is recommended by the authors of the STAIC as it is the order in which the scale was presented during its standardisation. Secondly an unstandardised measure of children's motivation to receive treatment and expectations of treatment, designed specifically for the study, was presented. A measure of the child's self esteem was then taken using the Harter Self-esteem Questionnaire (Harter, 1993 modified from 85). Finally a measure of the child's orthodontic locus of control was obtained using the Orthodontic Locus of Control Scale - Child Form (Tedesco et al, 1985).

A measure of the child's pain report was obtained by the use of a diary in which the child was asked to record their experience of wearing the appliance until such a time as they felt no more soreness or discomfort. They were then asked to return it in the stamped addressed envelope which was provided.

### ***2.3.2 Measures completed by the parent***

A booklet similar in content to that given to the child was given to the accompanying parent. The following questionnaires were contained within the booklet and were completed by the child's accompanying parent/ guardian prior to treatment ( prior to the appliance been fitted). Firstly, the State-Trait Anxiety Inventory (STAI ) (Speilberger, 1973), was presented. As recommended by the publishers, Form Y-1, which gives a measure of state anxiety, was presented first, then Form Y-2, which measures trait anxiety. An unstandardised measure of parental motivation for their child to receive orthodontic treatment and their expectations of their child's pain, both during fitting and wearing of the appliance was then presented. This measure was designed specifically for this study. Thirdly a measure of parental orthodontic locus of control was obtained using the Orthodontic Locus of Control Scale - Parents Form (Tedesco et al, 1985). Finally the Family Environment Scale Form R (Polmin, 1989) was presented.

## ***2.4 Description of measures completed by child.***

### ***2.4.1 State-Trait Anxiety Inventory for Children (STAIC) (Speilberger, 1973)***

Children's level of anxiety has been shown to influence their pain experience, which in turn has been shown to affect adherence to treatment in this patient group. (Haynes, 1982).

The STAIC is comprised of separate, self report scales for measuring two distinct anxiety concepts; state anxiety and trait anxiety. The state anxiety scale is designed to measure transitory anxiety states, that is consciously perceived feelings of apprehension, tension and worry that varies in intensity and fluctuate over time. The trait anxiety scale measures relatively stable individual differences in anxiety proneness, that is differences between children in the tendency to experience anxiety states. High trait anxiety children are more prone to respond to situations perceived as threatening with elevations in state anxiety than low trait anxiety children. The STAIC is similar in conception and structure to the State Trait Anxiety Inventory (STAI) which provides measures of state and trait anxiety for adolescents and adults (Spielberger, Gorsuch, & Lushene, 1970). Although the STAIC was constructed to measure anxiety in nine to twelve year olds it is stated that it can be used with younger children with average or above average reading ability and older children who are below average in ability. For the purposes of this study the STAIC was administered to all children regardless of age in order to allow more accurate comparison of anxiety scores between subjects.

The STAIC state anxiety scale consists of 20 statements that ask children how they feel at a particular moment in time. The STAIC trait scale also consists of 20 item statements , but subjects respond to these items by indicating how they generally feel. Individual STAIC items are similar in content to those included in the STAI, but the format for responding to the STAIC has been simplified to facilitate its use with

young children. Children respond to the individual items on the STAIC by selecting one of three alternative choices from each item which describes them best.

In the standardisation of the STAIC, the state anxiety sub-scale was given first, followed by the trait anxiety scale, and this order is recommended when both scales are given together.

*Reliability:* The internal consistency of the STAIC scales is reasonably good and the test re-test reliability (stability) of the trait scale is moderate. The test re-test correlations for the STAIC state anxiety are quite low, as would be expected for a measure designed to be sensitive to the influence of situational factors. In general the subscales of the STAIC are somewhat less stable and not as internally consistent as the corresponding STAI scales (Spielberger, et al, 1970).

*Validity:* Evidence of the concurrent validity of the STAIC trait anxiety scale is shown by its correlation with the two most widely used measures of trait anxiety in children- the Children's Manifest Anxiety Scale for Children (Castaneda, et al, 1956) and the General Anxiety Scale for Children (Sarason, et al, 1960). In a sample of 75 children, the STAIC trait anxiety scale correlated .75 with the CMAS and .63 with the GASC (Platzek, 1970). Evidence bearing on the construct validity of the State anxiety scale is available from a sample of more than 900 fourth, fifth and sixth grade children.

#### *2.4.2 Harter Self-esteem Questionnaire (Harter, 1993 modified from 85)*

Patients undergoing orthodontic treatment often do so for aesthetic reasons rather than functional (Albino, 1984; Jenny, 1986). Self-esteem is one facet of self-perception and is being examined here as having a mediating role in adherence to treatment.

Until relatively recently the use of the Harter Self Esteem Questionnaire (Harter, 1985) for research purposes in the United Kingdom has been hampered by the lack of normative data for a British population. However the questionnaire has now been modified for use with Scottish school children and normative data is available on children between 8 and 15 years old who live in Scotland. It was therefore the best available questionnaire to use in this study.

The Harter (1983) has benefits over other popular self esteem measures. Two of the other most popular scales, the Coppersmith Self Esteem Inventory (Coopersmith, 1959,1967) and the Piers Harris, (1969) have major weaknesses that decrease their usefulness. As Harter (1983) argued, the Coopersmith Self Esteem Inventory was originally derived from an adult scale and the questions therefore may not be applicable to,or understood by children. The Piers Harris Self Concept scale is quite time consuming to complete and Harter (1983), argues that children find the questions hard to understand. In addition, the Piers Harris Self Concept Scale uses is dependant on factor analysis for the derivation of the subscales, so it may not adequately reflect the developmental changes in self esteem during childhood.

The construction of the Harter (1983) was based on two principles. The first principle is that children's evaluation of their self esteem is based upon a comparison of their attributes with those of their peers. The second principle is that self esteem has several components. The questionnaire is a 36 item self completed questionnaire which measures global self esteem in addition to five subscales physical appearance, social acceptance, athletic competence, behaviour and scholastic performance.

*Reliability and Validity:* Correlations between subscales on modified Harter questionnaire show that global self worth correlates most strongly with physical appearance for boys and girls, indicating that children attach much importance to physical appearance or attractiveness. Within each subscale, reliability's <sup>ies</sup> as measured by Cronbachs alpha, range from 0.72 to 0.83 (Hoare et al, 1993). This finding supports the internal consistency and construct validity of the modified questionnaire. However, like the original standardisation of the of the Harter (1985) Questionnaire, the Hoare et al (1993) study did not have an independent measure of self esteem so that the construct validity of the modified questionnaire is not known. The high correlation between the global and appearance subscales and the other subscales supports the rationale behind the design of the questionnaire, that self esteem has individual categories in addition to an overall component.

### *2.4.3 Orthodontic Locus of Control Scale - Child Form (OLOC) (Tedesco et al, 1985)*

It has been suggested that internal locus of control is an important variable in adhering to treatment . Identifying those who have an external locus of control can ensure that the orthodontist gears the patient towards internalisation of their control beliefs and this may improve adherence to treatment.

General locus of control and health locus of control measures have been useful in the study of health behaviours however these measures are not specific enough to provide meaningful assessments of psychosocial responses to malocclusions. The Orthodontic Locus of Control (OLOC) Scale was developed to be specific enough to assess ways in which parents and children view responsibility for occlusional states and orthodontic treatment.

The children's OLOC Scale is a 34 item self administered inventory with a 6 point response format (strongly agree to strongly disagree). It is comprised of four subscales which reflect the degree to which the child attributes control or responsibility for occlusional status, and orthodontic treatment related events, to four sources. These sources are, internal factors controlled by the individual, and external factors controlled by, chance, parents, or the orthodontist. The external sources are labelled external-chance, external-powerful others-parents, and external -powerful others-parents, and external-powerful others/professionals.

*Validity:* For validity studies, children completed the Multidimensional Health Locus of control (HLOC) Scale and the Orthodontic Opinion Poll (OOP) Subscales (Tedesco et al, 1985). The authors concluded that moderate to high moderate subscales correlations on the child form offer promise for the validity of the Orthodontic Locus Of Control Scale.

*Reliability:* The internal consistency estimates for reliability on the child version of the OLOC Scales has been found to be in the moderate to high moderate range of 0.33 to 0.69 (Tedesco, 1985). Age ranges are not specified in publication.

#### ***2.4.4 Assessment of child's motivation and expectations before treatment***

Pain is a perception which is determined by both physiological and psychological factors (McGrath, 1990). In particular, expectations of pain following treatment can influence the level of pain children report (McGrath, 1990; Beales, 1983). Motivation to receive orthodontic treatment, has not previously been examined in relation to pain report or adherence to treatment in children undergoing fixed appliance therapy. However parents motivation for their children to undergo orthodontic treatment is often a major factor in referral and subsequently may affect the patients adherence to treatment. Whether the child is personally motivated to receive treatment or not may also affect their perception of control over treatment. There are no standardised measures available measuring <sup>(CV)</sup> child's motivation to receive orthodontic treatment or children's expectations of treatment. A short questionnaire comprised of seven items was therefore developed specifically for the



study. Three questions were designed to give an indication of the extent to which the motivation to receive orthodontic treatment came from each of three possible sources, the child themselves, the child's parents/family/friends, or the dentist. Responses were recorded on a seven point scale ranging from 0-6. The remaining four questions were designed to give an indication of expectations of; worry caused by wearing the appliance, expectation of improvement in dental appearance after completion of orthodontic treatment, expectation of pain during fitting of the appliance and finally expectation of pain whilst wearing the appliance. A 10cm visual analogue scale was used to record responses for the questions relating to worry and pain.

#### *2.4.5 Pain Diary*

A multidimensional measure of pain report was used to obtain information regarding children's pain report on a daily basis until such a time as they experienced no more discomfort. Questions were taken mainly from the Varni-Thompson Paediatric Pain Questionnaire (1987), which itself is derived from the McGill Pain Questionnaire. Additional questions were also added. The diary was comprised of eleven items. The child was asked what words they would use to describe their pain or hurt. The child was also asked to choose from a list of 45 pain descriptors comprising of the three areas of sensory, affective and evaluative experiences of pain, the words which describe how it feels when they are in pain and the words which describe the pain they were feeling while completing the diary. A 10 cm visual analogue scale was

used to obtain a measure of the worst pain the child had felt that day and also the pain felt at that moment in time i.e. during completion of the diary. Each line was anchored with a drawing of a happy face at one, indicating no pain and a sad face at the other end indicating a whole lot of pain or hurt. Three questions focused on obtaining a measure of how worthwhile the child considered the pain to be. Children were asked to choose from four responses ranging from very much worth it to not at all worth it. They were also asked about what made any pain worth while and were asked to choose from three responses, not being teased, having straight teeth and looking better. In addition the children were asked to select from a sample of 21 situations and mood states, times at which their pain seemed worse. Examples being, when they felt angry, bored, lonely or when they were playing, at school, or in bed. The final question asked the child to list which painkillers had been taken that day for brace related pain.

## *2.5 Description of measures completed by parent.*

### *2.5.1 State-Trait Anxiety Inventory (STAI- Form Y)(Spielberger, 1970)*

It has been shown in previous similar research that the psychological state of the parent (in particular trait anxiety) interacts with that of the child and affects the child's ability to cope with hospital procedures (Gil et al, 1992).

The State-Trait Anxiety Inventory (STAI) has been used extensively in research and clinical practice. It comprises separate self report scales for measuring state and trait anxiety. The S-Anxiety scale (STAI Form Y-1) consists of twenty statements that evaluate how respondents 'feel right now, at this moment' The T-Anxiety scale (STAI Form y-2) consists of twenty statements that assess how people generally feel. In the standardisation of the STAI (Form Y), the S-Anxiety scale was always administered first, followed by the T-Anxiety scale. This order is recommended when both forms are given together.

*Reliability:* The STAI has been found to be a sensitive indicator of changes in transitory anxiety. Test re-test correlations for trait anxiety have been found to be between 0.73 and 0.83. Test re-test correlations for state anxiety are low, 0.15 to 0.65, as would be expected from a measure assessing changes in anxiety resulting from situational stress. Research on the STAI with adolescents and adults has consistently demonstrated that trait anxiety scores are relatively impervious to the conditions under which this scale is given (Johnson & Spielberger, 1968; Lamb, 1969; Spielberger, et al 1970), but state anxiety scores are by design influenced by the immediate environment.

*Validity:* Adequate construct validity has been suggested by evidence that the STAI discriminates between normal and psychiatric populations on trait anxiety scores and between stressed and non-stressed populations on the state anxiety scores, (Spielberger, 1970).

*2.5.2. Orthodontic Locus of Control Scale - Parent Form (OLOC)* (Tedesco et al, 1985)

Internal locus of control is an important variable in adhering to treatment. Identifying those who have an external locus of control can ensure that the orthodontist gears the patient towards internalisation of their control beliefs and improve adherence to treatment.

The parents OLOC Scale, is similar in construction to the child's OLOC Scale. It is self administered inventory, comprised of three subscales, containing a total of 28 items. The subscales identify three sources to which adults attribute control or responsibility for their child's occlusional status, and orthodontic treatment related events. These sources are internal, external -chance, and external powerful others-professionals. The three subscales also reflect the extent of control attributed by the parents to each of the three sources. Items are rated on a six point response scale (strongly agree to strongly disagree) and high scores on each subscale of the measures indicate greater attributions of control to the source reflected by the subscale.

*Validity:* For validity studies, mothers also completed the Multidimensional Health Locus of control (HLOC) Scale and the Orthodontic Opinion Poll (OOP) Subscales (Tedesco et al, 1985). The authors concluded that moderate to high moderate

subscales correlations on the parents forms offer promise for the validity of the Orthodontic Locus Of Control Scale.

*Reliability:* The internal consistency estimates for reliability the parent versions of the OLOC Scales have been found to be in the moderate to high moderate range of 0.50 to 0.74. (Tedesco, 1985).

### ***2.5.3 Family Environment Scale-form R, (Plomin et al 1989)***

How children cope with pain is very much determined by family reactions and attitudes (McGrath, 1993). Therefore, the mediating role of the familial atmosphere is examined in this study.

The family environment scale form R is a shortened version of the original Family Environment Scale (Moos and Moos, 1981) which is a widely used self report questionnaire that assess the family atmosphere. The family environment scale form R (Plomin, 1989) is comprised of eight sub scales; family cohesion, expressiveness, conflict, achievement orientation, cultural-intellectual orientation, active recreational orientation, organisation and control. There are forty items in total, each of which is rated on a five point scale (completely true, true to a certain extent, neither true nor untrue, not particularly true, not true).

Reliability in terms of both internal consistency and test re-test reliability have been found to be high.

#### ***2.5.4 Assessment of parental motivation and expectations before treatment***

Research has shown that parents exert a powerful influence on how their children cope with pain. In this study parents motivation for patient to undergo orthodontic treatment is often a major factor in referral and, subsequently may affect the patient's adherence to treatment. Furthermore, parents expectation of pain following treatment may influence the patients subsequent experience.

There are no standardised measures available measuring the parents motivation for their child to receive orthodontic treatment, or their expectation of the pain which their child might experience as a result of treatment. A short, five item questionnaire, similar to the slightly longer child's version, was therefore developed specifically for the study. These questions were designed to give an indication of the extent to which the motivation to receive orthodontic treatment came from each of three possible sources, the parent or the parents family or friends, the child, the dentist. Responses were recorded on a seven point scale ranging from 6-0. In addition, a 10 cm visual analogue scale was used to record parental expectation of the pain that their child might experience during fitting of the appliance and also whilst wearing the appliance.

#### ***2.6 Measures completed by the orthodontist***

The Index of Orthodontic Treatment (IOTN) is a index used by dentists and orthodontists to provide estimates of treatment need based on 1) the extent of

malocclusion and 2) the aesthetic appearance of the patients mouth. The extent of malocclusion is graded on a scale of 1-5 ranging from no treatment need to very great treatment need respectively. Various occlusal features are considered, details of which can be found in the appendix. The aesthetic appearance is graded on a ten point scale, where a score of 1 represents the most attractive teeth and 10 the least attractive, and judgement is made with reference to ten photographs illustrating the ten points on the scale. Variation between dentists on this scale, has found to be in significant.

### *2.7 Procedure*

Once informed consent had been obtained, questionnaires were given to children and accompanying parent to fill out. Whenever possible time was taken to explain the content of the questionnaires verbally to the participants, however in cases where the orthodontist was recruiting, this was not possible due to time limitations and unfamiliarity with the questionnaires. Children and their parents were asked to complete the questionnaires at the clinic or at home depending on what was most convenient for them. The measures were presented to the child and accompanying parent in the form of a booklet to ensure that as far as possible, questionnaires were completed in a standard order. Time limitations of the study, made recruitment on the day on which the brace was fitted necessary. This unfortunately meant that some subjects completed all questionnaires with the exception of their pain diary, some weeks prior to having their appliance fitted while others completed questionnaires

after having had the appliance fitted. However in cases where time was not available for children to complete their questionnaires prior to treatment, it was still necessary to ask them to complete one of the questions before their appliance was fitted. This question was question 6 of the motivation and expectation questionnaire, "How much do you expect having a brace fitted will hurt?" This was necessary as the question specifically aimed to examine expected pain rather than pain reported retrospectively. Allowing for this exception, measures were completed by the child, in order of presentation above.

## ***2.8 Protocol for the Placement of Orthodontic Appliances***

### ***Components of fixed orthodontic appliance***

The appliance components consist of brackets which are directly bonded onto the outside (labial) surface in the case of incisors, canines and premolars, while the brackets are welded to bands fitted on the molar teeth. The bond to the tooth is formed by the polymerisation (setting) of a resin on the acid etched enamel surface. The bond to the bracket is formed by polymerisation of the adhesive which readily penetrates into the mesh on the fitting surface of the bracket. Archwires performed in the shape of the dental arches are used to align the teeth and these are secured to the brackets by means of elastic ligatures.



### *Procedure for fitting of fixed orthodontic appliance*

Any extractions required as part of the orthodontic therapy were carried out at least one week prior to the fitting of the fixed appliances. Patients had fixed appliances placed on either one or both arches. The procedure for the fitting of the appliances was as follows:

- 1 *Tooth Preparation:* All of the enamel surfaces to be bonded are prepared by cleaning thoroughly with pumice and water, followed by drying with an air syringe.
- 2 *Enamel Etching:* An etching solution containing 36% phosphoric acid is applied to the enamel at the site where the brackets are to be placed for approximately 30 seconds. This is then rinsed thoroughly with an air water spray and then dried with clean dry air.
- 3 *Bracket Placement:* A sealant is applied to both the enamel surface and the bracket surface, and the adhesive containing the polymerisation catalyst is applied to the bracket. While maintaining continuous soft tissue retraction and positive saliva control, each bracket is placed in the appropriate position on the labial surfaces of the teeth. After 30 seconds the adhesive has sufficiently polymerised ensuring a firm mechanical bond between the bracket and the tooth surface.
- 4 *Placement and Sequencing of Arch Wires:* Arch wire placement involved placing the smallest diameter 0.012” nickel titanium archwire (Nitinol).

These arch wires are pre-formed, have a very high modulus of elasticity and have the quality described as 'shape memory'. This means that they will tend to return to their original shape after placement in the bracket slots, and being attached to the brackets bonded on the tooth surfaces they will tend to bring all the brackets, and therefore the teeth, into alignment. This first arch wire therefore will begin to exert aligning forces on the teeth from the moment it is ligated into the brackets. The wires were ligated into place with small rubber elastic ligatures which secure the arch wire in the horizontal wire slot of the bracket (see Figure 1).

- 5 *Post appliance fitting advice:* After placing the wire and ligating it to all the brackets, the ends that protrude past the last banded molar are cut flush with the end of the bracket tube using a special plier. Patients are given advice on management of the appliance, in particular with respect to oral hygiene, diet and pain including advice on analgesia if required. Patients will routinely be given wax to place on the brackets in case any minor irritation on the insides of the lips or cheeks occur. A soft diet is advised for two reasons: a) to avoid the dislodgement of the fine gauged arch wire or the newly placed brackets, and b) because the teeth are expected to be tender for the first few days after placement.

At subsequent appointments progressively larger wires are ligated into the brackets in order to progressively align, level and de-rotate any irregularly positioned teeth.

## *2.9 Data Analysis*

All analysis was carried out using SPSS statistical package for windows (SPSS, Inc,1993)

### *2.9.1 Analysing pain outcome*

Distribution of the worst pain (WP) reported by the children, on each day was tested using the Kolimogorov-Smirnov Goodness of Fit Test. Analysis revealed that worst pain on each of the first three days, the average pain over the first three days and the total days of pain reported by each child, belongs to a normal distribution, without significant kurtosis or skewness. However, from the forth day onwards, worst pain report is not normally distributed and there is significant skewness. For this reason average pain over the first three days is used as a measure of pain outcome in subsequent analyses.

Using Pearsons correlations worst pain report on days two and three correlate significantly, however pain report on day one does not correlate significantly with the other days of pain. This might indicate that taking an average of pain on days two and three would be a better measure of acute pain. To exclude pain report on day one from the analysis may however produce a bias average pain score and an average over three days may produce a more balanced and fair score. This may be particularly true given that times of fitting of the appliance varied throughout the day.

Some individuals had appliances fitted early morning, allowing for up to thirteen hours to intervene before they reported their pain for day one (based on recording at 10pm). Other children had appliances fitted late in the afternoon which would mean that they would be reporting their worst pain for day one up to five hours after fitting of the appliance (based on recording at 10pm). Due to this variation in time of reporting after fitting the last day on which pain is reported may also be affected and children may continue to report pain for a day longer than other children purely because of the fact that their appliance was fitted late in the afternoon and therefore they have not had their brace on as long. An average over the three days would therefore help to accommodate this difference.

In this study pain outcome is defined in this study in four ways.

- 1) Expected pain
- 2) Mean pain over three days (taking the worst pain scores for each day).
- 3) Number of words chosen.
- 4) number of days pain

### *2.9.2 Analysis used to examine the relationship between pain report and psychological variables*

Independent samples t-tests were used to initially identify whether there were significant gender differences in pain report. Differences in pain report in children

who had appliances fitted on one arch (either lower or upper teeth) compared to children who had appliances fitted to both arches (upper and lower teeth) were also examined using t-tests. In order to examine the relationship between pain report and the various psychological factors, Pearson correlations were carried.

### ***2.9.3 Examining predictors of pain report***

Linear stepwise multiple regression was used in order to find which of the child and parental psychological factors examined best predicted pain report over 1) the initial three days of wearing the appliance; 2) the total number of days that pain was reported for.

## ***2.10 Design: Study 2***

Study 2 uses a randomised control trial design to investigate the value of enhancing control/coping of pain in patients having fixed appliance orthodontic treatment.

### ***2.10.1 Criteria for subject selection***

A group of 6 children were, as far as possible, randomly selected from the pool of twenty nine children to participate in the experimental group. Six subjects from study one were matched as far as possible in terms of age and sex to the experimental group and used as controls. It was intended that every third child participating in the

study would be assigned to the experimental group in which strategies to help cope with pain would be given. However practically this was not possible. Instead, the first six children who were having appliances fitted while I was present at the clinic and who had previously agreed to take part in the study were selected for the experimental group. Whilst not a truly random sample this was considered to be acceptable enough to make the study valid. Ideally subjects would have been matched on more variables such as locus of control, anxiety and self esteem however this was not possible due to the small sample size.

### *2.10.2 Procedure*

Children selected for the experimental group completed the pre-treatment questionnaires in an identical order to that described in study one. After having had their braces fitted, children in the experimental group were taken into a side room of the clinic and a standard passage was read from a protocol. This explained that children who have braces fitted sometimes feel some discomfort which may last for a couple of hours or a few days but that there is quite a lot of difference between children. They were also told that if we can find ways of controlling our discomfort it often helps to make it feel better. The children were then asked about ways in which they had relieved discomfort in the past, for instance when they had a sore stomach, head, or when they had cut themselves. The aim of this was to provide insight into previous coping strategies used by the children and also to cue them into thinking about ways of coping. If the children simply reported that they would take

pain killers they were asked what they would do if they did not have pain killers. The children were then given a list of extra things that children often do when they feel sore and it was suggested that they might like to try some of the strategies if and when they felt sore over the next few days. The list which the children took home with them was comprised of suggestions of positive self talk, distraction techniques, the use of imagery and the use of relaxation.

Children in the experimental and control groups were asked to complete their dairies until they experienced no more discomfort or pain.

### *2.10.3 Data Analysis*

T-tests were carried out to examine whether or not there was a statistically significant difference in pain report between children in the experimental group, who had been given additional information on coping strategies and children in the control group who had not. The experimental and control groups were also compared on their use of analgesics.

### 3. RESULTS

#### 3.1 EXPECTED PAIN

##### *3.1.1 The relationship between expectation of pain and reported pain*

Expectation of pain and actual pain report were examined in order to find out whether children who expected to experience more pain actually reported more pain once their appliance had been fitted.

Table 1. Pearson correlation coefficients between 1) expected pain and worst pain for the first three days following orthodontic treatment; 2) expected pain and the total number of days pain was reported for.

	average pain over three days	number of days of reported pain
child's expectation of pain during fitting of the appliance	.4348 (n=28)*	.2446 (n=27)
child's expectation of pain whilst wearing appliance	.3869 (n=28)*	.1423 (n=27)
parental expectation of pain during fitting of the appliance	-.0892 (n=26)	.0158 (n=25)
parental expectation of pain whilst wearing appliance	-.0128 (n=26)	.0774 (n=25)

\* =  $p < 0.05$  (one tailed)

There was a significant positive correlation between child's expectation of pain during both fitting and wearing of the appliance and average pain report over the first



three days of wearing the appliance. This provides support for hypothesis 3. Parental expectations of their child's pain during fitting or wearing of the appliance does not correlate significantly with worst pain reported by the child. No significant correlations were found between the number of days that pain was reported for and either child, or parental, expectation of pain during fitting, or wearing, of the appliance.

***3.1.2 The relationship between child and parental anxiety and expected pain following fitting of appliance.***

The relationship between child and parental expected pain and anxiety was also examined using Pearson correlations.

Table 2: Pearson correlation coefficients between child anxiety and expected pain during fitting and wearing of the appliance.

	expected pain during fitting of appliance	expected pain of wearing appliance
child state anxiety	.4490 (41) **	.2369 (41)
child's trait anxiety	.3434 (41) *	.1698 (41)
parental state anxiety	.1882 (42)	.2828 (42)
parental trait anxiety	.0439 (42)	.1696 (42)

\* = p<0.05 level

\*\* = p< 0.01 level

Analysis revealed that there was a significant positive correlation between child state and trait anxiety and expected pain during fitting of the brace. No other significant correlations were found. Further analysis using Pearson correlations showed that children's expectation of pain during fitting and wearing of the appliance correlated significantly with parental expectation of pain during fitting of the appliance but not during wearing.

### ***3.1.3 Relationship between child and parental anxiety***

The relationship between child and parental anxiety is shown in the table below.

Table 3. Pearson correlation coefficients between child and parental state and trait anxiety.

	child's state anxiety	child's trait anxiety
parental state anxiety	.1927 (38)	.2462 (38)
parental trait anxiety	.1601 (38)	.2057 (38)

Analysis of results revealed no significant correlation between either parental state or trait anxiety and the anxiety of the child. As would be expected parental state anxiety correlated significantly ( $p < 0.001$ ) with parental trait anxiety, and similarly the same relationship was found between child state and trait anxiety.

### 3.1.4 The relationship between worry and expected pain

Analysis using Pearsons correlations was also carried out to ascertain whether children who expect to experience more pain feel more worried about wearing an appliance.

Table 4: Pearson correlation coefficients between expected pain and child's report of how much wearing a brace will worry them.

	child's report of how much wearing a brace will worry them
child's expectation of pain during fitting of the appliance	.6257 (41)***
child's expectation of pain whilst wearing appliance	.5798 (41)***

\*\*\* =  $p < 0.001$

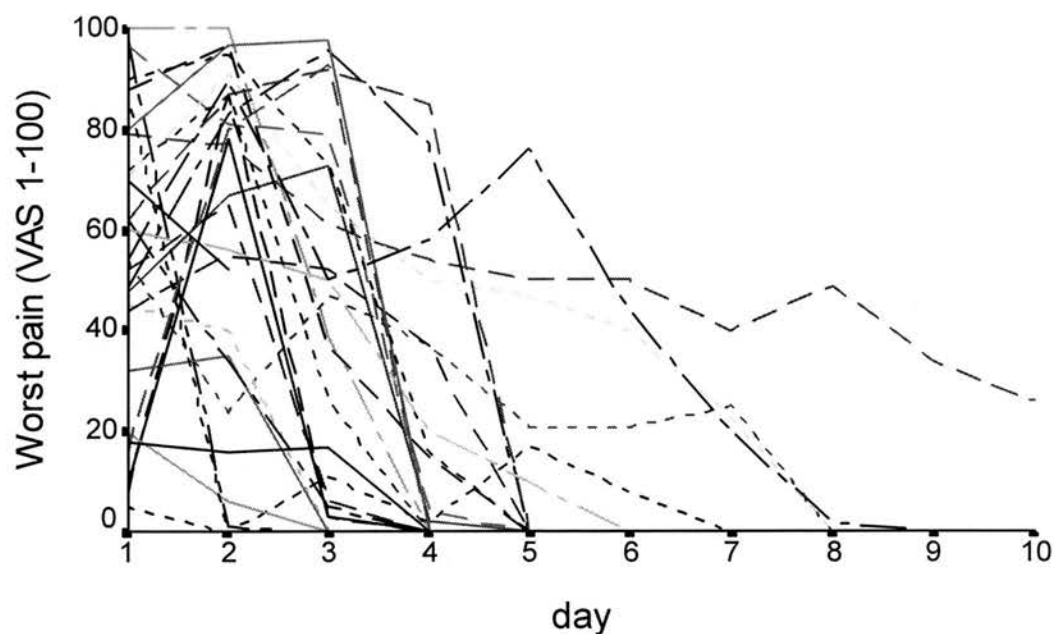
Results show that there is a strong significant positive correlation between how worried the child reports being about wearing an appliance, and the amount of pain they anticipate experiencing during both fitting and wearing of the appliance.

## 3.2 ACTUAL PAIN FOLLOWING FITTING OF APPLIANCE

### 3.2.1 Description of children's report of pain after undergoing fixed appliance orthodontic treatment

Descriptive statistics were carried out on the data obtained from the children's pain diaries. A measure of *worst pain* (WP) was taken from each day by taking the highest pain reported on the visual analogue scale (VAS) of either question 4 or 5 of the child's diary. Question 4 asked the child to "put a mark on the line that best shows the worst pain you have felt today". Question 5 asked the child to put a mark on the line that best shows how you feel now". Figure 1 shows worst pain by subject for the first ten days of wearing the appliance as measured by the VAS.

Figure 1: worst pain by subject for the first ten days of wearing the appliance.



As can be seen in Figure one, pain report ranged from 0-100 on the first day of wearing the appliance with the majority of children (n=19), reporting a worst pain score of >40 on the visual analogue scale on day one. Most children reported a significant decrease in WP between either days 2 and 3 of wearing the appliance or between days 3 and 4. By the fifth day of wearing the appliance the majority of children ( n=23) are reporting no pain with the exception of six individuals, one of whom goes on reporting pain up to day ten. Another child had his appliance removed after two days because, as his mother reported, “it was too painful.”

### ***3.2.2 The relationship between gender and pain report***

Independent samples t-tests comparing boys and girls average pain report, over the first three days of wearing their appliance, reveal no significant gender difference. Analysis also shows no significant age difference in the total number of days over which pain is reported for.

### ***3.2.3 The relationship between age and pain report***

Pearson correlations were carried out between age and 1) worst pain report over the initial few days; 2) the total number of days of pain. No significant correlations were found. It is therefore not surprising that independent samples t-tests revealed no significant difference in pain report between the two age groups.

### *3.2.4 The relationship between type of appliance and pain report*

Independent samples t-tests also showed no significant difference in pain report between the type of appliance fitted i.e. whether it was single or double.

### *3.2.5 The relationship between index of orthodontic treatment need (IOTN) and pain report*

Pearson correlations were carried out to investigate if the IOTN correlated with pain report of children over the first three days of orthodontic treatment. No significant correlations were found between pain report and either, index of orthodontic treatment need/health or, the index of orthodontic treatment need/aesthetic, indicating that the orthodontists perception of the severity of the malocclusion is not related to pain report.

Table 5: Means and standard deviations of pain reported during the first ten days of wearing their appliance for all the children who completed their pain diaries.

	(n)	mean	range	sd
worst pain day 1	29	54.21	0-100	34.74
<b>worst pain day 2</b>	<b>29</b>	<b>57.97</b>	<b>0-100</b>	<b>30.38</b>
<b>worst pain day 3</b>	<b>28</b>	<b>38.43</b>	<b>0-98</b>	<b>35.17</b>
<b>worst pain day 4</b>	<b>28</b>	<b>16.32</b>	<b>0-85</b>	<b>25.90</b>
worst pain day 5	28	7.89	0-75	18.83
worst pain day 6	27	6.04	0-50	14.62
worst pain day 7	27	4.00	0-40	10.23
worst pain day 8	27	1.89	0-49	9.42
worst pain day 9	27	1.26	0-34	6.54
worst pain day 10	27	.96	0-26	5.00

The above table shows the extent of the decrease in the mean pain report for the ten days following application of the brace. The greatest changes can be seen to occur between days 2 and 3, and days 3 and 4 of wearing the appliance.

**3.2.6 The day on which children experienced their greatest pain**

Table 6: Percentage of children reporting that they experienced their greatest pain on each day.

	day 1	day2	day3	day 4	day5	days 6-10
% of children who report that their worst pain was on each day.(n=28)	39 (n=11)	39 (n=11)	14 (n=4)	0 (n=0)	4 (n=1)	0 (n=0)

As can be seen in the above table over three quarters of children reported that they experienced their worst pain on day one or two. All but one of the remaining children reported that they experienced their worst pain on the third day. One child reported experiencing no pain on any day.

Table 7: Means and standard deviations of the average pain reported over the first three days of wearing the appliance and the total number of days over which pain was reported.

	mean (n=28)	sd
average worst pain over first three days	48.75 (28)	26.57
total number days of pain	3.56 (28)	2.41

The above table shows children reported on average between three and four days of pain. The average worst pain reported over the first three days was a score of 50 on the visual analogue scale.

**3.3 Use of analgesics**

The percentage of children who used analgesics to relieve pain caused by the appliance can be seen in Table 8

Table 8: Percentage of children reporting use of analgesic on each day.

	day1	day2	day3	day4	day 5	day 6 -
% of children reporting use of analgesic (n=29)	59 (n=17)	43 (n=12)	21 (n=6)	21 (n=6)	4 (n=1)	0 (n=0o)

Over half of the children reported use of analgesic during the first day of wearing their appliance. Analgesics used were calpol, aspirin and paracetamol. After day two there was a 50% decrease in the amount of children who were taking analgesics and by day five only one was taking medication to relieve pain.



### 3.4 Number of words children use to describe their pain

Children were asked to chose from a group of 45 words the words which, “best describe the way it feels when you are hurt or in pain”.

Table 9: Means and standard deviations of the number of words used to describe pain on each day.

	mean	sd
words used to describe pain day 1	8.00 (29)	6.43
words used to describe pain day 2	7.31 (29)	6.94
words used to describe pain day 3	6.36 (28)	7.38
words used to describe pain day 4	3.04 (28)	4.19
words used to describe pain day 5	1.50 (28)	3.52
words used to describe pain day 6	1.11 (28)	3.03
words used to describe pain day 7	1.07 (27)	3.01
words used to describe pain day 8	.30 (27)	1.35
words used to describe pain day 9	.04 (26)	.20
words used to describe pain day 10	.04 (27)	.19

As can be seen there was a steady decline in the number of words used to describe pain as time went on. Analysis using Pearson correlations showed a significant positive correlation ( $p < .001$ ) between number of words used to describe pain on the first three days of wearing the appliance and worst pain report on these days. This

finding provides additional support for the use of the visual analogue scale as a useful measure of reported pain.

**3.5 Situations in which the children reported that their pain seemed worse.**

Each day on which the child reported some pain, they were asked to identify, from a list of 21 different situations, the situations in which their pain seemed worse. Their responses are summarised in the table 10.

Table 10: Percentage of children who reported at some stage during their pain report that their pain seemed worse in the above situations.

situation	% of children (n=29)	situation	% of children (n=29)
at home	24.14	upset	7 (n=2)
at school	20.70	eating	90 (n=26)
out with friends	0.00	playing	10 (n=3)
with boys	0.00	reading	3 (n=1)
with girls	0.00	watching TV	14 (n=4)
sad	17.24	tired	21 (n=6)
angry	13.79	anxious	10 (n=3)
arguing	27.59	bored	14 (n=4)
busy	3.45	in bed	41 (n=12)
lonely	10.35	happy	3 (n=1)

As can be seen in the above table the vast majority of children reported that their pain seemed worse when they were eating. Just under a quarter of children reported that their pain seemed worse when they were arguing or at home and slightly less (1 child less) indicated that being at school or being tired made pain seem worse. Less

than a fifth of children said that their pain seemed worse when they were sad. None of the children reported that their pain seemed worse when they were out with either boys or girls.

### **3.6 Children’s motivation to receive orthodontic treatment.**

#### **3.6.1 Relationship between motivation to receive treatment and pain report**

Pearsons correlations revealed no significant correlation between worst pain and the extent to which children or their parents perceived orthodontic treatment to be their own idea or the idea of the orthodontist

As an indicator of motivation to continue wearing the brace despite pain children were asked on each day during which they reported some pain. “Do you think it is worth having sore teeth for a while”. The child was asked to choose from four responses ranging from very much worth it to not at all worth it. Table 11 shows the percentage of children who chose each response on any of the days during which they reported some pain.

Table 11: Summary of responses to question 6 “Do you think it is worth having sore teeth for a while”.

	% of children choosing response on at least one day (n=29)
very much worth it	59 (n=17)
quite worth it	31 (n=9)
a little bit worth it	28 (n=8)
not worth it at all	0 (n=0)

Over half the children reported, on one or more days, that it was very much worth having sore teeth for a while. Just under a third of children reported, on one or more days that it was quite worth it while a slightly smaller number reported that it was a “little bit worth it”. No child reported that there soreness was not worth it at all.

Children were also asked on each day during which they reported some pain to identify from four possible responses what made any pain worth while. The responses which could be selected were not being teased, having straight teeth and looking better. Table 12 shows the percentage of children who chose each response on any of the days during which they reported some pain.

Table 12: Summary of responses to question 7 “Which of the following make it worthwhile.”

	% of children choosing each response (n=29)
not being teased	4 (n=1)
having straight teeth	70 (n=20)
looking better	28 (n=8)

The vast majority of children reported, on one or more days, that having straight teeth was what made any soreness worth while. Less than a third of children reported that looking better made any soreness worth while. Only one child reported that not being teased was what made soreness worth while.

### 3.6.2 Relationship between motivation to receive treatment and worry

The relationship between motivation to receive treatment and worry was also examined and the results of the analysis using Pearson's correlation's can be seen in the table below.

Table 13: Pearson correlation coefficients between expected pain and child's report of how much wearing a brace will worry them.

	child's report of how much wearing a brace will worry them (n=41)
child's perception of extent to which having teeth straightened was their idea	-.1707
child's perception of extent to which having teeth straightened was their parents/families or friends idea	.3402*
child's perception of extent to which having teeth straightened was their dentists idea.	.0598

\* =  $p < 0.05$

There is a significant positive correlation between how much children report that their appliance will worry them and the children's perception of the extent to which having teeth straightened was their parents/families or friends idea. If children perceive that having their teeth straightened was largely the idea of their parents/family or friends they are likely to report being more worried about wearing an appliance.

### 3.7 Relationship between children's reported pain and anxiety measures

Table 14 shows the relationship between child and parental anxiety and, 1) the average worst pain report over the initial three days; 2) the total number of days pain reported.

Table: Pearson correlation coefficients between child and parental anxiety and reported pain. (one tailed).

	average pain over 3 days	total number of days pain reported
child state anxiety	.1317 (28)	.0130 (27)
child's trait anxiety	.3319 (28)*	.1445 (27)
parental state anxiety	-.1244 (26)	.4236 (25)*
parental trait anxiety	-.0669 (26)	.4973 (25)**

\* =  $p < 0.05$  (one tailed)

Analysis revealed a significant positive correlation between child trait anxiety and actual pain report over the initial three days. This provides some support for hypothesis 1. However child trait or state anxiety did not correlate with the number of days over which pain was reported. Although parental state or trait anxiety did not correlate significantly with the average actual pain over the initial three days, a significant positive correlation was found between parental anxiety and the number

of days that pain was reported for. This provides some support for hypothesis 2. Parental anxiety therefore appears to be the crucial factor which differentiates those children who experience pain only for a few days and those who go on to experience it for longer. Although not significant it there was a negative relationship between child internal locus of control and average pain report over three days, indicating that children who have a high internal locus of control may report less pain, although not significantly so.

### ***3.8 The relationship between locus of control and pain***

The relationship between the seven subscales of the Orthodontic Locus of Control Scale and actual pain report over the initial three days was examined using Pearson Correlations.

Table 15: Pearson correlation coefficients between the average worst pain over the initial three days and child and parental locus of control.

locus of control subscale	average pain over three days
child internal locus of control	-.2448 (28)
child chance locus of control	.4144 (28)*
child external (parent) locus of control	.0768 (28)
child external (dentist) locus of control	.2062 (28)
parental internal (parent) locus of control	.0875 (26)
parental chance locus of control	.0243 (26)
parental external (dentist) locus of control	-.0885 (26)

\* =  $p < 0.05$  level

3.9 The results show that there is a significant positive correlation between average pain reported over the initial three days and child's chance locus of control. The higher children score on the chance locus of control scale the higher their average worst pain report in the first three days. No other correlations are significant. Pearson correlation coefficients were also carried out between the total number of days of reported pain and child and parental locus of control, however, no significant correlations were found.

### 3.10 SELF ESTEEM

#### *3.10.1 The relationship between self esteem and pain*

Pearson correlations were used to examine the relationship between the six subscales of the Harter Self Esteem Questionnaire and pain report over the initial three days.

Table 15: Pearson correlation coefficients between average worst pain on the first three days of wearing the appliance and subgroups of the Harter Self Esteem Questionnaire.

self esteem subscale	average pain over three days
physical appearance	-.6401 (28)***
athletic competence	-.5179 (28)**
scholastic performance	-.4894 (28)**
behaviour	-.3408 (28)
global self esteem	-.3950 (28)*
social acceptance	.0854 (28)

\* =  $p < 0.05$

\*\* =  $p < 0.01$

\*\*\* =  $p < 0.001$



Analysis by Pearson correlation shows that there is a significant negative correlation between the physical attractiveness, athletic competence, scholastic performance and the global self worth subgroups of the Harter Self Esteem Questionnaire. Children who have a lower score on these subgroups of the self esteem measure i.e. consider themselves to be not very physically attractive, athletically competent, good at their school work or who have a low global self esteem on average report more pain over the first three days of wearing the appliance. Further analysis revealed that there were no significant correlation's between any of the self esteem subscale scores and the number of days that pain was reported for.

### **3.10.2 The relationship between self esteem and age**

In order to ascertain whether there were any differences in self esteem between the age groups, independent t tests were carried out. No significant differences were found.

### ***3.10.3 The relationship between IOTN and physical attractiveness***

The relationship between index of orthodontic treatment need and the physical attractiveness subscale of the Harter Self Esteem Questionnaire was also investigated using Pearsons correlations. No significant correlation was found indicating that children don't necessarily perceive themselves to be physically unattractive even if the orthodontist perception that their need for orthodontic treatment for aesthetic reasons to be high.

### 3.11 *The relationship between pain and family environment.*

In order to ascertain whether subscales of the Family Environment Scale correlated with pain report Pearson correlations were carried out.

Table 16: Pearson correlation coefficients between subgroups of the family environment scale and average worst pain during the first three days and total days of pain reported.

subscale of family environment scale	average pain over three days	number of days of pain reported
expressiveness	.3735 (26)	.0998 (25)
family cohesion	.2671 (26)	-.0488 (25)
organisation	.2694 (26)	-.1374 (25)
cultural and intellectual orientation	-.1200 (26)	-.4680 (25)*
conflict	.0555 (26)	-.1354 (25)
control	.0280 (26)	-.1594 (25)
active-recreational orientation	.2231 (26)	-.2966

None of the subgroups of the family environment scale correlated significantly with children's actual pain report over the first three days of wearing the appliance. There was however a significant negative correlation between the cultural and intellectual subgroup of the FES and the total number of days over which pain was reported. A negative trend between all except one (expressiveness) of the subgroups of the family environment scale and the total number of days that pain was noted.

### ***3.12 Predictors of pain report***

Linear stepwise multiple regression was used to establish the predictors of 1) children's average worst pain report over the initial three days of wearing the appliance 2) the number of days of pain reported by the children.

#### ***3.12.1 Predictors of children's worst pain report over the initial three days***

Average worst pain over the initial three days of wearing the appliance was again taken to provide an measure of acute pain. The seven variables which correlated significantly with average worst pain report over the initial three days, were considered. These variables were as follows; the athletic competence, global self esteem, physical attractiveness and scholastic performance subgroups of the Harter self Esteem questionnaire; the child chance locus of control subgroup of the Orthodontic Locus of Control Questionnaire; the child's expectation of pain during fitting of the appliance, the child's expectation of pain during wearing of the appliance (as measured on the visual analogue scale) and child trait anxiety as measured by the STAIC Form-Y2. Child trait anxiety, expectation of pain during fitting and wearing of the appliance and child scholastic achievement were excluded as they were found not to make a significant contribution to the equation.

Table 17: Variables in the equation and the multiple correlation coefficient, R square, final equation Beta and Significant T values.

Variables in the equation	multiple R	R square (x100)	Final equation Beta	Sig T
child locus of control (chance)	0.414	17.2	0.304	0.023
physical attractiveness	0.702	49.3	-0.389	0.011
athletic competence	0.765	58.5	-0.335	0.016
global self esteem	0.816	66.5	-0.2955	0.028

After regression four variables remained which explain 67% of the variance in worst pain report over the initial three days. These variable were , in order of significance, the physical attractiveness and athletic competence subscales of the Harter Self Esteem Questionnaire, the child chance locus of control subgroup of the Orthodontic Locus of Control Questionnaire, and finally global self esteem as measured by the Harter Self Esteem Questionnaire. Self esteem measures by themselves were found to explain nearly half of the variance in pain report. These psychological factors have therefore been identified as possible predictors of the acute pain reported by children undergoing fixed appliance orthodontic therapy.

### ***3.12.2 Predictors of the number of days pain reported by children under going fixed appliance orthodontic therapy.***

Multiple linear stepwise regression was carried out in order to find out predictors of the number of days of pain reported. The three variables which correlated

significantly with the total number of days over which pain was reported were considered. These were parental state and trait anxiety as measured by the STAI forms Y1 and Y2 respectively and the cultural and intellectual orientation subscale of the family environment scale. Parental trait anxiety was excluded as it was found not to make a significant contribution to the equation. The two variables remaining in the final equation were parental state anxiety and the cultural and intellectual subscales

Table 18: Variables in the equation and the multiple correlation coefficient, R square, final equation Beta and Significant T values.

	multiple R	R square (x100)	Final equation Beta	Sig T
parental state anxiety	0.424	17.9	0.433	0.01
cultural and intellectual orientation	0.638	40.7	-0.477	0.01

Final analysis revealed that two variables parental state anxiety and the cultural and intellectual subgroup of the family environment scale explained 41% of the variance in total days of pain reported by the children. Differences in cultural and intellectual orientation explained the most variance accounting for almost a quarter of the total variance in number of days pain report.

Parental trait and state anxiety correlate very significantly ( $p < .001$ ), therefore parental trait anxiety may have been excluded from the initial equation by

the effect of the presence of parental state anxiety. Further analysis was therefore carried out by removing parental state anxiety from the equation and inserting parental trait anxiety.

Table 19: Variables in the equation and the multiple correlation coefficient, R square, final equation Beta and Significant T values.

	multiple R	R square (x100)	Final equation Beta	Sig. T
parental trait anxiety	.497	24.7	.472	.073
cultural and intellectual orientation	.664	44.8	-.441	.113

Analysis revealed that the two variables parental trait anxiety and the cultural and intellectual subgroup of the family environment scale explained 45% of the variance in total days of pain reported by the children. Parental anxiety accounted for just over half of this figure. Including parental trait anxiety in the regression equation rather than parental state anxiety is probably more valid due to the fact that some parents completed their STAI questionnaire some weeks before their child's appliance was fitted whereas others completed it as their child was undergoing orthodontic treatment. As state anxiety is by its very definition supposed to be sensitive to the influence of situational factors, variations in state anxiety would be expected depending on when and where the questionnaire was completed. Placing too much emphasis on state anxiety may not be very wise in this study in which it has been measured inconsistently.

There seem to be different psychological factors predicting the acute pain reported by the majority of the children and the more long lasting or chronic pain reported by a small minority of children. Predictive factors become more external and more to do with parental anxiety and certain aspects of the family environment when pain report continues for over three or four days.

**3.13 Study 2: Enhancing control /coping in patients having fixed appliance orthodontic therapy.**

In order to try and establish whether providing children with positive coping strategies affected pain report, t-tests for independent samples were carried out between the experimental (n=6) and control groups (n=6). Children in the experimental group had been given information on strategies to help cope with pain. Children in the experimental group had not been given this additional information.

Table 20: Independent t-tests between pain report in the experimental group and the control group, t and p values.

	mean exp group	mean control group	t	p value (2 tailed)	df
average worst pain report over initial three days	55.83	45.00	.71	.493	10
days pain	5.16	4.33	.25	.811	9

\*= significant at 0.05 level (two tailed)

Analysis of the two groups showed no significant difference between the experimental and control groups average worst rating of pain report over the initial three days of wearing an appliance. Results also show no significant difference in the number of days of pain reported by the two groups. Providing children with additional information on how to cope with pain did not therefore have the effect of reducing pain report in this sample group.

Analgesic use in the groups was also examined, to establish whether or not children who had been given additional information on psychological coping strategies used any less analgesics than children who did not receive this information. No differences were found however.



## 4. DISCUSSION

### *4.1 Summary of results*

The study fulfilled its aims to: 1) examine the relationship between psychological factors and pain report in children undergoing fixed appliance orthodontic therapy; 2) to identify the specific factors which help to predict actual pain report; 3) to investigate the use and value of enhancing children's control/coping with pain when they have fixed orthodontic therapy.

One of the most interesting findings was that the psychological factors which influence the acute dental pain reported in the few days following orthodontic treatment, are different from those influencing pain longer lasting pain. Pain report over the initial few days appeared to be influenced by factors internal to the child (self esteem, locus of control, trait anxiety and expectation of pain), however as time went on external factors became more important (family environment and parental trait and state anxiety). Self esteem was found to have a major influence over the acute dental pain reported within the first few days. Three of the subscales from the Harter Self Esteem Questionnaire: physical attractiveness, athletic competence and global self esteem were found to account for a substantial amount of the variance in pain report over the initial three days. The extent to which children attributed their orthodontic status and treatment to chance also contributed significantly to the variance in pain report over this time period. Other factors which correlated with pain report over the initial few days were the scholastic performance subscale of the

Harter Self Esteem Questionnaire, and the child's expectation of pain both during and after fitting of the appliance.

With regard to variables influencing the length of time that pain was reported for, parental state anxiety and the cultural-intellectual orientation of the family as a whole were found to contribute significantly to the variation in how long pain was reported for. Parental trait anxiety also correlated significantly with the number of days over which pain was reported. Possible explanations for these findings are discussed.

Children reported on average between three to four days of pain after having had their appliances fitted. A minority of children however went on to experience pain for longer and the reasons why this might have been the case are discussed later in this text. Only three children reported pain after seven days which is considerably less than that reported in the recent study by Scheurer (1997), where a quarter of patients reported discomfort after seven days. The present study found no significant age effect on pain report. Some previous studies have indicated that older adolescents (14-17 years ) report more pain than the younger adolescents (11-13 years ) undergoing the same fixed appliance orthodontic therapy (Brown, 1991). However the lack of age effect found in the present study may not be that surprising given the relatively small sample size and the small age range of children who took part in the study. With regards to gender differences, boys and girls did not differ significantly in their pain report. Previous research looking at differences in pain

report between the sexes have been somewhat inconclusive (Schechter et al 1991; Grunau & Craig, 1987; Ross & Ross, 1984).

## ***4.2 The influence of psychological factors on pain report***

### ***4.2.1 Motivation to receive treatment***

The role of motivation to seek orthodontic treatment as a factor which may influence pain report has not been examined in previous research. The present study found no significant correlation between pain report and whether having a brace fitted was primarily the idea of the child, the dentist, or the parents. However, children who reported that having treatment was their own idea tended to report that wearing a brace would not worry them very much. Children who perceived that having their teeth straightened was their parents/families or friend's idea tended to report that they would worry more about their orthodontic treatment. It is also interesting to note that the only subject who discontinued treatment and had his appliance removed was one of only two cases where both child and parent reported that having an appliance fitted had not been their idea and had been totally the idea of the dentist. In this particular case, the child did not report a level of pain which was exceptional in comparison to the other children, nor were any of his scores on any of the other measures exceptional, most being close to the mean. His mother did however report that intense pain was the reason for discontinuation of treatment . This might indicate that child and parental motivation to receive treatment may be the most important factor influencing, not pain report per se, but whether or not they will persevere with treatment. A child who has doesn't really feel the need for treatment

is perhaps far less likely to tolerate even a moderate amount of pain than a child who really wants orthodontic treatment. Further research in this area would however have to be carried out in order to validate this assertion.

Motivation to persevere with treatment was also assessed in the pain diary by asking the children about how worthwhile they considered any pain to be and what made the pain worthwhile. The vast majority of children reported that, any pain was either very much worth it or quite worth it, for the primary reason of having straight teeth. Less than a quarter of children said that “looking better” was what made the pain worth while. In hindsight it is perhaps not surprising that more children did not chose this response given that at the time they would have been wearing their appliance and were therefore not “looking better”. Also by indicating that the pain was worthwhile so that they could have straight teeth, the assumption may have been made that this would make them look better. In other words “having straight teeth” may have been seen as a more specific response than simply “looking better”. Only one child indicated that “not being teased” would make any pain worthwhile. This may simply reflect the fact that any teasing which had occurred prior to having the appliance fitted, continued once the child was wearing the appliance and therefore the response “not being teased” would not be relevant at that time. A response of “not being teased, once treatment is complete and my brace is off”, may be helpful in future studies of this nature.

#### *4.2.2 The role of expectation*

There was a strong significant correlation between children's expectation of pain and how much they reported wearing a brace would worry them. Therefore, children who expected to feel a lot of pain reported that they would worry a lot about wearing the brace once it had been fitted. This could indicate that children were primarily worried about wearing the appliance because of their anticipated pain. Alternatively the result may suggest that children who tend to worry in general, would be inclined to worry about wearing the appliance for many reasons, only one of which may be anticipated pain.

Children's expectations of pain during both fitting and wearing of their appliances correlated significantly and positively with their average pain report taken over the first few days, providing some support for Hypothesis 3. Children who expected to experience more pain therefore tended to report more pain. Although expectation of pain in children undergoing fixed orthodontic therapy has never previously been examined in relation to pain report, results are consistent with other research which has examined pain report in children undergoing various other medical procedures.

#### ***4.2.3 The role of anxiety:***

Children's trait and state anxiety was found to correlate with their *expectation* of pain during fitting of the appliance. A significant positive correlation was also found between children's trait anxiety and *actual* pain report over the initial three days. This supports previous research which has highlight the importance of anxiety as a factor influencing pain report in medical and dental situations (Gatchel, 1992; Litt, 1994, Klepac et al, 1982; Bernstein et al, 1979), although anxiety and pain report in children undergoing fixed appliance therapy has not to date been examined. Although significant, the correlation between child trait anxiety and pain report over the initial few days was perhaps not as strong as may have been predicted. One possible explanation for this may be that previous research has tended to examine pain reported subsequent to relatively invasive or traumatic procedures, over which the child has had little control and which have been necessarily primarily for health reasons rather than for aesthetic reasons. Neither parental state or trait anxiety correlated with children's average pain report over the initial three days of wearing the appliance. Previous research has shown a link between parental trait anxiety and the pain behaviour of children in medical (Jay, 1983; Gil et al 1992) and dental situations (Johnson et al, 1968, 1969). An explanation as to why a correlation between parental anxiety and pain report was not found in the present study could be that in the overwhelming majority of case parents were not present in the room during the procedure. Parental anxiety would therefore have been less likely to be transmitted to the child during the actual procedure of fitting the appliance. It might also be reasonable to suggest that a correlation between parental anxiety and acute

pain report is often found due to parental influence on child's anxiety i.e. parental anxiety acts as a mediator for the child's anxiety, which in turn influences child's pain report. In the present study a correlation between child and parental anxiety was not however found, indicating that in this sample parental anxiety had no significant influence over child's anxiety or vice versa. This is perhaps a surprising finding in itself as previous research (Rachman, 1990 b) tends to indicate that there is a correlation between parental anxiety and child anxiety more generally, possibly as a result of learning. Of particular interest was the finding that both parental state and trait anxiety correlated with the total number of days of pain reported by children. Children whose parents report high state and trait anxiety therefore tended to report pain over a longer period of time than children whose parents report lower levels of anxiety. According to the research on the physiology of pain after fixed appliance orthodontic therapy, pain should be expected to last between 2 and 4 days (Proffit & Fields, 1986). It may be therefore, that parental anxiety is an important factor in maintaining children's pain report, when any physiological basis for pain report is no longer present. Certainly, research examining chronic pain indicates that parental response to pain can influence pain behaviour and report (McGrath 1990). There are several different explanations as to why this might have been the case. Parents who are more anxious may behave in such a way as to reinforce the child's pain behaviour and pain report, by for instance by continually seeking reassurance that their child is feeling okay and showing lots of sympathy and concern when the child reports that they are not, perhaps excusing them from their household chores or other undesirable activities. This explanation is based on the Operant Conditioning Model

(Fordyce, 1976), and helps to explain the persistence of pain behaviour, in the absence of a noxious stimulus. Another explanation could be that parental anxiety is transferred to the child over the course of a few days when the child had previously not reported particularly high anxiety themselves. The child's increased anxiety may then influence their pain report at that stage.

Further evidence for the role of parental anxiety in children's pain report was provided by analysis using multiple regression. Parental anxiety was found to make a significant contribution to the variance in length of time for which pain was reported.

#### ***4.2.3 The role of locus of control***

Analysis revealed that the higher that children scored on the *chance* subscale of the Orthodontic Locus of Control scale the higher their average pain report over the first three days of wearing their appliance. This indicates that children who attributed control or responsibility for occlusal status and orthodontic treatment to chance factors tend to report more pain than children who attribute control and responsibility to other factors. This finding supports previous research in other areas of health psychology which has found that patients who view outcomes as controlled by chance factors such as luck or fate rather than internal control., tend to rate their ability to control and decrease pain as poor (Crisson, 1988).



Further more, it was interesting that there was a negative relationship between child *internal* locus of control and pain report over the three days and although this result was not significant it does add to the above argument. A tentative suggestion may therefore be made that when children attribute control or responsibility for occlusal status and orthodontic treatment to internal factors over which they themselves have control they experience less pain. Further research is needed to examine this in greater detail.

Multiple regression revealed that children's chance locus of control score was one predictor of the acute pain report over the initial three days, accounting for just under a fifth of the variance in pain report over this time period.

#### ***4.2.4 The role of self esteem***

Four of the subscales from the Harter Self Esteem Questionnaire correlated significantly with average pain over the initial three days of wearing the appliance. The physical appearance subscale correlated most significantly indicating that children who consider themselves to be not very physically attractive report more pain whilst wearing the appliance than children who consider themselves to be more attractive. Previous research has examined self esteem in individuals undergoing orthodontic treatment however the relationship between esteem and malocclusion is unclear. It certainly seems to be the case however that most orthodontic treatment is carried out for aesthetic rather than functional reasons (Albino, 1985; Jenny 1986). Although self esteem in relation to pain report has not been examined in previous

research, research examining pain report in children of different ages has however found that older adolescents tend to report more pain than younger children. For example, in a study of individuals undergoing fixed appliance orthodontic therapy, Brown et al (1991), found that adolescents (14-17 years) generally reported higher levels of pain and lower levels of psychological well being than did pre adolescents (11-13 years) or adults (18 years and over). It has been suggested that this may be due to the greater psychological impact which wearing an appliance has, at a time in development when greater emphasis is placed on physical attractiveness and adolescents become particularly conscious of their appearance (Tierno, 1983). Although the present study found no significant difference between pain report in the two age groups (9-11) and (12-16) this may have been due to the small numbers of children in each group and the relatively large age range of children in the older group.

One's perception of our own physical attractiveness is in general known to be an important component of overall self esteem. The present study found that of all the subgroups of the Harter Self Esteem Questionnaire, physical attractiveness correlated most strongly with global self esteem. This supports previous research which has examined the relationship between the components of this particular self esteem questionnaire (Hoare, 1993). The present study supports the suggestion made in previous studies that differences in pain report may be influenced by differences in psychological adjustment to wearing an appliance, which it has been suggested may be due to differences in concern over appearance. The present study provides

evidence that self-perception of physical attractiveness may influence pain report in children undergoing fixed appliance orthodontic therapy. One explanation for this may be that children who consider themselves to be unattractive, may feel less confident about their appearance and may tend to worry more about what they look like. Wearing an appliance may increase their anxieties and cause distress. Pain report could then be an expression of this distress, translating feelings of anxiety, depression or perhaps even embarrassment from peers into a tangible physical problem. Previous research has indeed supported the view that reported pain can be a somatization of anxiety or depression (Elton et al, 1983). Future research examining pain report and mood state in children undergoing other dental or medical procedures which affect physical appearance may also be of interest and may help to substantiate this finding.

The three other subscales of the Harter Self Esteem Questionnaire which were found to correlate significantly with pain report over the initial three days were athletic competence, scholastic performance and global self esteem. Previous research has found that athletic competence is a particularly important component of self esteem particularly in boys (Hoare, 1993). Also, this facet of self esteem may have been particularly prominent at the time over which the research was carried out as the vast majority of children had their braces fitted in the summer, which it could be argued is a time when greater emphasis is placed on playing sports outside. Similarly many of the children taking part in the study were in the process of sitting, or had just

completed end of term exams. This may have made scholastic performance a particularly prominent aspect of self esteem influencing pain report.

Further evidence for the importance of components of self esteem as variables influencing pain report in children undergoing fixed appliance orthodontic therapy was provided by further analysis using multiple regression. Multiple regression identified physical attractiveness, athletic competence and global self esteem as being predictors of the acute pain reported over the initial three days, accounting for nearly half of the variance in pain report over this time period.

#### ***4.2.5 The role of family environment***

The role of the family environment has not been examined previously in relation to pain report in children undergoing fixed appliance orthodontic therapy. Research with children suffering from chronic pain suggests that family factors may influence pain report, although the nature of this influence has not been examined in any detail. One might anticipate however that in a home environment in which there is a lot of tension or conflict children are under greater stress and may report more pain as an expression of this distress. Similarly one also might anticipate that in a family which is cohesive and supportive, the home environment may be less stressful and therefore children would report less pain. In a home environment in which emphasis is placed on recreational activities, one might also anticipate that pain report would be lower as children who engage in lots of activities may be more distracted from any pain. In a family in which individuals express themselves openly a lot, it might be anticipated

that pain report would be high, not necessarily because they experienced more pain but because they were more used to expressing the way they feel about things in general.

Although none of the above mentioned subscales correlated significantly with pain report over the first three days or with total number of days of pain report, when correlated with total number of days of pain a trend emerged in the direction which might have been anticipated. This may indicate that after the first few days of acute pain family factors may start to play a greater role in influence over pain report. Future research with greater numbers of subjects could examine this further in order to ascertain whether or not this is in fact the case.

One subscale, the cultural and intellectual subscale, did however correlate significantly with number of days pain reported although not with the average pain over the initial three days. Children of families who are more culturally and intellectually orientated tend to report fewer days of pain than children from families where less emphasis is placed on cultural and intellectual activities. This is interesting as it suggests that cultural factors may become a more important influence on children's pain report as time goes on and the child has moved out of the initial acute pain stage into the more chronic phase, in which physiological factors should no longer be playing a significant role in influencing pain report. Previous research has indeed indicated the importance of cultural influences on pain report (McGrath 1993). The culture in which children grow up is likely to have an important role in

shaping what they learn about pain, how they express their pain and how they cope with pain. It should therefore come as no surprise that cultural factors play an important role in influencing pain report.

Further evidence of the importance of cultural- intellectual orientation was provided by analysis using multiple regression. Almost a quarter of the variance in the total number of days that pain was reported for was explained by differences in this subscale of the F.E.S.

#### ***4.3 Enhancing control /coping in patients having fixed appliance orthodontic therapy.***

Children who had been told that finding ways of controlling discomfort helps us to feel better and had also been given additional information on useful coping strategies (experimental group) did not differ significantly in pain report from the control group of children who had not received this additional information. There are numerous possibilities why this may have been the case and small sample size may well have made the effect of any one of these more prominent. Firstly children were given the information immediately after having their brace fitted. They may have been distracted, worrying about what they looked like for instance, or being in a rush to get home, and therefore may not have paid full attention when the additional information was given to them. Although they had the information to take home with them, there is no information as to whether or not they looked at it once at

home. There is therefore no guarantee that children used the coping strategies suggested to them, or that control was enhanced. In cases where children did take on board what was said, providing additional information with the aim of enhancing control may only have been useful for children who desired control. Previous research would certainly suggest that this is in fact the case (Baron, 1993). For children who do not actually desire control, telling them that by controlling our discomfort we can make our pain feel better, and suggesting ways in which they can gain this control, may have the effect of making them feel more anxious which in turn may increase their pain report. The examples of coping strategies provided may not have made may not have been the preferred coping strategies of the children taking part. Previous research has indeed shown that requiring individuals to adopt non preferred coping strategies can exacerbate stress (Burger, 1989; Miller, 1987). This explanation is however unlikely as children were specifically cued to think about coping strategies which they themselves usually found helpful. In addition, information about coping strategies was presented as a possible option which the child might like to try out rather than being something which they had to do.

Another possibility may be that these particular coping strategies were used by the children but weren't particularly helpful for the small number of children taking part in the experimental design. Given the range of different types of coping strategy suggested to the children it seems unlikely that none of the strategies would have been helpful. An alternative explanation may be that when children in the experimental group did use coping strategies, they used the coping strategies which

they would have used naturally prior to being given the additional information. Some of these strategies may well have been included in the information sheet as was indeed, often the case. Children in the control group may have been just as likely to use some of these strategies naturally as well. Asking children in both the control and experimental group about what strategies they did use may have clarified this. The finding that children in both groups used the same amount of analgesics may suggest that children who had been provided with the additional information on psychological coping did not use these methods any more than the control group.

#### ***4.4 Difficulties with subject recruitment***

Recruitment of subjects: Due to time limitations and the very nature of research in the area of health psychology, many difficulties were encountered in recruitment of orthodontal patients into the study. The main difficulty arose when it became clear that the number of subjects who were actually going to be coming for orthodontic treatment in the time available fell considerably short of the number that had initially been anticipated. For this reason the geographical band from which subjects were recruited had to be broadened and the number of orthodontists involved in the study increased. Individual orthodontists enthusiasm for the study then had to be relied upon more heavily, in order to recruit subjects successfully. Recruitment of patients in the summer was difficult for many reasons; 1) many children were either in the process of sitting exams or had just completed exams and therefore filling out questionnaires was not high on their list of priorities; 2) due to holidays appointments with dentists (for extraction of teeth) and with orthodontists for the



actual fitting of the brace were sometimes delayed. This meant that a number of children who had consented to take part in the study and had filled out the questionnaires did not have their appliance fitted in time to be included in the study (n=13).

An additional difficulty was that there was a heavy reliance on subjects good will and commitment to continue with the research once they had initially agreed to take part in the study, given that they were often relied upon to return in the first instance questionnaires and then at a later date diaries through the post.

#### ***4.5 Limitations of the study***

One limitation of the methodology was that due to time limitations, subjects who were recruited from Perth were first approached to take part in the study on the day on which they were having their appliance fitted. Parents therefore filled out the questionnaires while the children had their appliances fitted. Children often did not have time to complete their questionnaires before their appliance had been fitted. They were however asked to respond to the question relating to their anticipation of pain during fitting before their appliance was fitted. The times at which questionnaires were completed in relation to when the appliance was fitted therefore differed between Perth and Dundee. This may have influenced responding particularly on the state anxiety questionnaire as it might be anticipated that parents who completed the questionnaire weeks or even months before their child's appliance was fitted have a lower score than they may have had had been completing

the questionnaire at the orthodontic clinic while their child was having the appliance fitted. Similarly the child who fills out their state anxiety questionnaire weeks or months before their appliance is fitted may report a lower state anxiety than that which they may report once they are wearing their appliance. In addition individuals who were approached on the day may have been cued to worry about the fact that they might experience some discomfort by the nature of the study. In cases where children were enrolled in to the study weeks before hand this may not have been so prominent, alternatively it may have given them more time to worry and cued them to anticipate more pain. These difficulties were acknowledged at the time of the research but due to time limitations they could not have been avoided.

Again due to time limitations, it was necessary for seven orthodontists to participate in the study. Individual differences between orthodontists may also have influenced pain report by either relieving or exacerbating a child's anxiety about the procedure. Differing abilities to establish good rapport and to make children feel relaxed and secure may for instance be important, this assertion is certainly supported by the research.

There may also have been some bias in the subjects who agreed to take part in the study. It could for instance be that only reasonably well motivated subjects would agree to take part. This however is largely unavoidable.

Previous experience of dental treatment in both children and their parents is likely may have been an important factor influencing expectation of pain and anxiety in

particular. Previous research would certainly suggest that this is likely to have been the case. Unfortunately due to time limitations, previous dental experience was not examined in the present study. Future research in this area may however be useful.

With regards to study two, larger numbers of subjects would have allowed more accurate matching of factors other than simply age and gender.

#### ***4.6 Conclusions***

Psychological factors influencing pain report over the few days immediately after fitting of a fixed orthodontic appliance, tend to be internal to the child. As time goes on however the influence of external factors becomes more important. Children who have a poor self esteem, particularly a poor self-perception of their own physical attractiveness, are likely to report more pain in the initial few days of wearing their appliance. The reasons for this are unclear, although it is possible that pain report may be an expression of their distress and increased anxiety concerning their appearance. It may be that after a few days they begin to feel less anxious about their appearance as any concerns they may have about peer's reactions to their appliance do not materialise. Anecdotal evidence would certainly seem to suggest that the social stigma attached to wearing an appliance has decreased dramatically over recent years and by some children it is even desired as a status symbol. The child's locus of control also appears to be important, in that the greater the extent to which children consider orthodontic status and treatment to be due to chance factors the more pain in the initial three days. Where pain continues for longer than three or four

days parental anxiety seems to play an important role, possibly as a consequence of operant conditioning and the reinforcing properties of certain aspects of parental behaviour. Cultural factors also play an important role in the maintenance of pain report. The culture in which children grow up is likely to influence what they learn about pain, how we express pain and how they cope with pain.

It is likely that in the case of the child who discontinued treatment, that both child and mother were poorly motivated and perhaps didn't see the need for orthodontic treatment and therefore any pain was not tolerated.

#### ***4.7 Implications***

When children and parents are poorly motivated to receive treatment they may be at increased risk of discontinuing treatment. Care should therefore be taken when selecting patients for treatment to ensure that what is thought of as appropriate by the dentist is considered to be acceptable to child and parents. It may also be useful to identify children who have very poor self esteem prior to treatment. In extreme cases psychological help may then be necessary to help improve self esteem prior to treatment in order to reduce any psychological impact that treatment may have. Reduction of parental and child anxiety is always helpful in dental situations. Providing children and their parents with further information about the procedure may be helpful, as it may increase their understanding of the situation and possibly their sense of control. It may also help to reduce expectations of pain in cases where pain expectation is unrealistically high. This may help to reduce the level of pain

actually experienced. Much of this can be undertaken by dentists who recognise the role of psychological factors in this area and who are skilled to deal with such situations when they arise.

#### ***4.8 Future research***

Conclusions drawn from this study will need to be supported by further research using larger numbers of children undergoing orthodontic procedures and other procedures which involve a change in physical appearance. It may also be beneficial to examine in more depth, the usefulness of providing children with information on coping strategies. A longitudinal study examining changes in self esteem during the 18 -24 month period over which the child wears the appliance, and then subsequently once the appliance has been removed, would also be of interest. Identifying the psychological profiles of children who chose to discontinue treatment later on may be important, as it would save time and effort on the part of the child concerned and time and cost to the Health Service.

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## APPENDIX 1

## **Explanation Form for Children**

We are doing a project looking at the reasons why children get their teeth fixed, how they feel about wearing a brace and how well their brace works. When you come to get your brace fitted we will be giving you and lots of other children some questionnaires to fill out. Some of the questions will ask you about the way you feel about yourself. Then, once your brace has been fitted, we will give you a diary to take home so that you can write down how you feel about having your brace fitted and your experience of wearing it for the first week or so. We will also be giving some of you ideas about what to do if you feel sore once your brace has been fitted. It would be very helpful if you could send your diary back to me in the envelope provided as soon as you have completed it. About every six months when you come back to the dental hospital for an appointment, we will ask you to fill in one of the questionnaires again.

When you fill out the questionnaires there will be no right or wrong answers to any of the questions and it would be helpful if you could answer them as honestly as possible.

If you feel that you do not want to take part, that is okay, just let us know. It will not affect your treatment.

Tammy Spencer

## APPENDIX 2

## **Explanation Form for Parent**

Yourself and your child are invited to take part in a research project which looks at factors which may be important in delivering orthodontic treatment.

The following information is to help you understand what the research is about, and decide whether or not you want your child to take part. Be sure to ask questions you have about what you read here and we will do our best to explain and answer any questions you may have.

If you decide to take part in the study, we will be asking yourself and your child to fill out some questionnaires relating to both your views of your child's treatment and also about the kind of family your child lives in. When your child visits the dental hospital to get their brace fitted, four questionnaires will be given to yourself and your child. Whenever possible yourself and your child will be able to complete these questionnaires in natural breaks during treatment on the day of your visit. If these questionnaires are not completed by the end of your visit, the questionnaires can be completed at home. Your child will also be given a diary to take home so that they can write down how they feel about having their brace fitted and their experience of wearing it for the first week or so. We may also give your child some ideas about what to do if they feel sore once their brace has been fitted. We will be asking your child to return their diary in the envelope provided as soon as they have completed it. Approximately every six months thereafter, we will ask your child to repeat one of the questionnaires.

We hope that the information will enable us to provide better information to parents and patients requiring treatment like your child's. The information you give will remain confidential.

If you would like further information about the research then this can be obtained from the principle researcher, Miss Tammy Spencer, Department of Clinical Psychology, Edward Street, Dundee, DD1 5NS. Telephone: 01382 346025.

Taking part in this study is entirely voluntary and you are free to refuse to take part or to withdraw from the study at any time without having to give reason and without this affecting your future dental and orthodontic care.

Tammy Spencer

## APPENDIX 3

# WHAT I AM LIKE

Name \_\_\_\_\_ Age \_\_\_\_\_ Birthday \_\_\_\_\_ Class \_\_\_\_\_  
 Boy or Girl(Please Circle) Day Month  
 Child number \_\_\_\_\_

## SAMPLE SENTENCE

	Really True for me	Sort of True for me			Sort of True for me	Really True for me	
(a)	<input type="checkbox"/>	<input type="checkbox"/>	Some kids would rather play outside in their spare time	BUT	Other kids would rather watch T.V.	<input type="checkbox"/>	<input type="checkbox"/>
1.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids feel they are very good at their school work	BUT	Other kids worry about whether they can do their school work	<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids find it hard to make friends	BUT	Other kids find it's pretty easy to make friends	<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids do very well at all kinds of sports	BUT	Other kids don't feel they are good when it comes to sports	<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are happy with the way they look	BUT	Other kids are not happy with the way they look	<input type="checkbox"/>	<input type="checkbox"/>
5.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids often do not like the way they behave	BUT	Other kids usually like the way they behave	<input type="checkbox"/>	<input type="checkbox"/>
6.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are often unhappy with themselves	BUT	Other kids are pretty pleased with themselves	<input type="checkbox"/>	<input type="checkbox"/>
7.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids feel they are just as clever as other kids	BUT	Other kids aren't so sure and wonder if they are as clever	<input type="checkbox"/>	<input type="checkbox"/>
8.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids have a lot of friends	BUT	Other kids don't have very many friends	<input type="checkbox"/>	<input type="checkbox"/>

	Really True for me	Sort of True for me			Sort of True for me	Really True for me	
	<input type="checkbox"/>	<input type="checkbox"/>	Some kids wish they could be a lot better at sports	<b>BUT</b>	Other kids feel they are good enough at sports	<input type="checkbox"/>	<input type="checkbox"/>
10.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are happy with their height or weight	<b>BUT</b>	Other kids wish their height or weight was different	<input type="checkbox"/>	<input type="checkbox"/>
11.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids usually do the right thing	<b>BUT</b>	Other kids often don't do the right thing	<input type="checkbox"/>	<input type="checkbox"/>
12.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids don't like the way they are leading their life	<b>BUT</b>	Other kids do like the way they are leading their life	<input type="checkbox"/>	<input type="checkbox"/>
13.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are pretty slow in finishing their school work	<b>BUT</b>	Other kids can do their school work quickly	<input type="checkbox"/>	<input type="checkbox"/>
14.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids would like to have a lot more friends	<b>BUT</b>	Other kids have as many friends as they want	<input type="checkbox"/>	<input type="checkbox"/>
15.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids think they could do well at any new sport	<b>BUT</b>	Other kids are afraid they not do well at new sports	<input type="checkbox"/>	<input type="checkbox"/>
16.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids wish their body was different	<b>BUT</b>	Other kids like their body the way it is	<input type="checkbox"/>	<input type="checkbox"/>
17.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids usually act the way they know they are supposed to	<b>BUT</b>	Other kids often don't behave the way they're supposed to	<input type="checkbox"/>	<input type="checkbox"/>
18.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are happy with themselves as a person	<b>BUT</b>	Other kids are often not happy with themselves	<input type="checkbox"/>	<input type="checkbox"/>
19.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids often forget what they learn	<b>BUT</b>	Other kids can remember things easily	<input type="checkbox"/>	<input type="checkbox"/>
20.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are always doing things with a lot of kids	<b>BUT</b>	Other kids usually do things by themselves	<input type="checkbox"/>	<input type="checkbox"/>

	Really True for me	Sort of True for me			Sort of True for me	Really True for me	
21.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids feel they are better at sports than their friends	BUT	Other kids don't feel they can play as well	<input type="checkbox"/>	<input type="checkbox"/>
22.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids wish they looked different	BUT	Other kids like the way they look	<input type="checkbox"/>	<input type="checkbox"/>
23.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids usually get in trouble because of things they do	BUT	Other kids don't do things that get them into trouble	<input type="checkbox"/>	<input type="checkbox"/>
24.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids like the kind of person they are	BUT	Other kids often wish they were someone else	<input type="checkbox"/>	<input type="checkbox"/>
25.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids do very well at their classwork	BUT	Other kids don't do very well at their classwork	<input type="checkbox"/>	<input type="checkbox"/>
26.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids wish more people their own age liked them	BUT	Other kids feel that most people their own age do like them	<input type="checkbox"/>	<input type="checkbox"/>
27.	<input type="checkbox"/>	<input type="checkbox"/>	In games and sports some kids usually watch instead of play	BUT	Other kids usually play rather than just watch	<input type="checkbox"/>	<input type="checkbox"/>
28.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids wish something about their face or hair was different	BUT	Other kids like their face and hair the way they are	<input type="checkbox"/>	<input type="checkbox"/>
29.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids do things they know they shouldn't do	BUT	Other kids hardly ever do things they know they shouldn't do	<input type="checkbox"/>	<input type="checkbox"/>
30.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are very happy being the way they are	BUT	Other kids wish they were different	<input type="checkbox"/>	<input type="checkbox"/>
31.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids have trouble working out the answers in school	BUT	Other kids almost always can work out the answers	<input type="checkbox"/>	<input type="checkbox"/>
32.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are popular with others their own age	BUT	Other kids are not very popular	<input type="checkbox"/>	<input type="checkbox"/>



	Really True for me	Sort of True for me			Sort of True for me	Really True for me	
33.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids don't do well at new outdoor games	<b>BUT</b>	Other kids are good at new games right away	<input type="checkbox"/>	<input type="checkbox"/>
34.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids think that they are good looking	<b>BUT</b>	Other kids think that they are not very good looking	<input type="checkbox"/>	<input type="checkbox"/>
35.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids behave themselves very well	<b>BUT</b>	Other kids often find it hard to behave themselves	<input type="checkbox"/>	<input type="checkbox"/>
36.	<input type="checkbox"/>	<input type="checkbox"/>	Some kids are not happy with the way they do a lot of things	<b>BUT</b>	Other kids think the way they do things is fine	<input type="checkbox"/>	<input type="checkbox"/>

THANK YOU FOR YOUR HELP

## APPENDIX 4

### Orthodontic Locus of Control Scales (Children's Form)

	1	2	3	4	5	6
1) It is my own behaviour that will determine whether my teeth will be crooked as I become older.	strongly agree	pretty much agree	agree a little	disagree a little	disagree pretty much	strongly disagree
2) I am responsible for whether or not my teeth will be crooked as I become older.	1	2	3	4	5	6
3) The person involved plays a big part in determining how soon crooked teeth will become straightened.	1	2	3	4	5	6
4) The things I do play a big part in determining how soon crooked teeth will become straightened	1	2	3	4	5	6
5) Crooked teeth will only straighten out if the person involved does something about the.	1	2	3	4	5	6
6) I have more control than my parents over whether or not I get my teeth straightened by an orthodontist	1	2	3	4	5	6
7) The best way to keep teeth straight is by taking care of them myself	1	2	3	4	5	6
8) I can protect myself from having problems caused by crooked teeth	1	2	3	4	5	6

	strongly agree	pretty much agree	agree a little	disagree a little	disagree pretty much	strongly disagree
1) Luck plays a big part in how straight and well-spaced my teeth appear.	1	2	3	4	5	6
2) It is just bad luck if a persons teeth are crooked or do not come together properly.	1	2	3	4	5	6
3) I feel I have no control over whether or not I get my teeth straightened by an orthodontist	1	2	3	4	5	6
4) Good luck is the best way to keep teeth straight.	1	2	3	4	5	6
5) Crooked teeth will often straighten out by themselves as a person gets older.	1	2	3	4	5	6
6) There is nothing I can do to prevent problems caused by crooked teeth.	1	2	3	4	5	6
7) Fate will determine whether my teeth will be crooked as I become older	1	2	3	4	5	6
8) Luck plays a big part in determining how soon crooked teeth will become	1	2	3	4	5	6
9) It would not matter much whether or not a person does what an orthodontist tells him or her to do.	1	2	3	4	5	6

strongly agree      pretty much agree      a little disagree      a little disagree      pretty much disagree      strongly disagree

1) My dentist or orthodontist plays a big part in how straight and well spaced my teeth appear.      1      2      3      4      5      6

2) My dentist or orthodontist is responsible for whether my teeth will be crooked as I become older.      1      2      3      4      5      6

3) If a dentist told me I do not need braces, there would be nothing I could do about it, even though I thought my teeth were crooked, I would go along with what the dentist said.      1      2      3      4      5      6

4) I would do what an orthodontist tells me to do even if I don't agree.      1      2      3      4      5      6

5) If I see a dentist or orthodontist regularly, I am less likely to have problems caused by crooked teeth.      1      2      3      4      5      6

6) The best way to keep teeth straight is by going to a dentist or orthodontist      1      2      3      4      5      6

7) If a dentist told me I do not need braces, even if I thought my teeth were crooked, I would go along with what the dentist said.      1      2      3      4      5      6

strongly agree      pretty much agree      agree a little      disagree a little      disagree pretty much      strongly disagree

1) Parents play a big part in determining how soon crooked teeth will be straightened      1      2      3      4      5      6

2) If a persons teeth do not come together properly, it is his or her parents fault.      1      2      3      4      5      6

3) Even if a dentist told me I do not need braces, my parents would take me to see an orthodontist if they thought my teeth were crooked.      1      2      3      4      5      6

4) I would not do what an orthodontist tells me to do if my parents did not agree      1      2      3      4      5      6

5) If a persons teeth do not come together properly, it is his or her parents fault.      1      2      3      4      5      6

6) Crooked teeth will only straighten out if a person's parents take them to get them straightened.      1      2      3      4      5      6

7) My parents have more control than I do over whether or not I get my teeth straightened by an orthodontist.      1      2      3      4      5      6

8) My parents are responsible for whether my teeth will be crooked as I become older.      1      2      3      4      5      6

## APPENDIX 5

## M & E Questionnaire (Child)

1. To what extent is having your teeth straightened your own idea?(please circle)

totally my idea    6    5    4    3    2    1    0    not at all my idea

2. To what extent is having your teeth straightened your parents/ families or friends idea?.

totally their idea    6    5    4    3    2    1    0    not at all their idea

3. To what extent is having your teeth straightened your dentists idea?

totally dentists idea    6    5    4    3    2    1    0    not at all  
dentists    idea

4. How much will wearing a brace on your teeth worry you?(please indicate how much worry by putting a mark somewhere along the line)

will worry me    \_\_\_\_\_    will not  
a lot    worry me  
at all

5. After my orthodontic treatment I expect my teeth will look much better

a lot    6    5    4    3    2    1    0    not at all

6. How much do you expect having a brace fitted will hurt?(please indicate how much pain by putting a mark somewhere along the line)

hurt a    \_\_\_\_\_    not hurt at  
whole lot    all

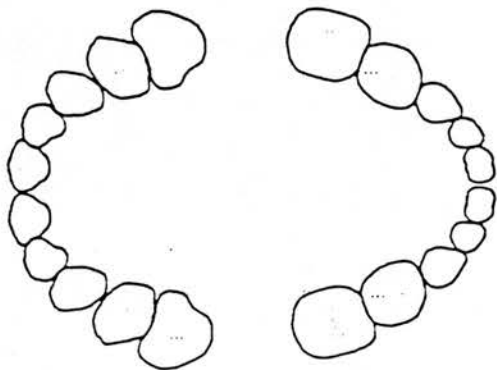
7. How much do you expect wearing a brace fitted will hurt? (please indicate how much pain by putting a mark somewhere along the line)

hurt a    \_\_\_\_\_    not hurt at  
whole lot    all



## APPENDIX 6

# DIARY



ID Number:

After you have had your brace fitted could you fill out this diary until you feel no more discomfort. If you could then send it back to me in the envelope provided I would be very grateful.

Thank you

Fanny Spencer

Name:

Date  
Time

Today's date is \_\_\_\_\_  
Time is \_\_\_\_\_

1. What words would you use to describe pain or hurt?  
\_\_\_\_\_
2. From the words listed below, circle the ones that best describe the way it feels when you are hurt or in pain.

cutting	pounding	tingling	tiring
beating	squeezing	throbbing	horrible
burning	pulling	sickening	biting
scraping	aching	uncomfortable	cold
miserable	deep	stabbing	screaming
pricking	cruel	warm	stretching
pinching	unbearable	sad	itching
stinging	cool	sore	flashing
fearful	pins/needles	sharp	jumping
bad	lonely	pressing	punishing
terrible	scared	spreading	tight
hot			

3. From the words circled, which three words describe the way you are feeling right now?  
\_\_\_\_\_

4. Put a mark on the line that best shows the worst pain you have felt today. If you had no pain, no hurt, you put a mark at the end of the line by the happy face. If you had some pain, some hurt you would put a mark near the middle of the line. If you have had a whole lot of pain or hurt you would put a mark by the sad face.



5. Put a mark on the line that best shows how you feel now. If you have no pain, no hurt, you put a mark at the end of the line by the happy face. If you have some pain, some hurt you would put a mark near the middle of the line. If you have a whole lot of pain or hurt you would put a mark by the sad face.



6. Do you think it is worth it having sore teeth for a little while?  
very much  quite  a little bit  not worth  
worth it  worth it  it at all

7. Which of the following make it worthwhile?

Not being teased  Having straight teeth  Looking better

8. Do any other things make your pain worth while?

---

9. Does the pain seem worse when you are (please tick)

at home <input type="checkbox"/>	upset <input type="checkbox"/>
at school <input type="checkbox"/>	eating <input type="checkbox"/>
out with friends <input type="checkbox"/>	playing <input type="checkbox"/>
with boys <input type="checkbox"/>	reading <input type="checkbox"/>
with girls <input type="checkbox"/>	watching TV <input type="checkbox"/>
sad <input type="checkbox"/>	tired <input type="checkbox"/>
angry <input type="checkbox"/>	anxious <input type="checkbox"/>
arguing <input type="checkbox"/>	bored <input type="checkbox"/>
busy <input type="checkbox"/>	in bed <input type="checkbox"/>
lonely <input type="checkbox"/>	happy <input type="checkbox"/>
upset <input type="checkbox"/>	

10. Can you write down any other situations in which your pain seems worse?

---

---

Did you take painkillers because your teeth were sore? yes/no

What did you take for pain today?

---

## APPENDIX 7

### Orthodontic Locus of Control Scales (Parents Form)

	strongly agree	pretty much agree	agree a little	disagree a little	disagree pretty much	strongly disagree
1) If children's teeth do not come together properly, it is their parents fault.	1	2	3	4	5	6
2) I can protect my child from problems caused by having crooked teeth.	1	2	3	4	5	6
3) I would not make my child do what an orthodontist tells him or her to do if I did not agree	1	2	3	4	5	6
4) The best way for a child to keep straight teeth is his or her parent' taking care of them	1	2	3	4	5	6
5) Crooked teeth will only out if parents take the child to get them straightened.	1	2	3	4	5	6
6) The things I do play a big part in how straight and well spaced my child's teeth appear.	1	<b>2</b>	3	4	5	6
7) It is my own behaviour that will determine whether my child's teeth will be crooked as he or she becomes older.	1	2	3	4	5	<b>6</b>

	strongly agree	pretty much agree	agree a little	disagree a little	disagree pretty much	strongly disagree
7) Luck plays a big part in how straight and well spaced my child's teeth appear	1	2	3	4	5	6
8) If a child's teeth do not come together properly, it is a matter of chance	1	2	3	4	5	6
9) There is nothing I can do to prevent my child from having problems caused by crooked teeth	1	2	3	4	5	6
1) The dentist or orthodontist is responsible for whether my child's teeth will be crooked as he or she becomes older.	1	2	3	4	5	6
2) My dentist or orthodontist plays a big part in how straight and well spaced my child's teeth appear.	1	2	3	4	5	6
3) Even if a dentist told me my child does not need braces, I would take my child to see an orthodontist if I thought his or teeth were crooked.	1	2	3	4	5	6
4) The best way for a child to keep straight teeth is by going to the dentist or orthodontist.	1	2	3	4	5	6
5) If my child sees a dentist or orthodontist regularly, he or she is less likely to have problems caused by crooked teeth.	1	2	3	4	5	6

	strongly agree	pretty much agree	agree a little	disagree a little	disagree pretty much	strongly disagree
8)I am responsible for whether or not my child's teeth will be crooked as he or she becomes older	1	2	3	4	5	6
9)I can control whether or not my child gets his or her teeth straightened by an orthodontist.	1	2	3	4	5	6
10)Parents play a big part in determining how soon their children's crooked teeth will become straightened out	1	2	3	4	5	6
1)Luck plays a big part in determining how soon crooked teeth will become straight	1	2	3	4	5	6
2)It would not matter much whether or not a child does what an orthodontist tells him or her to do.	1	2	3	4	5	6
3)Crooked teeth will often straighten out by themselves as a child gets older	1	2	3	4	5	6
4)Good luck is the best way for a child to keep his or her teeth straight	1	2	3	4	5	6
5)Fate will determine whether my child's teeth will be crooked as he or she becomes older.	1	2	3	4	5	6
6)I feel I have no control over whether or not my child gets his or her teeth straightened by an orthodontist	1	2	3	4	5	6



strongly agree	1	strongly agree	2	pretty much agree	3	agree a little	4	disagree a little	5	disagree pretty much	6	strongly disagree
-------------------	---	-------------------	---	-------------------------	---	----------------------	---	-------------------------	---	----------------------------	---	----------------------

6) If a dentist told me my child does not need braces, I would go along with what the dentist said even if I thought my child's teeth were crooked.

7) I would make my child do what an orthodontist tells him or her to do even if I didn't agree.

8) It is the dentist or orthodontist who will determine whether my child's teeth will be crooked as he or she grows older.

9) If a dentist told me my child does not need braces, there would be nothing I could do about it, even if I thought his or her teeth were crooked.

## APPENDIX 8

FAMILY ENVIRONMENT SCALE  
FORM R

There are 40 statements in this booklet. They are statements about families. You are to decide which of these statements are true of your family and which are not true.

You may feel that some of the statements are true for some family members and not true for others. If the members are evenly divided between true and not true, decide what is the overall impression and answer accordingly.

Remember we would like to know what your family seems like to you. So do not try to figure out how other members see your family, but do give us your general impression of your family for each statement.

PLEASE CIRCLE THE NUMBER WHICH APPLIES TO YOU.

- 1= COMPLETELY TRUE
- 2= TRUE TO A CERTAIN EXTENT
- 3= NEITHER TRUE OR UNTRUE
- 4= NOT PARTICULARLY TRUE
- 5= NOT TRUE

- |  |   |   |   |   |   |
|--|---|---|---|---|---|
| 1. Family members really help and support one another.       | 1 | 2 | 3 | 4 | 5 |
| 2. We fight a lot in our family                              | 1 | 2 | 3 | 4 | 5 |
| 3. We feel it is important to be the best at whatever you do | 1 | 2 | 3 | 4 | 5 |
| 4. We often talk about political and social problems         | 1 | 2 | 3 | 4 | 5 |
| 5. Family members rarely become openly angry                 | 1 | 2 | 3 | 4 | 5 |
| 6. Getting ahead in life is very important in our family     | 1 | 2 | 3 | 4 | 5 |
| 7. We rarely go to lectures plays or concerts                | 1 | 2 | 3 | 4 | 5 |
| 8. Friends often come over for dinner or to visit            | 1 | 2 | 3 | 4 | 5 |

9. We are generally very neat and orderly	1	2	3	4	5
10. There are very few rules to follow on our family	1	2	3	4	5
11. It's hard to "blow off steam" at home without upsetting somebody.	1	2	3	4	5
12. Nobody in our family is active in sports, leagues, bowling etc.	1	2	3	4	5
13. There is a feeling of togetherness in our family	1	2	3	4	5
14. We tell each other about our personal problems	1	2	3	4	5
15. Family members hardly ever lose their tempers	1	2	3	4	5
16. We are not that interested in cultural activities	1	2	3	4	5
17. We often go to movies, sports events, camping etc.	1	2	3	4	5
18. Being on time is very important in our family	1	2	3	4	5
19. There are set ways of doing things in our home	1	2	3	4	5
20. Family members often criticise each other.	1	2	3	4	5
21. We always strive to do things just a little bit better the next time	1	2	3	4	5
22. We rarely have intellectual discussions	1	2	3	4	5
23. There is a strong emphasis on following the family rules	1	2	3	4	5
24. Someone usually gets upset if you complain in our family	1	2	3	4	5
25. Family members rarely worry about job promotions, school grades, etc.	1	2	3	4	5
26. Family members are not very involved in recreational activities outside work or school	1	2	3	4	5
27. Family members make sure their rooms are neat	1	2	3	4	5
28. There is very little group spirit in our family	1	2	3	4	5
29. Money and paying bills is openly talked about in our family	1	2	3	4	5

30. In our family we don't try that hard to succeed	1	2	3	4	5
31. Each person's duties are clearly defined in our family	1	2	3	4	5
32. We rarely get along well with each other.	1	2	3	4	5
33. Family members often try to one-up or out-do each other	1	2	3	4	5
34. Family members go out a lot.	1	2	3	4	5
35. Rules are pretty inflexible in our household	1	2	3	4	5
36. There is plenty of time and attention for everyone in our household.	1	2	3	4	5
37. There are a lot of spontaneous discussions in our family.	1	2	3	4	5
38. Family members really like music, art and literature	1	2	3	4	5
39. Dishes are usually done immediately	1	2	3	4	5
40. You can't get away with much in our family	1	2	3	4	5

## APPENDIX 9

**M & E Questionnaire (Parent/guardian)**

1. **To what extent was having your child's teeth straightened your own idea or the idea of other family members or friends? (please circle)**

totally mine or their idea    6    5    4    3    2    1    0    not at all mine or their idea

2. **To what extent was your child having orthodontic treatment his or her idea? (please circle)**

totally my childs idea    6    5    4    3    2    1    0    not at all my childs idea

3. **To what extent was having your child's teeth straightened your dentists idea? (please circle)**

totally dentists idea    6    5    4    3    2    1    0    not at all dentists idea

4. **How painful do you expect having an orthodontic brace fitted will be for your child? (please indicate the degree of pain by putting a mark somewhere along the line)**

very painful \_\_\_\_\_ not at all painful

5. **How painful do you expect wearing a brace will be for your child? (please indicate the degree of pain by putting a mark somewhere along the line)**

very painful \_\_\_\_\_ not at all painful

APPENDIX 10



We know that some children who have braces fitted sometimes feel some discomfort. This may last for a couple of hours or a few days. There is quite a lot of difference between different children. What we do know is that if we can find ways of controlling our discomfort it often helps it to make it feel better.

I want to explore with you any ways in which you can help yourself to feel less sore after having your brace fitted.

What kind of things have you used to relieve discomfort/stop yourself from feeling sore in the past e.g. when you have had a sore stomach or head or when you've cut yourself?

What other things could you do to stop yourself feeling sore if you didn't have any pain killers?

Here is a list of extra things that children often do when they feel sore or uncomfortable. You might want to try some of these strategies when you go home today and for the next few days if you feel sore.

We know that some children who have braces fitted sometimes feel some discomfort. This may last for a couple of hours or a few days. There is quite a lot of difference between different children. What we do know is that if we can find ways of controlling our discomfort it often helps it to make it feel better.

These are some things that children often do when they feel sore or uncomfortable.

1. Sometimes it helps to say positive things to yourself.

e.g. I am doing really well  
It won't last a long time and I can cope with it  
I know I'm going to be okay

2. Sometimes it helps to distract yourself

e.g. Do something you enjoy doing  
Do some exercise  
Watch something nice on T.V  
Try and think about other things  
Say the alphabet backwards



3. Sometimes it helps to imagine things

e.g. Imagine having a dimmer switch and turning down your pain

Imagine being in a wonderful place where you can feel happy, somewhere you've been to or that you imagine.

4. Sometimes it helps to relax

e.g. Take nice deep breaths and as you breath out imagine breathing out all your worries.

Close your eyes and imagine your eyelids feeling lovely and comfortable. Try and relax all the muscles in your face and jaw. Imagine pushing out any pain that's there.

## APPENDIX 11

Figure 1a: Upper and lower fixed appliances in situ-frontal view.



Figure 1b: Upper and lower fixed appliances in situ-right lateral view.





Figure 1c: Upper fixed appliance in situ-occlusal view.

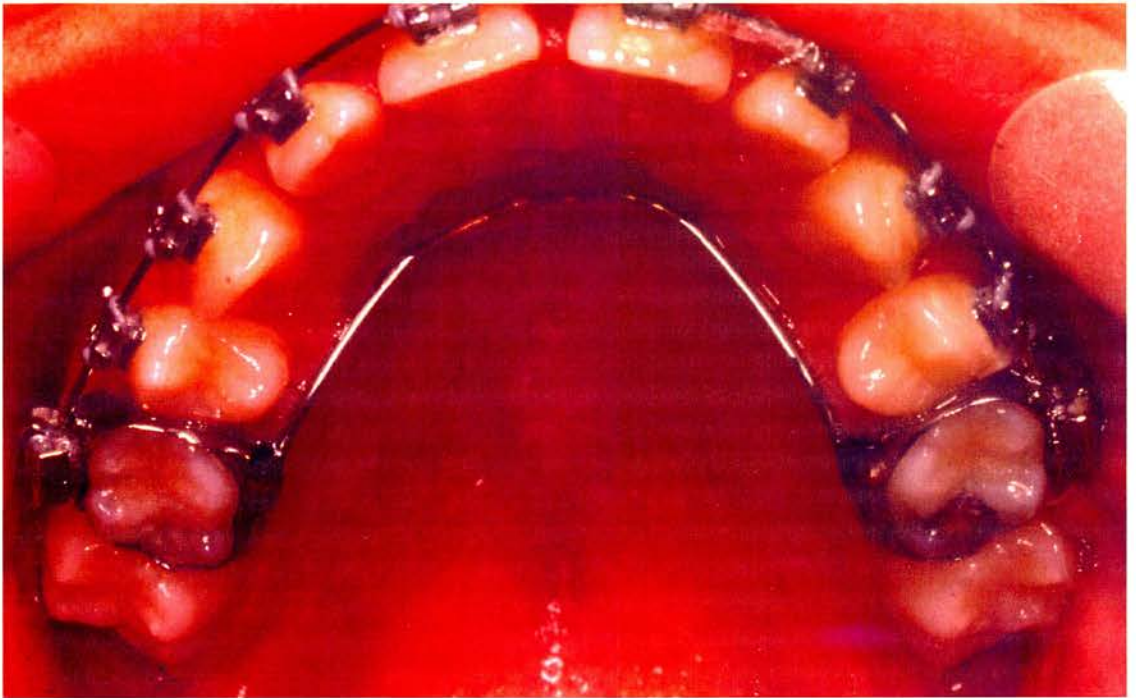


Figure 1d. Lower fixed appliance in situ-occlusal view.

